PECULIARITIES OF OPTIMIZATION OF TEACHING MATHEMATICS TO STUDENTS OF ECONOMIC SPECIALTIES IN HIGHER EDUCATION INSTITUTIONS

In the article, the author studies the peculiarities of optimizing the teaching of mathematics to students of economic specialties in higher education institutions. It has been found that teaching mathematics to students of economic specialties is accompanied by a number of problems, in particular, the subject area, the peculiarities of the modern educational environment and the social context. Some students do not show sufficient interest and do not realize the importance of mathematics in professional activities. Low motivation leads to the lack of concentration in the classroom and worsening the outcomes. The quality of mathematics education is negatively affected by the lack of a sufficient level of students’ basic mathematical knowledge. They may not understand real economic scenarios of future professional activities and have difficulty using mathematical concepts to model and analyze real economic situations. Some mathematical concepts and categories, such as differential equations or statistics, can be difficult to understand and apply in the context of complex economic models.

Optimization of teaching means bringing this process to a state that ensures the achievement of goals in accordance with the requirements.
for the content and level of professional training of students, taking into account their interests and capabilities in conditions of limited use of time and effort resources. The main ways to optimize mathematics teaching are: use of specific economic examples and tasks to explain mathematical concepts, because learning can be more effective if students see how they can use mathematics in their future economic activities; integrating teaching with economic models and mathematical concepts so that students can see the use of math in analyzing economic phenomena; use of computer and specialized programs for visualization of mathematical concepts and their use in economic issues; introduction of interactive online resources to facilitate the learning process; active use of applied tasks, inclusion in the curriculum of tasks that require the use of math skills to solve specific economic problems, etc.

**Keywords:** mathematical education; optimization; students of economic specialties; mathematics; higher mathematics; optimization conditions; higher education institutions.

1. **INTRODUCTION**

The reform of vocational and higher education in accordance with the needs of the Ukrainian education system requires constant updating of the educational process. Recently, a lot of attention has been paid to the quality of professional mathematical education. It is quite understandable, since in the modern world of intelligent technology, without the knowledge of the basics of mathematics, it is impossible to develop and further improve professional activities. However, fewer studies have focused on the quality of mathematics teaching in higher education institutions (HEIs).

**Problem statement.** It has to be stated that teaching mathematics to modern youth is associated with various problems, including the subject area, the peculiarities of the modern educational environment and the social context. Some students do not show sufficient interest and do not realize the importance of mathematics in their lives. Low motivation leads to the lack of concentration in the classroom and worsening the outcomes.

Also, with the introduction of technology and electronic gadgets in everyday life, students are often distracted during class, which can negatively affect their ability to focus on math tasks.
The quality of mathematics education is negatively affected by the lack of a sufficient level of basic mathematical knowledge among students, which can make it difficult to learn new concepts and tasks. This may be due to the quality of prior education or the lack of support for school students with poor knowledge. Also, due to the lack of practical application, students may not be able to predict specific scenarios where their math skills can be applied in real life. This factor also reduces students’ motivation to study mathematics.

The quality of mathematics education is also affected by the fact that some instructors may use outdated or non-adaptive teaching methods, which can make it difficult for students to learn the material.

For some students, especially if they are afraid of math, high demands and structured nature of math tasks can cause stress and psychological discomfort.

Thus, the problem of improving the quality of students’ mathematical knowledge is relevant and needs to be addressed.

It can be solved by using innovative teaching methods, increasing students' interest, providing practical applications of mathematics and taking into account individual characteristics of students, as well as by optimizing the teaching of mathematics to students, in particular, those majoring in economics in higher education institutions.

It should be noted that teaching mathematics to students of economic specialties, besides the above mentioned, is also accompanied by specific problems arising in the context of their educational needs and interests. In particular, students of economic specialties may not fully understand the real economic scenarios of their future professional activities and have difficulty in using mathematical concepts to model and analyze real economic situations. Students may also not see a direct connection between mathematical concepts and their future professional activities in economics, which may affect their motivation to study mathematics.

Some mathematical concepts and categories, such as differential equations or statistics, can be difficult to understand and apply in the context of complex economic models. There are many different approaches to solving problems in economics, and the use of different mathematical methods can
cause uncertainty and divergence of opinions of students. Also, a low level of math skills can affect the effectiveness of teaching. If mathematics is not presented as a tool for solving specific economic problems, students may feel that this science is quite distant from their professional application.

In order to solve the problems related to the mathematical education of students of economic specialties, it is necessary to use applied tasks and real examples from economics, to model classes with active participation of students and to give practical examples of the application of mathematical concepts in the field of economics. It is also important to stimulate interest in mathematics through the realization of its importance for economic analysis and managerial decision-making.

**Analysis of recent research and publications.** In pedagogical science, the problem of optimizing the educational process is directly related to various scientific approaches and concepts. As for optimizing teaching mathematics to students of economic specialties in higher education institutions, the role of mathematics in the system of professional education for future economists was studied by I. Hotynchan, I. Drin [1], Z. Bondarenko and S. Kyrylashchuk emphasized the importance of applied orientation of teaching higher mathematics to students of economic profile [2]. Important aspects of teaching higher mathematics in the course of training economists in accounting and taxation for the post-war economy are presented by I. Hevlych and L. Hevlych [3]. Papers [4]–[7] present the didactic features of teaching mathematics to future economists and the organizational and pedagogical conditions for optimizing the teaching of socio-economic disciplines.

At the same time, the issue of optimizing the teaching of mathematics to students of economic specialties in higher education institutions is not sufficiently addressed.

**The aim of the article** is to determine the peculiarities of optimizing the teaching of mathematics to students of economic specialties in higher education institutions.

2. **RESEARCH RESULTS**

The results of the analysis of theoretical works show a variety of approaches to the definition of the concepts of “teaching” and “optimization”.
In particular, “teaching” in the studies of S. Honcharenko, V. Loznytsia, A. Okon, P. Sikorskyi, and M. Yaremchenko is defined as an external component of the learning process, teaching management, and its essence as a procedural side of teachers’ activities, which is aimed at identifying such conditions for the organization of educational work, the observance of which will allow students to consciously navigate the discipline, update the acquired knowledge and skills, and exercise self-control. Generalization of different definitions and views on the teaching process allows us to identify the main activities of an instructor: selection, systematization, structuring, perception, awareness and mastery of educational information and methods of working with it; teaching itself; organization of rational, effective work with students; planning and organizing research work. All of these areas contribute to improving the teaching process. An analysis of the genesis of the problem under study shows that teaching in higher education institutions has always been the focus of pedagogical theory and practice. It was entirely dependent on theoretical concepts and requirements of regulatory documents for its implementation. Since the 70s of the XX century, the concept of optimizing the learning and teaching process has been introduced in scientific research. It involved finding and choosing the best teaching option in the existing conditions. However, the ideas that were put forward and developed on its basis were designed for a secondary school, which did not reflect the specifics of higher education institutions.

There is a certain contradiction in the very concept of “optimization” in relation to the problem considered in this article, since optimization (formally) implies the establishment of stability, structuring and segmentation of the learning process, keeping it at the proper level set by the target component of learning. At the same time, the introduction of innovations, on the contrary, involves increasing chaotic movements in the “teacher-student” system, increasing the speed of progress to the point of bifurcation (culmination), etc. However, this contradiction is also the realization of specific dialectical laws:

1) the law of unity and struggle of opposites, which is manifested in the fact that innovation and optimization, complementing each other, ensure development (in methodological meaning of the word);
2) the law of negation of negation, since the innovative activity of a higher education instructor, denying the stable optimality of the educational process, generates in its place a new optimality endowed with more effective characteristics;

3) the law of transition of quantitative changes into qualitative ones. This pattern is manifested in at least two phenomena: first, the increase of innovations in professional activity itself indicates a new quality of teaching (an individual instructor or teaching in a higher education institution in general); secondly, innovation itself is usually the result of the transformation of a certain number of innovations into systemic education, which is called innovation.

Today, the higher education system is experiencing a period of learning optimization due to social reasons. Its main characteristic is a significant increase in scientific and technological progress.

The optimization of the educational process is carried out primarily at the stage of its design – when planning a lesson, but it nevertheless goes through all pedagogical activities. Some specific situation requires the instructor to deviate from the developed plan, to choose the best solutions based on the goal and pedagogical possibilities – means and methods of influence and taking into account the individual characteristics of the students themselves. There can be no strict algorithms in educational work with students, as many components determine its effectiveness. Choosing a solution in non-standard situations is always about finding the best option [8].

Thus, optimization of the educational process is a constant, uninterrupted activity of the instructor.

Having summarized different approaches to the interpretation of the concept of “optimization”, we have concluded that the optimization of teaching should be understood as bringing the process to a state that ensures the achievement of goals in accordance with the requirements for the content and level of professional training of students, taking into account their interests and capabilities in the context of limited use of time and effort resources. Such a definition is also acceptable for the problem under study in the article on optimizing the teaching of mathematics in higher education institutions.
The purpose of optimizing the teaching of mathematics in humanities universities is to achieve the following two important goals: preparing students for their future specialty (in particular, students of economics) and the development of their worldview, as well as the development of thinking of future specialists (in economics), setting complex problems for them and their interpretation.

Another important mission of higher mathematical education for students of economics is to overcome the discrepancy between their mathematical knowledge and the requirements of modern science and technology. The reasons for this discrepancy are the following: the content of higher mathematics for humanitarian universities cannot reflect all the achievements of science and technology; inappropriate units and topics are included in the new curricula; the solution of general pedagogical issues regarding the ways and means of improving the teaching of mathematics to students of humanitarian higher education institutions in theoretical and practical directions is not completed.

In order to eliminate the difference between the mathematical knowledge of university students (in particular, students of economics) and the requirements of modern science and technology, it is necessary to update the process of optimizing the teaching of higher mathematics. This process requires revising the content of the higher mathematics course; reducing repetitive sections; adding basic sections of modern mathematics; using analogies, etc.

It should be noted that mathematical knowledge is an important tool for analyzing and modeling economic processes, and its proper use helps economists make reasonable conclusions and predictions. Understanding of mathematics also makes it easier for economists to communicate with representatives of other specialties where mathematical analysis is an important element.

Future economists need to have a variety of mathematical knowledge to be successful in the field of economics and finance. Here are some key math skills that may be important for economists:

- solving systems of linear equations and inequalities;
- matrices and determinants for analyzing economic models;
derivatives and integrals to study changes in functions;
use of differential equations for modeling economic processes;
analysis of statistical data and distributions;
study of probabilities for risk assessment and decision-making;
use of optimization methods to maximize or minimize economic functions;
development of logical thinking to analyze economic situations and make conclusions;
use of mathematical proofs in economic theory;
studying functions and their properties to understand changes in systems;
application of statistical methods in the study of economic dependencies and modeling;
calculation of the value of cash flows, discounted value and other financial parameters;
studying the interaction of various participants in markets and decision-making in conditions of conflict or cooperation;
use of geometric models to study economic relations and spatial aspects.

The results of generalizing the conclusions of scientific works and analyzing the practice of teaching mathematics to students of economic specialties allow us to conclude that the main ways to optimize the teaching of mathematics can be:

use of specific economic examples and tasks to explain mathematical concepts, as learning can be more effective if students see how they can use mathematics in their future economic activities;
integrating teaching with economic models and mathematical concepts so that students can see the use of math in analyzing economic phenomena;
use of computer and specialized programs for visualization of mathematical concepts and their application in economic problems;
introduction of interactive online resources to facilitate the learning process;
active use of applied tasks, inclusion of tasks that require the application of mathematical skills to specific economic problems into the curriculum;
individualization of the approach, taking into account different levels of student’ preparation and support for those who need additional assistance; intensification of students’ motivation to study mathematics by demonstrating the importance of having mathematical tools for solving complex economic problems and making reasonable decisions; providing feedback to students to assess their understanding and address possible difficulties in the course of studying mathematics; encouraging students’ success and enhancing their motivation to further study of mathematics.

The study also helped to formulate the conditions under which it is possible to optimize the process of teaching mathematics in higher education institutions to students of economic fields of study. These conditions include the following:

- adequacy of the content of mathematics in the professional activity of future specialists in the field of economic;
- development of a set of measures to structure the content of higher mathematics;
- rational use of technical means of training;
- availability of appropriate educational and material resources in the HEI;
- improving control and assessment of students’ learning;
- rational organization of independent work in the study of higher mathematics.

The condition of the adequacy of the content of mathematical training for professional economic activity and its selection and structuring implies that the task of effective teaching of mathematical disciplines should be considered not only through optimization of the content itself and its structure, but also through determining the interaction of all its elements. Taking into account the existing approaches to the process of optimizing the content of academic disciplines in higher education institutions, we have determined that the optimization of the structure of mathematical training should be understood as follows:

- firstly, a clear definition of the structural elements that make up the mathematical discipline;
secondly, applying optimization procedures to each of these structural elements;

thirdly, establishing and maintaining in an optimal state the links and relations between the elements of the structure of the mathematical discipline in accordance with the integrative criteria for assessing the effectiveness of its construction.

Regarding the rational use of existing and new technical means of teaching (TMT), this implies that technical teaching aids are used not only during lectures, but also during all other types of classes; teachers of different academic disciplines use a variety of TMT, including computer systems. It requires self-improvement in the field of computer literacy. Ideal conditions for studying mathematics are created by such technical means that can demonstrate the dynamics of events and phenomena, reproduce certain problem situations that serve as an indicative basis for independent thinking, a guide for establishing internal regularities. These requirements are best met by multimedia and modern computer programs for mathematical modeling.

Another condition for optimizing mathematics teaching is the improvement of control and assessment of students’ learning. The analysis of the traditional system of semester control made it possible to identify its shortcomings, in particular: lack of consistency in preparing for classes, weak encouragement of students’ current work, and subjectivity in assessing knowledge. The introduction of module-rating technology into the educational process helps overcome these shortcomings.

As for the organization of independent work in higher mathematics, it has certain specific features. First of all, independent work in higher mathematics causes difficulties for students, since one of the principles of didactics plays a particularly important role in teaching mathematics – the principle of visibility, which is achieved through lecture demonstrations (formulaic, graphic) and laboratory work. Therefore, there is a need for an extremely careful selection of educational material for self-study not only by sections and topics, but also taking into account the future specialty of students (namely, economics).

It should also be noted that there is a problem with independent work in higher mathematics in terms of its control. To a large extent, the problem can be solved by testing with the help of computer technology.
The above list of conditions for optimizing the teaching of mathematics in higher education institutions to students of economics is minimal, since the optimization itself may involve changes in such components as: the purpose of learning, methods and means of teaching, activity results, diagnostics and control of learning outcomes, organization of the educational process.

3. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

Teaching mathematics to students of economic specialties is accompanied by a number of problems, including the subject area, the peculiarities of the modern educational environment and the social context. Some students do not show sufficient interest and do not realize the importance of mathematics in professional activities. Low motivation leads to a lack of concentration in the classroom and poor results. The quality of mathematics education is negatively affected by the lack of a sufficient level of basic mathematical knowledge among students. They may not have sufficient understanding of real economic scenarios of future professional activities and have difficulty using mathematical concepts to model and analyze real economic situations. Some mathematical concepts and categories, such as differential equations or statistics, can be difficult to understand and apply in the context of complex economic patterns.

Optimization of teaching means bringing this process to a state that ensures the achievement of goals in accordance with the requirements for the content and level of professional training of students, taking into account their interests and capabilities in conditions of limited use of time and effort resources. The main ways to optimize mathematics teaching are use of specific economic examples and tasks to explain mathematical concepts, as learning can be more effective if students see how they can use mathematics in their future economic activities; integrating teaching with economic models and mathematical concepts so that students can see the uses of mathematics in the analysis of economic phenomena; use of computer and specialized programs for visualization of mathematical concepts and their usage in economic tasks; introduction of interactive online resources to facilitate the learning process; active use of applied tasks, inclusion of...
tasks requiring the application of mathematical skills to specific economic problems in the curriculum, etc.

Promising areas for further scientific research include highlighting foreign experience in the formation and development of diagnostic competence of applicants for education; researching the possibilities of distance learning for the development of diagnostic skills of cadets and students.

Список використаних джерел


Желавський О. ОСОБЛИВОСТІ ОПТИМІЗАЦІЇ ВИКЛАДАННЯ МАТЕМАТИКИ СТУДЕНТАМ ЕКОНОМІЧНИХ СПЕЦІАЛЬНОСТЕЙ У ЗАКЛАДАХ ВИЩОЇ ОСВІТИ

У статті автор досліджує особливості оптимізації викладання математики студентам економічних спеціальностей у закладах вищої освіти. З’ясовано, що викладання математики студентам економічних спеціальностей супроводжується низкою проблем, зокрема предметною сферою, особливостями сучасного освітнього середовища та суспільним контекстом. Деякі студенти не виявляють достатнього інтересу та не усвідомлюють важливості математики у професійній діяльності. Низька мотивація призводить до відсутності зосередженості на заняттях та погіршення результатів. Негативно впливає на якість математичної освіти відсутність достатнього рівня базових математичних знань у студентів. Вони можуть недостатньо розуміти реальні економічні сценарії майбутньої професійної діяльності. Низька мотивація призводить до відсутності достатнього рівня базових математичних знань у студентів. Вони можуть недостатньо розуміти реальні економічні сценарії майбутньої професійної діяльності. Низька мотивація призводить до відсутності достатнього рівня базових математичних знань у студентів. Вони можуть недостатньо розуміти реальні економічні сценарії майбутньої професійної діяльності.

Під оптимізацією викладання розуміється доведення зазначеного процесу до такого його стану, що забезпечує досягнення цілей відповідно до вимог, які висуваються до змісту і рівня професійної підготовки студентів, з урахуванням їх інтересів та можливостей в умовах обмеженого використання ресурсів часу та зусиль.

Основними шляхами оптимізації викладання математики є використання конкретних економічних прикладів та завдань для пояснення математичних концепцій, оскільки засвоєння матеріалу може бути ефективнішим, якщо студенти бачать, як вони можуть використовувати математику в своїй майбутній економічній діяльності; інтеграція викладання з економічними моделюваннями і математичними концепціями, щоб студенти могли бачити застосування математики в аналізі економічних явищ; використання комп’ютерних і спеціалізованих програм для візуалізації математичних концепцій та їх застосування в економічних задачах; впровадження інтерактивних онлайн-ресурсів для полегшення засвоєння навчального матеріалу;
активне використання прикладних завдань, включення до навчальних програм завдань, які вимагають застосування математичних навичок до конкретних економічних проблем тощо.

Ключові слова: математична освіта; оптимізація; студенти економічних спеціальностей; математика; вища математика; умови оптимізації; заклади вищої освіти.

References


