Developing Future Officers' Analytical Thinking During Their Practical Sessions Based on Stem Technologies

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Abstract

The ability to think analytically is helpful for the military, as it allows you to find optimal solutions to difficult situations in extreme conditions. The aim of this article was to study the effect of STEM technologies used during practical sessions of future officers on the development of their analytical thinking. The method of numerical series and self-assessment by cadets was used to determine the level of analytical thinking. Semi-structured interviews were conducted. The case method, virtual and augmented reality, project method, simulation and business games were used during STEM training. It was found by using the numerical series method that the level of future officers' analytical thinking increased from satisfactory to the medium within one academic year using STEM technologies during practical sessions. Students of the experimental group also note the growth of interest in learning, improvement of professional training, and the possibility of individual development. They rated their level of analytical thinking at the beginning of the experiment at 3 points on average and after the experiment — at 4 points on a five-point scale. The difficulties of STEM education were also found: the complex stage of mastering new methods, lack of technical support, and lack of skills for discussing the situation in groups. The results of the work can be used in the planning and selection of effective forms, methods and approaches to the organisation of practical training for future officers. Teachers can use STEM technologies effectively in future officers' practical training, including developing analytical thinking.

Keywords: professional skills, latest technologies, scientific approach, engineering design, teaching methods, training of specialists

1. Introduction

At the beginning of the 21st century, there are still some territories with ongoing military conflicts. Both the governments of these and other countries, for example, the United States in Afghanistan, are involved in resolving them (Brooks, 2020). The military participates both in hostilities in the hot spots of the planet and in peacekeeping in all other territories. Their contribution to peace depends on their training. Digitization and technological influence on all spheres of life are also changing the military industry and intelligence, wars are becoming more difficult over time (Winkler et al., 2019). This greatly complicates the protection of territories and the civilian population. Therefore, an important task in training the military is the integration of technologies into the educational process, which contribute to the improvement of the level of country's military defence (Kaleci & Korkmaz, 2018), along with physical training (Marionda et al., 2021), the development of 21st century skills (Uğur et al., 2020) and health-preserving knowledge (Diachenko-Bohun et al., 2019). Making predictions about what war will be like in the new technological environment requires highly qualified military analysts (Winkler et al., 2019) who have all the necessary knowledge of the latest technologies and high-level analytical thinking. Moreover, the role of front-line officers is important in the course of war. The effectiveness of human resource management and ensuring the use of new technologies in combat operations depends on their analytical thinking. Various strategies, approaches and methods are used to train future officers. For example, O'Carroll et al. (2020) state that 12 semesters of studies at the United States Naval Academy (USNA) are STEM-based (Science, Technology, Engineering, Mathematics). The

National Academy of the State Border Guard Service of Ukraine named after Bohdan Khmelnytskyi also uses STEM technologies in the training of future officers (Miroshnichenko & Stavytskyi, 2019 a). This approach to training future military officers is determined by the need to prepare them for ensuring national and international security in view of rapid advances in science and technology (Horowitz et al., 2018). However, the issue of the influence of STEM technologies applied during practical sessions of future officers on the development of analytical thinking remains unresolved. This was the aim of this study.

1.1 Aim

The purpose of the study was to determine the influence of STEM technologies on the development of analytical thinking of future officers during practical classes.

1.2 Research Objectives

The aim involved the following research objectives:

1) determine the level of analytical thinking of the cadets included in the sample;

2) introduce STEM-based training during practical sessions for future officers;

3) find out the influence of STEM education on the development of analytical thinking.

1.3 Research Methodology

For the experimental part, it was decided to conduct a questionnaire of 399 future officers, semi-structured interviews, numerical series and self-assessment. Cohen's kappa coefficient, Pearson's method, and Cronbach's alpha reliability coefficient were used to check the experiment's validity.

2. Literature Review

A number of works deal with increasing the efficiency of training future officers in higher educational institutions. For example, Horowitz et al. (2018) surveyed 40 studies on the use of STEM. Kiv et al. (2020) emphasized the importance of using cloud technologies in building professional competencies of the military.

It was established that the STEM-based educational approach consists of seven stages, including: identification of the problem; identification of a possible solution; understanding of insufficient knowledge; decision making; testing and evaluation of the decision taken. According to Sutaphan and Yuenyong (2019), the increase in TIMSS scores testify in favour of the use of STEM education.

The governments of many states and teachers of different countries, for example, the USA, France, England, Scotland, Australia, are convinced of the need for STEM education reform, improving STEM literacy and training STEM specialists, introducing STEM education programmes starting from a young age, and integrating the STEM approach into various academic subjects (Sutaphan & Yuenyong, 2019, Murphy et al., 2019). The following STEM learning strategies can be used for those purposes: STEM team learning, STEM case study (Sutaphan & Yuenyong, 2019), creating projects (web quests, research, practice-oriented, creative, role-playing) (Kulalaieva et al., 2020), problem-based learning (Iatsyshyn et al., 2020 a), flipped classroom, work in small groups (O'Carroll et al., 2020), application of augmented reality technologies (Iatsyshyn et al., 2020 a, b), virtual reality (Akdere et al., 2121), simulation game (Uğur et al., 2020), business games for STEM (Troiano et al., 2019, Zvarych et al., 2019), etc.

STEM education involves the development of skills for the practical use of acquired knowledge in the real world, for example, scientific, mathematical, technological and others, as well as maintaining relations with the scientific world (Sutaphan & Yuenyong, 2019). STEM education forms not only a narrow range of professional skills, but also contributes to the development of 21st century skills and critical thinking (Mutakinati et al., 2018). It also contributes to the development of moral and ethical values that allow maintaining peace and avoiding conflicts (Bloshchynskyi et al., 2021), building an organizational culture (Shumovetska et al., 2021), and acting within the legal field when performing one's official duties (Khalymon et al., 2021). STEM approaches are used in the study of various subjects, for example, mathematics, biology, physics, chemistry and in obtaining professions of engineer, bioresearcher, biologist, programmer, administrator, etc. (Sutaphan & Yuenyong, 2019).

STEM education differs from other methods by the following components: scientific and mathematical subjects determine the main theoretical and practical content of education; engineering practice and engineering design of technologies are learning tools and require mathematical knowledge at the same time; real problems are solved in a team during training (Sutaphan & Yuenyong, 2019). It is necessary to focus more on the process in the course of such training rather than on the content. There are different approaches to STEM education. It can consist of five (for example, in Malaysia) to nine stages (Sutaphan & Yuenyong, 2019). It can be part of the curriculum, or it can be extracurricular.

The innovations caused changes in all industries (Troisi et al., 2021, Trevino, 2019). For example, the results of the development of artificial intelligence can be used to protect state borders, intelligence, cyber security, etc. (Horowitz et al., 2018, Sayler, 2022, November 1).

Cultivation of intercultural tolerance is important in the training of future military officers (Hanaba et al., 2019), as a lack of it often causes wars. So, it is necessary to learn to find ways of coming to an understanding in conflict situations. The world is multicultural, and no culture has priority. The impact of psychological well-being of the military on their productivity should also be taken into account (Hernández Varas et al., 2019).

STEM education involves an interdisciplinary approach, so it is used either as part of the curriculum or as an extracurricular activity (Miroshnichenko & Stavytskyi, 2019 a). Besides, it is important to use this approach from pre-primary education to master's and postgraduate studies (Granovskiy, 2018).

It is necessary to appropriately prepare teachers in order to achieve high results in STEM education (Murphy et al., 2019). Many studies have confirmed the shortage of specialists in the field of STEM education (Iatsyshyn et al., 2020 a, Miroshnichenko et al., 2019 b). Strategies for the development of educational institutions provide for improving the pedagogical skills of the teaching staff.

Along with critical thinking, researchers are actively engaged in studying analytical thinking and ways of its development. Analytical thinking skills, for example, of future border guards are supposed to mean "skills that ensure the ability of future border guards to understand the essence of the professional situation, evaluate it, forecast, make decisions by analysing its individual components" (Kyiv-Mohyla Business School, 2021).

Scientists use many methods to develop critical thinking, for example. For example, Ile and Chinedu (2022) suggest reading literary texts. Another authors Becker, Gilbert and Bezerra (2023), advised to use special reading aids that stimulate critical reading. Analytical thinking can be developed through writing texts (Matsumura, Wang, Correnti, & Litman, 2023). Miroshnichenko et al. (2019) noted that STEM technologies develop in future officers, along with others, the ability to analyse educational information to be active in educational activities on the way to professional life. The importance of using STEM technology, which involves the combination of science, technology, engineering and mathematics in the training of officers, is due to the peculiarity of their future profession — the need to integrate knowledge, skills and abilities from several subjects at once.

However, the scientific literature does not sufficiently discuss the issue of developing the analytical thinking of future officers using STEM methods.

3. Research methods

3.1 Research Design

This study was experimental. It was conducted in three stages. At the first, a pre-experimental check of the formation of analytical thinking of the cadets included in the sample was conducted. At the second stage, a pedagogical experiment was conducted, which consisted in the implementation of STEM learning technologies in the experimental group during practical sessions and lasted one academic year. At the third stage, a post-experimental check of the level of formation of analytical thinking in the cadets of the sample was carried out. A comparison of the obtained results of the experimental and control groups was made.

3.2 Participants

The sample included 399 cadets, 2-4 courses of the National Academy of the State Border Guard Service of Ukraine named after Bohdan Khmelnytskyi. They studied the following specialities: Security of the state border; Law enforcement activity. The criteria for selecting cadets were training in military specialities and the availability of practical classes in the curriculum, at least for the period of this study. The total sample was distributed as follows: 196 in the experimental group, 203 in the control group. The sample also included 12 people from the academic and teaching staff of the Academy. The teachers were selected according to the following criteria: research and teaching work experience of at least 5 years, having an academic degree (PhD or Dr), and participation in or management of practical sessions, which are part of the Academy's educational process.

3.3 Ethical Criteria

The management of the National Academy of the State Border Guard Service of Ukraine named after Bohdan

Khmelnytskyi gave their written permission, as well as all participants of the survey gave their written consent for the study. Participation in the study was voluntary, free of charge, the questionnaire survey was anonymous. All responses to the questions provided in the questionnaire were coded.

3.4 Instruments

Data were collected using a questionnaire and a semi-structured interview. Research on the level of analytical thinking was carried out with the use of numerical series (Kokun, Agaev, Pishko, Lozinska, & Kornya, 2019) and through self-assessment by cadets according to the methodology (Kyiv-Mohyla Business School, 2021). All data were processed in Statistica software. Mathematical methods were also used to check the reliability and validity of the obtained results and the teaching methods' effectiveness. Cohen's kappa coefficient, Pearson's method, Cronbach's alpha reliability coefficient were used.

3.5 Data Analysis

It was necessary to continue thirty numerical series with the following two members, having previously established the regularity of the series. The regularities were mathematical, including addition, subtraction, multiplication, division, exponentiation, root extraction, etc. Each subsequent series had a different pattern. The difficulty of the task increased with each series. The time for completing tasks was limited to 10 minutes. The cadet had to complete the tasks independently. One point was awarded for each correctly completed task. The maximum possible sum of points for all completed tasks is 30. Provided that the cadet scored a sum of points from 27 to 30 as a result of completing all tasks, it was considered that analytical thinking is developed at a high level; from 21 to 26 points — at a medium level; from 16 to 20 — at a satisfactory level; from 11 to 15 — at a low level; below 10 points — the level of analytical thinking is very low.

The criteria for self-assessment of the level of analytical thinking of cadets were developed based on Kyiv-Mohyla Business School (2021). After experimenting, the cadets of the experimental and control groups had to evaluate: 1) their ability to break down the proposed problem into parts and analyse each of them; 2) their ability to track cause-and-effect relationships; 3) predict the development of events under known initial conditions; 4) the ability to find solutions to the problem; 5) choose the most optimal one among the options for resolving the situation, foreseeing the consequences of your choice. The evaluation was measured on a five-point scale (1 - the lowest level of the proposed skill, 5 - the highest). Reliability was tested by Cronbach's alpha coefficient. It ranged from 0.74 to 0.86, which indicates its acceptability.

A semi-structured interview was also conducted to establish the participant's attitudes toward the educational process to the use of STEM technologies during practical sessions and their influence on the development of analytical thinking. It contained 5 questions. The responses were recorded, and their content analysis was carried out, based on which they were classified according to common features and coded according to categories. A total of 399 interviews were recorded. Three independent experts checked the reliability of the measurements. The reliability of the analysis of the obtained data was determined using the expression for reliability proposed by Miles and Huberman (1984), it was 78%. This allows concluding the reliability of the analysis.

4. Results

Analytical thinking is important in the military officer profession, as it enables one to show pragmatism in analysing available data about situations and make balanced decisions taking into account the priorities of national interests and national security of the country. The study involved practical sessions of future officers using STEM technologies held in the experimental group. They involve a combination of interdisciplinary knowledge and practical skills of cadets. The military-pedagogical composition of the sample integrated mathematical, technological, engineering and scientific components (Figure 1) in order to teach future officers to use the latest achievements of science and technology in their professional activities, as well as to promote the development of their analytical thinking.

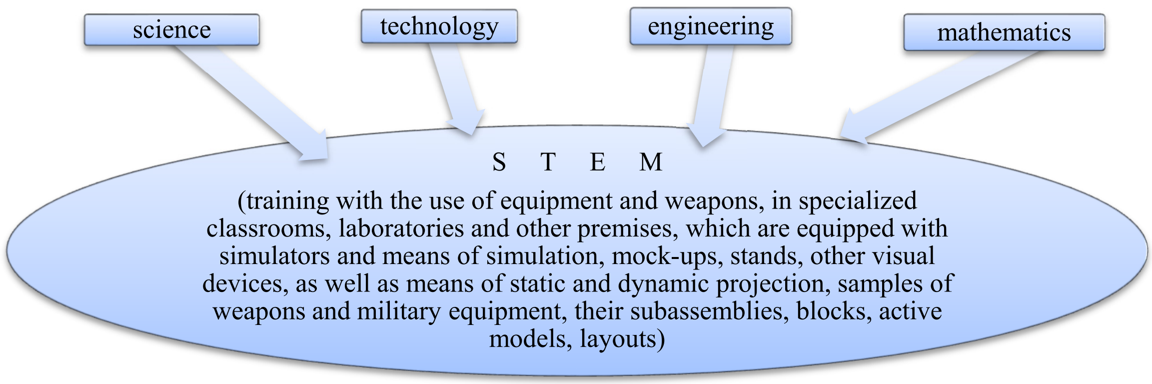

Figure 1. The Use of Stem Technologies in Higher Military Educational Institutions

Such teaching methods were used which contribute to the development of analytical thinking (Figure 2).

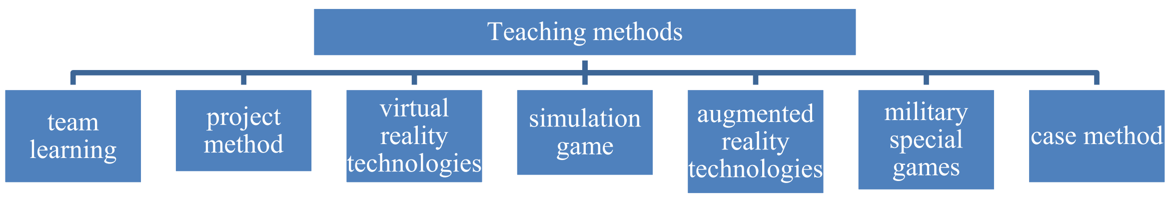

Figure 2. Teaching Methods Used to Develop Analytical Thinking

Practical sessions in the experimental group were structured in such a way that the cadets were active participants in the educational process most of the time. They performed training operational-strategic, operational-tactical and tactical tasks. They were offered to solve real situations that may occur during the future performance of professional duties, for example, organization and planning of operations, command and supply of troops. Different types of terrain and different environments were considered. The cadets proposed solution options, and found the correct solutions through joint efforts in the course of discussions, which were based on the principles of tolerance and respect for the opinions of the interlocutors. The visualizations using modern technical means were used to introduce them into the situation.

Knowledge and ability to work with technologies had to be used when searching for and justifying the right solution. In addition to case methods, role-playing games, quizzes, etc. were also used as teaching methods during practical sessions. The cadets simultaneously used knowledge and skills from various subjects: mathematics, engineering, technology, geography, chemistry, biology, physics, language, history, physical culture. Tasks for the analytical thinking development were performed. They often required breaking down a certain situation into its component parts and analysing each of them step by step.

During the practical sessions of the future officers who were included in the experimental group, their teachers organized training in such a way as to emphasize the development of research skills, the ability of cadets to engage in self-education, independently search for the necessary scientific information, and analyse it taking into account various points of view, make the necessary conclusions. Attention was drawn to the ability of cadets to apply their knowledge in practice to non-standard, new, often extreme professional situations, to take the initiative. In the course of the pedagogical experiment, methods were used that contributed to the development of skills necessary for team and group work. Practical work of a professional orientation was carried out all the time.

The latest technologies, which are a component of STEM education, were used at the practical sessions as a tool for fulfilling the set goals and as an object of study. For example, augmented reality technology was integrated into practical sessions through the use of technology as a learning tool. They were objects of AR technology that, with the help of special applications, were transformed into three-dimensional animations of objects from the professional environment of future officers. This helped to train professional skills, bring the necessary actions to automatism, analyse simulated situations step by step, which resulted in the development of analytical thinking. Such models of situations enabled to save time and achieve a much higher effect than traditional forms of conducting practical classes. Solutions to many of the proposed problem situations also required engineering design and the use of mathematical knowledge.

The positive dynamics were revealed during the study of the level of the analytical thinking of future officers, determined in the control and experimental groups before and after the pedagogical experiment using STEM technologies in the experimental group and traditional approaches to learning in the control group during practical sessions (Table 1).

Table 1. The Level of Analytical Thinking of Future Officers

	Number of cadets in percent			
	Control group		Experimental group	
Level of analytical thinking	Before the experiment	After the experiment	Before the experiment	After the experiment
very low	9 %	7 %	9 %	3 %
low	16 %	14 %	17 %	12 %
satisfactory level	47%	46 %	47 %	26 %
medium level	23 %	26 %	23 %	48 %
high level	5%	7 %	5 %	11 %

As Table 1 shows, there was a positive dynamic in the development of analytical thinking of future officers both in the control and in the experimental group during the academic year. However, it is more pronounced for cadets who were included in the experimental group. That is, conducting practical sessions of future officers using STEM technologies led to an increase in the level of analytical thinking. There were 6% of cadets with a very low level of analytical thinking who improved it (only 2% in the control group). There were 6% more cadets who reached the highest level in the experimental group than before the experiment (in the control group this indicator was 2%).

STEM technologies enabled to advance the maximum number of future officers from a satisfactory level (47% in the experimental group before the experiment) to a medium level of analytical thinking (48% after the experiment).

Self-assessment of the level of analytical thinking provided the following results. Only 2% of the future officers of the control group and 9% of the experimental group rated their ability to break down a problematic situation that may occur during the performance of their professional duties and analyse separate component problems with the highest score. At the same time, among the cadets of the control group, 52% had an average score of 3, while 27% had a score of 2. In the experimental group, the self-assessment of the level of this skill was higher on average. The maximum number of cadets (49%) rated it 4.

The cadets of both groups assessed their ability to track cause-and-effect relationships as follows: the largest number (27%) scored 2 points in the control group and 3 points (31%) in the experimental group. According to the cadets, the most difficult task was finding solutions to problems. They also rated these skills by an average of 2 points (36%) in the control group and by 3 points (24%) in the experimental group. The task of choosing the correct solution from the proposed solutions to the problem seemed to the cadets easier than the previous one, since in both groups it was assessed as 4 points by the majority (32% of the control group and 39% of the experimental group). Average scores obtained for the group for each skill are presented in Figure 3.

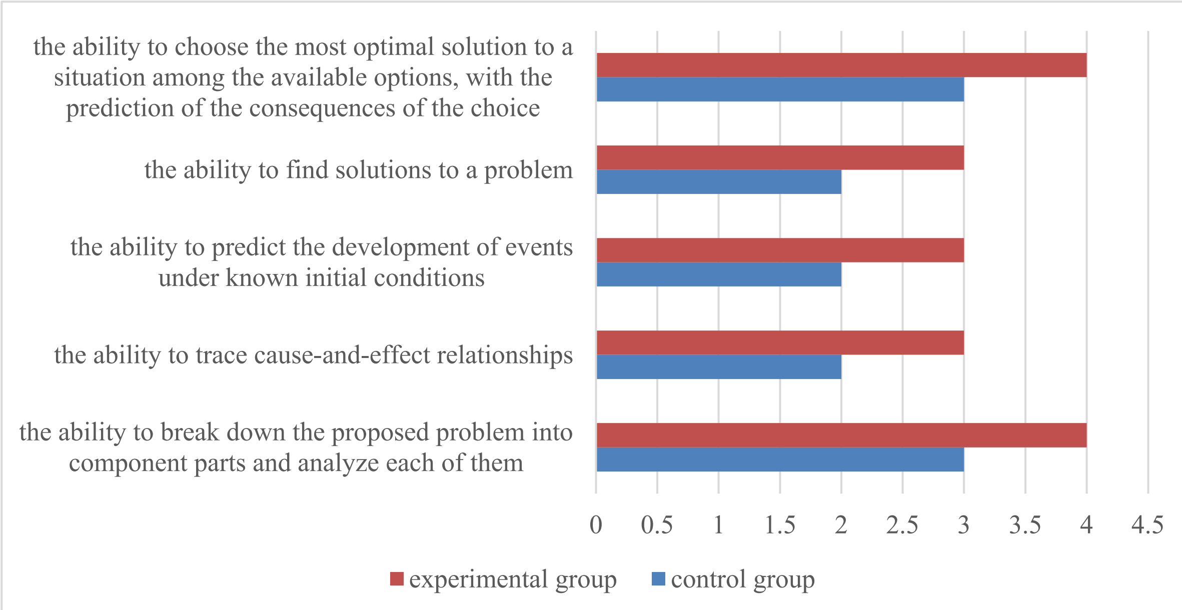

Figure 3. Results of Self-Assessment by Future Officers of the Level of Analytical Thinking Skills

The study using mathematical methods found that the weighted sum of the squared deviations of the group averages from the general average, that is, the intergroup variance d, was in the range 218 to 714. The reason for the occurrence of the intergroup variance was the heterogeneity of the sample. It is related to conducting research in different academic groups, which included cadets with different levels of training and different results of academic achievements.

The mean square deviations from the mean value for the same criterion of self-assessment of analytical thinking by cadets who belonged to different academic groups were different. The intergroup variance, which characterizes the fluctuations of these groups, and the intragroup variance, which characterizes the fluctuations caused by random factors not taken into account, had different values, which proves that the null hypothesis is not valid.

Using the Pearson test for the results of the study, it was found that the values of χ_1^2 obtained for the experimental group are greater than χ_{12}^2 calculated for the control group. Therefore, it can be argued that there is a certain relationship between the use of STEM technologies during practical sessions in the experimental group and the level of analytical thinking of future officers.

The calculated Cohen's kappa coefficient in the experimental group was 1.03. This was evidence that the use of STEM technologies during practical sessions of future officers had a high effect in the development of analytical thinking. In the control group trained according to the traditional methods, Cohen's kappa coefficient was 0.5, indicating a medium effect.

The answers to the questions of the semi-structured interview were divided into categories: skills that were developed during training using STEM technologies; the benefits of studying STEM technologies; disadvantages of education that involves STEM technologies; the influence of STEM technologies on the professional and practical training of cadets.

During the interview, the cadets noted the following skills that future officers developed during practical sessions using STEM technologies: research skills; search of academic materials; self-learning; search and analysis of information; finding solutions to problem situations, analysing them and drawing correct conclusions; analytical thinking skills (dividing the situation into parts, analysing each part separately, finding options for solving the problem and choosing the most optimal one); improving communication skills, cultivating respect for the opinion of colleagues and taking it into account when making decisions. Their percentage ratio in the control and experimental groups is shown in Figures 4 and 5.

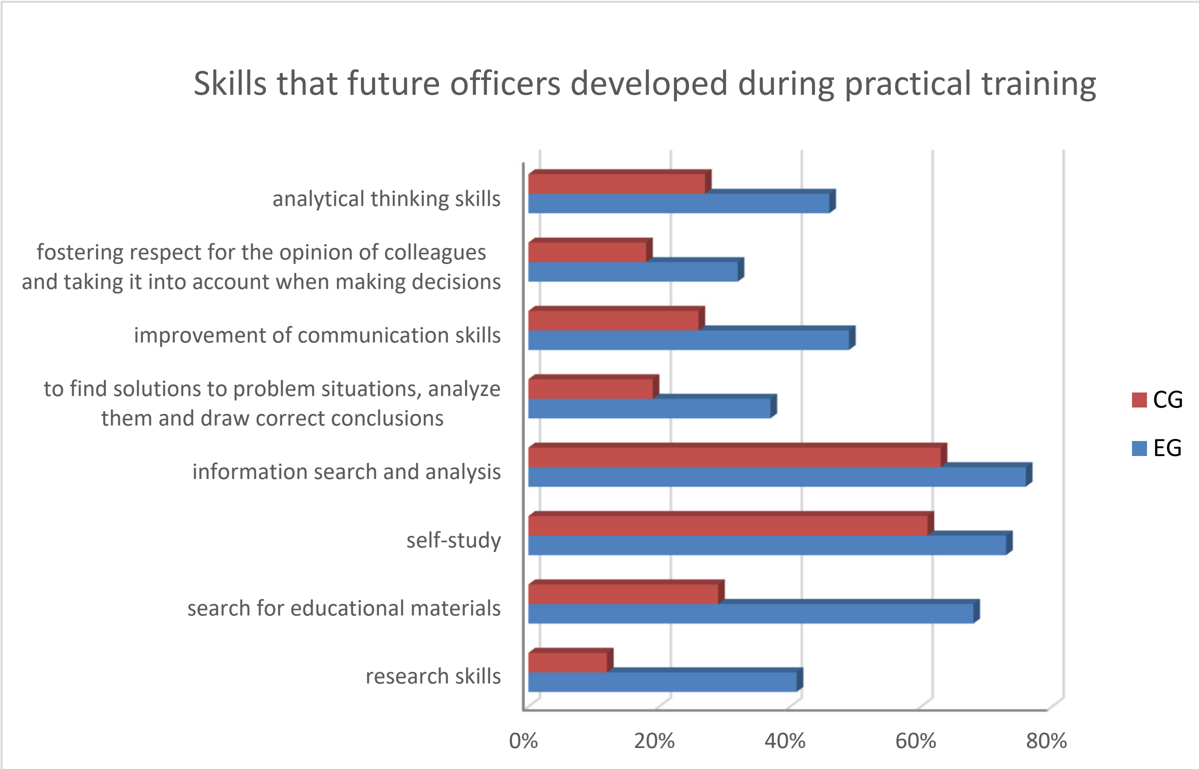

Figure 4. Research Results Regarding the Skills Acquired by Cadets During Practical Classes with the Use of STEM Technologies (Experimental Group) and Without Them (Control Group)

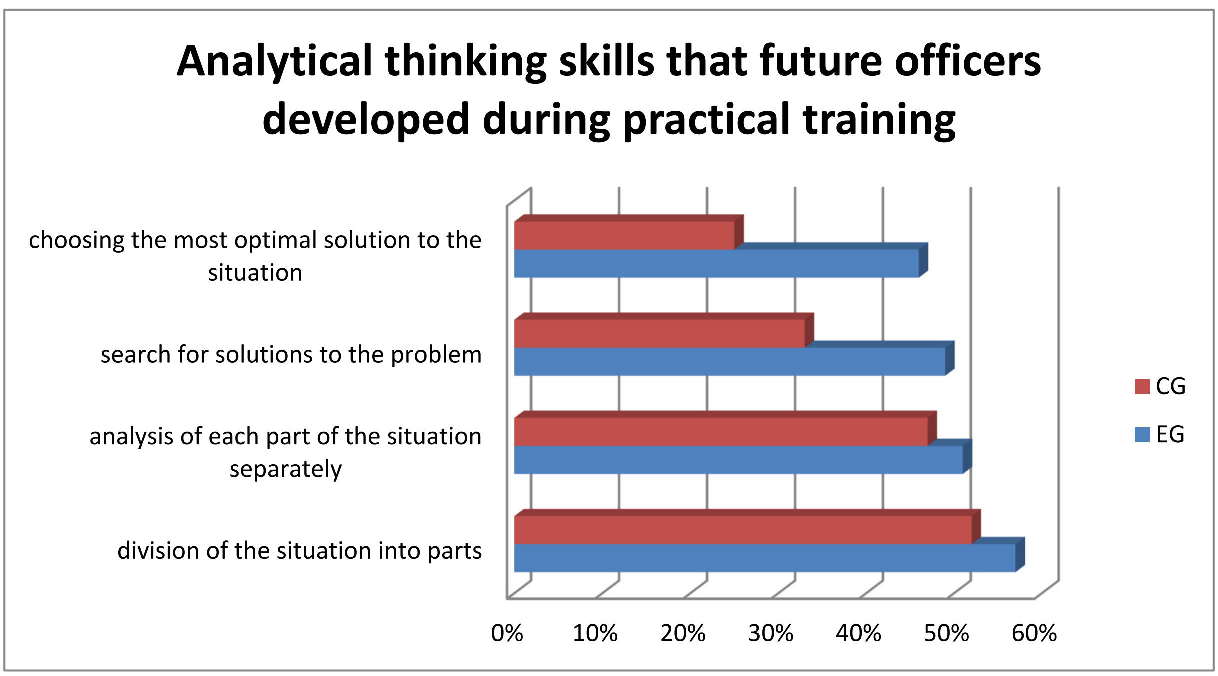

Figure 5. Research Results Regarding Analytical Thinking Skills Acquired by Cadets During Practical Classes Using STEM Technologies (Experimental Group) and Without Them (Control Group)

The cadets listed the following advantages of studying with the use of STEM technologies: an interesting form of conducting practical sessions; effectiveness of this form of conducting practical sessions; the opportunity to deepen and expand existing knowledge simultaneously in general scientific educational subjects, specialized educational subjects and especially in the professional component, form the ability to apply them to solve practical issues of future professional activity.

Another advantage is teamwork, which enables developing the ability to cooperate harmoniously with colleagues to achieve a common goal. The tasks performed by the cadets and the form of their presentation are interesting, this contributes to the growth of interest in learning. There is a possibility of individual development of the capabilities of each cadet.

Difficulties and disadvantages of studying with the use of STEM technologies, which the cadets of the sample mentioned most often:

the difficulty of the initial stage, accumulation of new, previously unfamiliar forms and methods of education;

long duration of work before the first results of it become apparent;

inability to move forward if there are gaps in knowledge in other subjects;

lack of technical support: not all necessary educational materials are presented in the form of three-dimensional models, or not all situations have the possibility to use augmented reality;

difficulties also included the inability to organize discussions in groups at the initial stages.

Practical sessions with the use of STEM technologies enable gaining practical experience in the performance of professional duties even while studying at the educational institution. This is possible due to the consideration of specific situations, the use of augmented and virtual reality technologies, role-playing, business and simulation games, training on simulators.

5. Discussion

Case method, virtual and augmented reality, project method, simulation and business games were involved when organizing training using STEM technologies during practical sessions of future officers. As this study showed, they contributed to the development of future officers' research skills, the ability to search and analyse information, including for self-education, to divide the situation into parts, analyse each of its components, and thus find optimal solutions. Likewise, to the authors (Sutaphan & Yuenyong, 2019), STEM education should be built in such a way to provide student’s structured activity. The latter includes problem solving, project work, inquiries and design. Such processes force students to generate solutions, conduct research, model and evaluate proposed solutions, identify knowledge gaps, fill them, find the right solutions, document and present them, and all this is accompanied by communication (Sutaphan & Yuenyong, 2019). Such processes enable achieving a high level of assimilation of knowledge and the development of skills important for future professional activity, including communication skills, flexible, creative thinking, teamwork (Hanaba et al., 2019), time management, etc.

In this study, specific professional situations were considered during practical sessions, for example, the tactics of protecting the state border in different conditions. The basics of service in various types and tasks of border units were studied: "Border patrol", "Surveillance post", "Technical observation post", "Working group on the border", "Secret", "Ambush", "Control post", "Response group ", "Administrative and operational group", "Zaslon", "Reconnaissance and search group", etc. Similarly, researchers (Sutaphan & Yuenyong, 2019) found improvement in analytical thinking in 11th grade students while learning with the use of the Yuenyong’s five-stage model. The knowledge of the nature of sound was deepened through the consideration of the specific situation of the fall of a spaceship on the studied planet. Another example of the organization of STEM training is described in (Kaleci & Korkmaz, 2018), where the renewable energy sources were studied based on a helicopter model powered by solar batteries. Such structure of the study of current issues had a positive effect on the students’ performance and on the choice of profession in the future in favour of STEM. Miroshnichenko et al. (2019 b) proved that the conditions of the development of a professional vocation influence the success of professional activities even during studies at an educational institution.

Miroshnichenko et al. (2019 b) noted that STEM technologies develop in future officers, along with others, the ability to analyse educational information, to be active in educational activities on the way to professional life. The importance of the use of STEM technology, which involves the combination of science, technology, engineering and mathematics in the training of officers, is due to the peculiarity of their future profession — the need to integrate knowledge, skills and abilities from several subjects at once.

According to Granovskiy (2018), despite significant public spending on STEM education in the US, it is believed to have little effect. However, the number of students who chose a technical field for further post-graduate studies has recently increased by 15%, which is believed to be a consequence of the active introduction of STEM education in the United States. The performance of students who participated in TIMSS have also improved recently. The percentage of employed people among former graduates of STEM institutions has increased. There is still a dependence of the number of people involved in STEM education on belonging to different demographic groups.

A survey conducted (Uğur et al., 2020) among students who studied with the use of STEM education showed that such education develops analytical thinking in addition to 21st century skills. Shumovetska et al. (2021) found that the use of case method during the training of future officers contributes to the development of their analytical thinking and the ability to make managerial decisions. The use of the latest technologies provided by STEM education, for example, the paperless approach, results in deepening of students' knowledge of the subjects being studied, as well as improvement of their academic performance (Chacko et al., 2015). This study revealed an increase in cadets' interest in practical sessions enhanced by the introduced STEM technologies. The positive influence on the development of other skills (communicative, self-learning, professional, etc.) was also confirmed.

6. Conclusions

The threat of military conflicts and illegal crossing of state borders continue to be on the rise, therefore, the issue of training highly qualified military personnel is urgent. Therefore, the issue of training highly qualified military personnel is urgent and finding new effective forms of training for future officers needs to be resolved. The rapid development of technologies necessitate a change in the training process followed and the issue of finding new effective forms of training future officers needs to be resolved. This study showed the high effectiveness of the use of STEM technologies during practical sessions of future officers in the development of analytical thinking. STEM technologies enabled increasing the level of cadets' analytical thinking.

The integration of the scientific approach, the latest technologies, knowledge and skills of engineering design and conducting mathematical calculations helped to more confidently demonstrate analytical thinking skills, such as dividing the situation into parts, analysing them, searching for a solution and choosing the right solution. They also contributed to the development of other skills: communication, teamwork, self-learning, self-organization, etc. The results of this study have theoretical and practical significance. They supplement knowledge on the issue of STEM education, in particular, its introduction in higher military educational institutions and its impact on the results of the development of professional competences.

The results of this work can be used in planning and choosing effective forms, methods and approaches to the organisation of practical sessions for future officers. Teachers can use STEM technologies effectively in the practical training of future officers, including developing their analytical thinking. Politicians should pay attention to the promotion of mass improvement of the material and technical base necessary for the training of future officers and the creation of a centralised digital database accessible to all teachers of military institutions to facilitate the preparation of teachers to conduct this type of educational activity. Further research should be focused on studying the impact of STEM technologies on the development of other military professional skills and the search for different methods and approaches to their development.

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