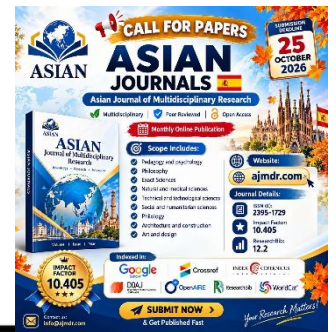




METHODOLOGY FOR TEACHING ALGEBRA DRAWN IN HIGHER EDUCATION ON THE BASIS OF MODERN PEDAGOGICAL TECHNOLOGIES

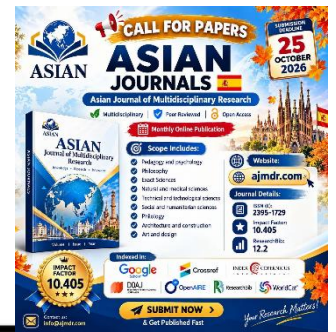
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Abstract: This article examines the theoretical and methodological aspects of teaching linear algebra in higher education through modern pedagogical technologies. It discusses approaches to developing students' mathematical competencies, logical reasoning, and professional skills. The didactic potential of problem-based learning, interactive teaching methods, project-based learning, the flipped classroom model, and digital technologies is analyzed. Practical approaches to teaching matrices, determinants, vectors, and systems of linear equations are considered. Methodological recommendations for improving the teaching and learning process in linear algebra are proposed.

Keywords: linear algebra, higher education, pedagogical technologies, interactive teaching methods, digital learning, mathematical competencies, problem-based learning, mathematical modelling.

Today, improving the quality of education in the higher education system, developing the ability of students to think independently and harmonizing theoretical knowledge with practical activities is one of the important pedagogical tasks. In particular, the need to enrich the traditional methods of explanation and demonstration in the teaching of mathematics with modern approaches based on the active participation of students is growing. A special place in this process is occupied by the science of linear algebra. Linear algebra is one of the fundamental sections of higher mathematics, covering the study of systems of matrices, determinants, vectors, linear spaces, linear reflections and linear equations. These concepts form an important theoretical basis not only of mathematical theory, but also of the fields of Economics, Engineering, Information Technology, Computer Graphics and data processing. A distinctive feature of the science of linear algebra is that it is important to understand the connection between abstract mathematical concepts and practical issues. For example, it is not enough to know the rules for performing actions on matrices. The student should also understand the content of these actions, the conditions of application and their importance in solving



various issues. Therefore, in the teaching of this subject, the consistent formation of concepts, the use of geometric images, the creation of problem situations and the application of practical tasks are of particular methodological importance.

In the course of traditional education, the main place can be played by the teacher in detail of theoretical information and solving model issues. While such an approach is necessary to some extent, it may not sufficiently engage all students in independent research, analysis, and mathematical conclusions. Modern pedagogical technologies, on the other hand, expand the possibilities of increasing the student's activity in the educational process, conscious assimilation of knowledge and their application in new situations. The purpose of the study is to analyze the theoretical and methodological features of teaching linear algebra in higher education on the basis of modern pedagogical technologies, as well as to develop recommendations aimed at improving the educational process. The tasks of the study include clarifying methodological problems in teaching linear algebra, analyzing the didactic possibilities of modern pedagogical approaches, showing ways to use digital tools and developing recommendations for organizing effective training. The methodological basis of the study is the analysis of pedagogical and methodological literature, comparison, systematization and generalization of didactic approaches that can be applied to the process of mathematical education.

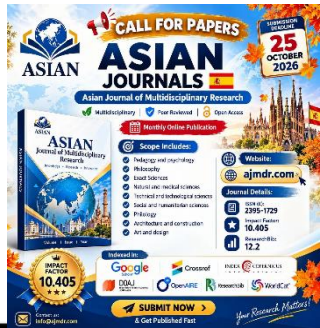
This article has a theoretical and methodological nature, in which modern approaches to the teaching of linear algebra are considered on the basis of analysis of scientific literature and didactic generalization. As the main methods of research, the study, comparison, systematization, theoretical generalization and methodological modeling of scientific sources are used.

The proposed methodological approach is based on three interconnected components:

1. The content component is the teaching of the concepts of linear algebra in logical consistency, revealing the connections between theory and practice.
2. An activity-oriented component is the involvement of students in the educational process through problem assignments, group work, independent research and project activities.
3. The technological component is mathematical applications, interactive visualization and targeted use of e-learning resources.

When these components harmonize, the teaching process is not limited to communicating only theoretical information. The student is also involved in the activities of interpreting mathematical concepts, determining the connection between them, choosing a method of solving the issue and checking the result obtained.

The use of a problematic educational method in teaching linear algebra Problem education is based on the creation of a certain intellectual challenge between the existing knowledge of students and the new teaching task. In this, the teacher, without



completely solving the problem, directs students to independent thinking, hypothetical advancement, comparison of solutions and drawing conclusions. Linear to use this method in algebra training, it is possible to create problem situations related to a system of linear equations, determinants and matrices.

For example, let the following system of equations be given:

$$x + y = 3 \quad 2x + 2y = 6$$

Students are instructed to determine how many solutions the system has. Initially, they try to solve the equations in the usual way. The second equation is then determined to be twice the size of the first equation. The result is based on the fact that the system has an infinite number of solutions rather than a single single solution.

After that, the teacher directs students to work on the following questions: what conditions do the system of equations have a solution depend on? How does the relationship between the coefficients of the equations affect the number of solutions? How can this state be expressed using matrices?

Such assignments help students understand mathematical relationships rather than the mechanical application of formulas. An important aspect is that the problem situation must correspond to the student's level of training and motivate him to think consistently. Didactic possibilities of interactive methods

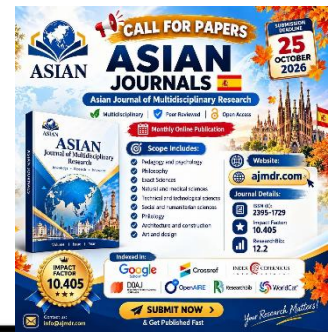
Interactive methods are based on students ' interaction, exchange of ideas and collaborative problem solving. In linear algebra, small group work, mental attack, question-and-answer, comparison, and mathematical discussion can be used.

For example, in the study of the topic of matrices, students are divided into small groups. The first group performs assignments regarding the addition and subtraction of matrices. The second group studies the properties of matrix multiplication. The third group analyzes the properties of the unit Matrix and the inverse Matrix. At the final stage of the training, teams present their results and discuss each other's solutions. This method serves to form in students not only mathematical knowledge, but also skills for substantiating one's own opinion, listening to the opinion of others and working in cooperation.

The effectiveness of interactive methods depends on the correct choice of assignments, the active participation of each student and the accuracy of the assessment criteria. Therefore, it is advisable to take into account not only the final answer in the group work, but also the justification of the solution and the individual contribution of students.

Teaching the concepts of linear algebra based on digital technologies

Some topics in linear algebra have a high level of abstraction, explaining them using formulas alone can be a challenge for students. Numerical tools allow visual



representation of mathematical concepts, verification of computational results, and comparison of different states.

In particular, the GeoGebra program can be used to describe vectors, coordinates, linear reflections, and geometric changes. Tools such as MATLAB and Python, however, have applications in performing actions on matrices, solving systems of linear equations, and studying computational algorithms.

This issue can also be solved using a software tool. In this case, the main methodological goal will be not to get a response through a computer, but to check the results of the calculations performed manually, understand the principle of operation of the algorithm and understand the convenience of matrix representation. In the process of using digital tools, several methodological requirements must be taken into account. First, the use of the program should correspond to the educational purpose. Secondly, it is necessary for the student to mathematically interpret the result of the calculation. Thirdly, the software result should be checked by theoretical rules and independent calculation. Otherwise, digital technologies can become a means of obtaining a ready-made answer instead of a tool for the development of Mathematical Thinking. Teaching linear algebra in higher education on the basis of modern pedagogical technologies deepens students' mathematical knowledge, makes sense it is an important methodological task aimed at developing thinking and expanding the possibilities of applying theoretical knowledge in practical matters. Based on the theoretical-methodological analysis considered in the article, the following conclusions can be drawn.

First, when teaching linear algebra, it is important to harmonize theoretical concepts, practical assignments and independent research activities. Teaching systems of matrices, determinants, vectors, and linear equations in relation to each other serves to make students realize logical connections between subjects.

Secondly, problematic education and interactive methods make it possible to organize the active participation of students in the educational process. In the use of these methods, it is necessary to direct students to independent thinking, substantiate solutions and draw mathematical conclusions.

Third, the use of numerical tools such as GeoGebra, MATLAB, and Python provides useful didactic opportunities in the visual representation of mathematical concepts, verification of computational results, and organization of mathematical modeling. However, these tools should not replace understanding of mathematical content and independent thinking.



In general, the purposeful and methodically justified use of modern pedagogical technologies in the teaching of linear algebra provides an important opportunity for improving the educational process. The main focus in this should be not on the technology itself, but on the student's understanding of the mathematical content, independent thinking and the ability to apply the knowledge gained in new situations.

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