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***Slabko V. Strategies for integrating SMART-complexes into the educational process of educational institutions of Ukraine***

*The article substantiates the influence of SMART-complexes on the modern education system and proves the improvement of the effectiveness of the educational process under the condition of using SMART-complexes of the educational discipline. It was found that there is a lack of consensus regarding a specific terminological definition that can be used to interpret the concept of a modern educational SMART complex. The existing models of the successful functioning of SMART-complexes have been studied and the criteria for success in the development and implementation of the SMART-complex in the education system and its integration into the educational environment have been formulated.*

*The main vectors of the use of SMART-complexes are characterized, as well as their influence on the creation of an educational environment in general and the learning outcomes of education seekers in particular. It is noted that now it is SMART-complexes that enable teachers to establish effective interaction with students, under the conditions of which the two-sidedness of the educational process is implemented.*

*A model of the effectiveness of the implementation of the SMART-complex was built, with the help of which the effectiveness and appropriateness of the content of the SMART-complex is determined in the presence of such factors as: quality of information: its display, accuracy, relevance and completeness; the quality of the structure of the SMART complex: system performance and response time, content creation tools; quality of the user interface: ease of use and convenience, design; reliability, security and availability; quality of service: fast response time, help desk. It has been proven that the available factors are capable of influencing the quality of the educational process and learning outcomes using SMART complexes. This model is defined as social-cognitive, its main parameters, tasks and functions are characterized, its place in modern science is determined. Methodological recommendations on the development of an effective SMART-complex and its integration into the educational process of educational institutions are provided.*

**Key words:** SMART environment, SMART complexes, educational process, efficiency model.

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***Sulima O.***

**FEATURES AND PROSPECTS OF TEACHING HIGHER MATHEMATICS AS A COMPONENT OF STEM EDUCATION IN A TECHNICAL UNIVERSITY DURING THE WAR**

*The article explores the features and prospects of teaching higher mathematics in a technical university, discusses the challenges faced in teaching higher mathematics during times of military conflict, as well as the ways to adapt and ensure quality education for students. The article also analyzes and justifies the main advantages of STEM education in a technical university, the peculiarities of teaching higher mathematics during war, the practical applications of mathematical concepts in military situations, the use of interactive technologies, and the development of students' critical thinking.*

*The article presents several main conclusions. Firstly, STEM education in a technical university is of great importance as it aims to develop an integrated approach to learning that combines scientific knowledge, technological skills, engineering creativity, and mathematical literacy. Secondly, teaching higher mathematics in a technical university helps students gain deep knowledge in scientific disciplines and develop critical thinking and problem-solving skills. Thirdly, STEM education promotes the development of practical skills and a research-oriented approach, as well as enhances students' creative abilities. Fourthly, graduates of STEM programs in technical universities have broad professional opportunities.*

*A survey was conducted among second-year students of the Faculty of Instrumentation Engineering at Igor Sikorsky Kyiv Polytechnic Institute to investigate their attitudes towards studying higher mathematics and analyze the peculiarities and pros-*

pects of teaching higher mathematics in the distance learning mode during wartime conditions. The survey results served as a basis for developing methods to improve the educational process and formulating proposals and practical recommendations for the future development and teaching methodology of higher mathematics as a component of STEM education in post-war times.

The article also discusses the peculiarities of teaching higher mathematics during a military conflict. First and foremost, lecturers and students must be prepared to adapt to unpredictable conditions that accompany a military conflict. Ensuring safety is important, and it is necessary to implement safety measures on the university premises and adhere to safety rules during lectures and practical assignments. Teaching higher mathematics in wartime may also involve using practical examples to demonstrate to students the practical applications of mathematical concepts in military situations. The use of interactive technologies and the development of critical thinking are also important aspects of teaching higher mathematics during a military conflict.

**Key words:** mathematics, distance learning, education, students, concepts, interactive technologies, critical thinking, motivation.

(статтю подано мовою оригіналу)

**Article objective.** The objective of this article is to explore the peculiarities and prospects of teaching higher mathematics as a component of STEM education in a technical university during the war. The article aims to discuss the challenges faced in teaching higher mathematics during a military conflict and to consider possible ways of adaptation and ensuring quality education for students. To achieve this, the article will examine the main advantages of STEM education in a technical university, the peculiarities of teaching higher mathematics during war, practical applications of mathematical concepts in military situations, the use of interactive technologies and the development of students' critical thinking.

STEM education (Science, Technology, Engineering, Mathematics) holds great importance in technical universities. It aims to develop an integrated approach to learning that combines scientific knowledge, technological skills, engineering creativity, and mathematical literacy, which are necessary for solving complex problems in the modern world. Technical universities that actively promote STEM education provide their students with numerous advantages that should be taken into account [1].

First and foremost, STEM education in a technical university allows students to acquire deep knowledge in scientific disciplines such as higher mathematics, physics, chemistry and engineering. This enables students to understand the fundamental principles underlying technologies and innovations. As a result, they can become true experts in their field and develop new solutions to address complex problems.

The second advantage of STEM education in a technical university is that it promotes the development of critical thinking and problem-solving skills. Students learn to analyze complex tasks, understand the root causes of problems and find effective solutions. These skills are highly valuable in any field of activity, especially in the technological industry, where the ability to find innovative solutions quickly and efficiently is crucial.

The third advantage of STEM education in a technical university is that it promotes the development of practical skills and a research-oriented approach. Students have the opportunity to participate in various projects, researches and laboratory work, which allows them to gain practical experience with modern technologies and equipment. This prepares them for the real challenges they will face in their professional careers.

The fourth advantage is that STEM education promotes the development of students' creative abilities. They learn to think creatively, generate new ideas and develop innovative projects.

It is necessary to emphasize the professional opportunities that open up for graduates of a technical university with STEM education. The modern world requires experts with deep knowledge in the fields of science and technology, engineering and mathematics. Graduates of STEM programs in technical universities are in high demand in the labour market. They can hold positions in scientific research centers, technological companies, engineering companies and many other fields. Therefore, the advantages of STEM education in a technical university are evident. It helps students acquire deep knowledge, develop critical thinking and problem-solving skills, promotes development of practical skills and a research-oriented approach, and also opens up a wide range of professional opportunities.

University education has always played a significant role in the development of society, particularly in the field of technology. Teaching higher mathematics, as an integral part of STEM education, holds special importance for students in technical universities, as it serves as a fundamental subject for understanding and applying scientific principles in technical disciplines [2]. However, in the context of military conflict, the teaching of higher mathematics may face various challenges and limitations. Let us consider the peculiarities and prospects of teaching this subject in a technical university during the war.

1. Adaptation to wartime conditions.

Lecturers and students must be prepared to adapt to unpredictable conditions that accompany a military conflict. This may involve changes to the class schedule, shifting classroom sessions to an online format, or even utilizing alternative teaching methods.

2. Ensuring safety.

It is important to ensure the safety of both lecturers and students during the teaching of higher mathematics. This may include implementing safety measures on university premises, protecting information and adhering to safety rules during practical assignments.

3. Application of practical examples.

Teaching higher mathematics in wartime conditions can be an effective way to demonstrate to students the practical applications of mathematical concepts in real-life situations. Additionally, it can contribute to increasing motivation level for studying higher mathematics at a technical university.

As it is known, mathematics plays an important role in many aspects of life, including military situations. Let's consider some practical applications of mathematical concepts in real military scenarios:

– Cryptography: cryptography is the science of protecting information from unauthorized access. In military situations the security of communications is of crucial importance. Mathematical concepts such as encryption and decryption are used to create secure communication systems. For example, RSA and AES algorithms are used for encrypting messages and data in military communications.

– Optimization of troop deployment: military planning requires the optimal placement of troops to achieve strategic objectives. Mathematical models such as the Traveling Salesman Problem and the Facility Location Problem are used to solve these problems. The Traveling Salesman Problem is a mathematical problem that involves finding the shortest route that passes through a given set of cities and returns to the starting city, passing through each city only once. This problem is one of the most well-known optimization problems and has wide application in various fields such as logistics, transportation planning, routing, and others. Mathematically, the Traveling Salesman Problem can be formulated as a graph, where each city is represented by a vertex and the distances between cities are the edges of the graph. The goal is to find the shortest cycle that passes through all the vertices of the graph, starting and ending at the same vertex.

These higher mathematical models help find the shortest path for troop movement and optimal placement for effective defense or attack.

– Forecasting: military teams often use mathematical models for forecasting the movement of enemy forces, assessing the probability of operational success and strategic planning. Concepts from higher mathematics, such as multivariate analysis, probability theory, statistical methods and machine learning, help make predictions based on available data and information about enemy forces. Machine learning is a branch of artificial intelligence that studies algorithms that allow computers to learn and improve their performance based on data. The core of machine learning is the idea that a computer can analyze and interpret data, identify patterns and make predictions or decisions without explicit programming. This is achieved through training models on large amounts of data, allowing the computer to identify patterns and make predictions on new data. Machine learning is used in various fields, including image recognition, natural language processing, recommendation systems, forecasting and much more.

– Calculation of artillery fire points: the calculation of artillery fire points is crucial for accurately striking enemy positions in military operations. Mathematical sciences such as trigonometry and geometry are used to determine distances, angles and coordinates for precise targeting of artillery fire.

– Data analysis and reconnaissance: military reconnaissance and data analysis require a mathematical approach to process large volumes of information and identify relevant dependencies. Mathematical methods such as statistics, clustering algorithms and machine learning are used to analyze data and identify important relations and trends. Clustering algorithm is a data analysis method used to group similar objects into homogeneous clusters. This process involves dividing a dataset into groups or clusters in such a way that objects within each cluster are similar to each other, while objects from different clusters are distinct. Clustering algorithms can be used in various fields, including machine learning, data analysis, bioinformatics and others. They enable the discover the hidden patterns and structure in a dataset, aiding in data understanding and decision-making.

These are just a few examples of practical applications of mathematical concepts in real military situations. Mathematics is an essential tool for solving complex problems and making strategic decisions in the defense sector. The use of mathematical models and algorithms helps ensure effective teamwork, accuracy and safety in military operations. For instance, studying probability theory can be useful for analyzing risks and making decisions in military operations.

#### 4. The use of interactive technologies.

The use of modern technologies, such as video conferencing, online platforms and specialized software can contribute to effective teaching of higher mathematics even in military conditions. This allows students to access educational materials and communicate with lecturers regardless of their location. The use of interactive technologies in teaching higher mathematics can significantly facilitate the learning process and make it more interesting and understandable for students. Interactive technologies enable the creation of visualizations, interactive demonstrations and other interactive materials that help students better understand complex mathematical concepts.

One of the most common tools for using interactive technologies in education is computer programs and online resources. These programs and resources allow students to interact with mathematical objects and immediately see the results of their actions. For example, there are programs that allow the creation of function graphs and display their changes when parameters are modified. This helps students better understand the dependencies between different mathematical objects.

In addition to computer programs, interactive technologies can include the use of interactive whiteboards, smartphone and tablet applications, virtual assistants and other tools. For example, the use of interactive whiteboards allows lecturers to demonstrate problem solving and facilitate collective discussions, while smartphone and tablet applications enable students to practice exercises and tests at their convenience.

Furthermore, interactive technologies can involve the use of virtual reality and augmented reality. These technologies allow students to virtually interact with mathematical objects and obtain realistic visual representations of complex mathematical concepts.

Overall, the use of interactive technologies in teaching higher mathematics can significantly improve the quality of education and make it more accessible and understandable for students, even in difficult wartime conditions. These technologies allow for the creation of an interactive learning environment that promotes active student engagement in the learning process and the development of their mathematical skills.

#### 5. Development of critical thinking.

Teaching higher mathematics truly contributes to the development of students' critical thinking and analytical skills. Higher mathematics requires students to analyze complex problems, solve logical tasks and apply various methods to reach a solution. The fundamental principles of higher mathematics, such as logic, proof of statements and mathematical reasoning develop students' critical thinking. They learn to analyze and understand complex mathematical concepts, formulate arguments and use logical reasoning to prove statements.

Additionally, higher mathematics promotes the development of analytical skills. Students learn to break down complex problems into individual components, utilize mathematical methods to solve problems and analyze the results. This helps them develop a systematic approach to problem solving and the ability to find efficient solutions.

Teaching higher mathematics also helps students develop creative thinking skills. They learn to apply mathematical concepts to solve new problems and find innovative approaches to task solving.

Therefore, higher mathematics has a significant impact on the development of critical thinking and analytical skills in students. It provides them with the foundations for solving complex problems, develops a systematic approach to task solving and promotes the development of creative thinking. Students learn to analyze complex problems, seek solutions and utilize mathematical methods to solve real-world tasks.

Teaching higher mathematics in a technical university during times of war can be challenging, but it also opens up new opportunities for students and lecturers. This subject remains an important foundation for understanding and applying scientific principles in technical disciplines, regardless of the circumstances. Lecturers and students must be prepared to adapt and utilize new teaching methods to ensure quality teaching of higher mathematics even in unpredictable conditions of military conflict.

Teaching higher mathematics in a technical university can be significant and beneficial even during times of war and in the post-war era. Despite the difficult conditions, learning mathematics can help develop intellectual abilities and prepare students for future challenges.

A survey was conducted among second-year students of the Faculty of Instrumentation Engineering at Igor Sikorsky Kyiv Polytechnic Institute to investigate their attitudes towards learning higher mathematics, motivation for studying, and analysis of the peculiarities and prospects of teaching higher mathematics in the context of distance learning during times of war [3]. The students were presented with the following questionnaire.

The questionnaire for surveying students of engineering specialties at Igor Sikorsky Kyiv Polytechnic Institute regarding the peculiarities and prospects of teaching higher mathematics during times of war includes the following questions:

1. Do you feel the impact of the military conflict on the process of teaching higher mathematics?
2. What are the main challenges that arise during the teaching of higher mathematics in conditions of war?
3. Does the military conflict affect your motivation to learn mathematics?
4. What changes do you notice in the teaching methods of higher mathematics during war?
5. What opportunities do you see for the use of military technologies in teaching higher mathematics?
6. Do you experience instability in teaching higher mathematics due to the military conflict?
7. What prospects do you see for the development of higher mathematics in the conditions of war?
8. What additional resources (books, materials, software) would be useful for you during the teaching of higher mathematics in conditions of war?
9. Does the military conflict affect your ability to concentrate on studying higher mathematics?
10. Do you feel the need to adapt the teaching of higher mathematics to the realities of the military conflict?
11. What role does the professional competence of the higher mathematics lecturer play in shaping and enhancing your mathematical competence?

These questions helped gather information about the thoughts and experiences of second-year students at the Faculty of Instrumentation Engineering of Igor Sikorsky Kyiv Polytechnic Institute regarding the teaching of higher mathematics in distance and blended learning formats during times of war. The collected data was used to analyze the situation and develop appropriate measures to improve the process of teaching higher mathematics.

The survey results of the students indicate a sufficiently high evaluation of the organization of the educational process during the period of distance learning. The survey results have served as a basis for the development of methods and educational concepts to improve the educational process, as well as to formulate proposals and practical recommendations regarding the peculiarities and prospects of teaching higher mathematics in times of war and post-war periods.

By analyzing the students' responses to the survey questions, we will formulate several main proposals and practical recommendations for teaching higher mathematics to students of engineering specialties at the Igor Sikorsky Kyiv Polytechnic Institute during times of military conflicts and post-war periods:



1. Provide access to educational materials.

Make every effort to ensure access to textbooks, study guides and other materials for students. This may include creating electronic versions of educational materials or organizing remote learning through video conferences.

2. Establish support groups.

Organize groups of students who can support each other and exchange ideas and resources. This can create a supportive learning environment and help students implement new mathematical concepts.

3. Continuously enhance the professional competence of the higher mathematics lecturer at the technical university.

The main professional competence of the higher mathematics lecturer lies not only in teaching students the fundamentals of higher mathematics but also in generating interest in the subject and developing mathematical competence as an integral part of their professional and general cultural competence [4].

4. Apply practical examples.

Use examples from real life that will help students see the practical application of mathematics. For example, studying statistics can be useful for analyzing data on the economic situation in a country or for evaluating the impact of wartime activities on the population.

5. Engage practitioners.

Invite practitioners from various fields that use mathematics in their work to give lectures or workshops. This will help students see how mathematics is applied in practice and can inspire them to further their learning.

6. Maintain motivation for studying higher mathematics.

It is important to maintain students' motivation during times of war and post-war times. It is necessary to praise their efforts, provide support to individual students and create incentives for achieving success.

7. Utilize technology.

The use of modern technologies such as video lessons, interactive exercises and online platforms can facilitate the learning process and make it more accessible for students.

**Conclusions.** Despite the challenging conditions of war, teaching higher mathematics can be a valuable contribution to the development of the younger generation and their preparation for future challenges. Providing access to educational materials, organizing support groups, using practical examples and involving practitioners can help students understand the importance of mathematics and develop their skills.

Therefore, teaching higher mathematics in a technical university during a military conflict has its peculiarities and requires adaptation to unpredictable conditions and ensuring safety.

However, it also provides students with deep knowledge, develops critical thinking and problem-solving approach, promotes the development of practical skills and a research-oriented approach and opens up broad professional opportunities.

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**Суліма О. В. Особливості і перспективи викладання вищої математики як складової STEM-освіти в технічному університеті під час війни**

В статті досліджуються особливості та перспективи викладання вищої математики в технічному університеті, розглядаються виклики, з якими стикається викладання вищої математики під час воєнного конфлікту, шляхи адаптації та забезпечення якісного навчання студентів. В статті також аналізуються і обґрунтовуються основні переваги STEM-освіти в технічному університеті, особливості викладання вищої математики під час війни, практичні застосування математичних концепцій у воєнних ситуаціях, використання інтерактивних технологій та розвиток критичного мислення студентів.

В роботі наведено декілька основних висновків. По-перше, STEM-освіта в технічному університеті має велике значення, оскільки спрямована на розвиток інтегрованого підходу до навчання, який поєднує наукові знання, технологічні навички, інженерну творчість та математичну грамотність. По-друге, викладання вищої математики в технічному університеті допомагає студентам отримати глибокі знання в наукових дисциплінах та розвивати критичне мислення та проблемний підхід. По-третє, STEM-освіта сприяє розвитку практичних навичок та дослідницького підходу, а також розвиває творчі здібності студентів. По-четверте, випускники STEM-програм у технічних університетах мають широкі професійні можливості.

Проведено анкетування студентів 2-го курсу приладобудівного факультету Київського політехнічного інституту імені Ігоря Сікорського з метою дослідити їх відношення до засвоєння ними курсу вищої математики і аналізу особливостей і перспектив викладання вищої математики в режимі дистанційного навчання в умовах війни. Результати опитування студентів стали підґрунтям для розробки методів удосконалення освітнього процесу та формулювання пропозицій і практичних рекомендацій щодо перспектив розвитку, методики викладання вищої математики, як складової STEM-освіти в поствоєнні часи.

В статті також розглядаються особливості викладання вищої математики під час воєнного конфлікту. Перш за все, викладачі та студенти повинні бути готові до адаптації до непередбачуваних умов, що супроводжують воєнний конфлікт. Для забезпечення безпеки важливо використовувати заходи безпеки на території університету та дотримуватися правил безпеки під час лекцій і виконання практичних завдань. Також викладання вищої математики в умовах війни може включати використання практичних прикладів для показу студентам практичних застосувань математичних концепцій у воєнних ситуаціях. Використання інтерактивних технологій та розвиток критичного мислення також є важливими аспектами викладання вищої математики під час воєнного конфлікту.

**Ключові слова:** математика, дистанційне навчання, освіта, студенти, концепції, інтерактивні технології, критичне мислення, мотивація.

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Чжао Жуйченъ

**ПЕДАГОГІЧНІ УМОВИ ФОРМУВАННЯ МІЖКУЛЬТУРНОЇ КОМПЕТЕНТНОСТІ  
МАЙБУТНІХ УЧИТЕЛІВ ФІЛОЛОГІЧНИХ ДИСЦИПЛІН**

Актуальність дослідження зумовлена тим, що модернізація вищої педагогічної освіти вимагає перегляду освітнього процесу закладів вищої освіти, який повинен бути спрямований на підготовку конкурентоспроможних майбутніх учителів, здатних здійснювати педагогічну діяльність в умовах полікультурності, а отже, потребує впровадження певних педагогічних умов. Під педагогічними умовами формування міжкультурної компетентності майбутніх учителів розуміються спеціально створені обставини, що сприяють формуванню практичних умінь і навичок міжкультурного спілкування, особистісних якостей студентів, які дозволять їм в майбутньому здійснювати успішну педагогічну діяльність з учнями на засадах толерантності в умовах міжкультурної взаємодії. Такими педагогічними умовами обрано: створення міжкультурного середовища в педагогічному закладі вищої освіти; контентне наповнення міжкультурним змістом психолого-педагогічних і фахових навчальних дисциплін із використанням інтерактивних методів навчання; залучення майбутніх учителів до міжкультурної взаємодії в позааудиторний час.

Вибір першої педагогічної умови зумовлений тим, що в педагогічному університеті навчаються як представники зарубіжних країн, так і представники етнічних груп, які є представниками інших культур і мають різне віросповідання. Подано власне розуміння автором міжкультурного середовища. Вибір другої педагогічної умови зумовлений тим, що сформувати міжкультурну компетентність майбутніх учителів засобами однієї навчальної дисципліни неможливо, для цього необхідно наповнювати міжкультурним змістом інші навчальні дисципліни, які викладаються в межах ОПП. Акцентовано увагу, що на зазначених дисциплінах доцільно використовувати інтерактивні методи навчання (дискусії, мозкові штурми, круглі столи, кейс-стаді, квести тощо). Вибір третьої педагогічної умови зумовлений значним зменшенням кількості аудиторних занять і збільшенням самостійної роботи студентів в освітньому процесі. Зазначено, що до позааудиторної діяльності належать участь у наукових гуртках, студентському науковому товаристві, олімпіадах, конференціях, різноманітних культурних центрів тощо.

**Ключові слова:** майбутні вчителі, міжкультурна компетентність, педагогічні умови, міжкультурне середовище, інтерактивні методи навчання, позааудиторна діяльність.