

THEORETICAL FOUNDATIONS OF THE PROFESSIONAL DIRECTION OF TEACHING MATHEMATICS COURSE IN HIGHER EDUCATIONAL INSTITUTIONS

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Abstract.

The article relevant topic is due to the importance of mathematics as one of the fundamental disciplines in the program of teaching students in higher educational institutions and the need to determine the theoretical foundations of the professional orientation of its teaching in the context of the formation of a particular set of competencies among students. In this regard, the work aims to consider the theoretical foundations of the professional direction of teaching a mathematics course in modern higher educational institutions. The leading methodological approach in the study is the combination of system analysis methods of the basic concepts of teaching higher mathematics with the study of prospects for improving the professional orientation in its teaching. In the course of the work, results were obtained that testify to the essential role of mathematics in forming the competencies of future specialists in the development and implementation of a set of measures aimed at a deeper study of the foundations of teaching a mathematics course in higher educational institutions.

The results and conclusions of the study have a particular practical value for teachers of higher mathematics in the system of higher educational institutions, who are faced with the need to plan curricula when teaching this discipline and students studying higher mathematics.

Keywords: mathematics, teaching, professional orientation, higher educational institution, theoretical foundations of teaching.

Introduction

Teaching mathematics in higher educational institutions has some features that are determined by the specifics of higher education didactics. At the same time, the specific goals and training nature and educational content formation and educational process organization features are of great importance. In current conditions, future engineers' professional training tasks may change. It is expressed in changes in the requirements both for the structure of training specialists and for the profession itself, which implies the introduction of new requirements for the quality of improving the mental activity of students; creating a wide range of practical skills and competencies; the formation of psychological readiness to replenish the accumulated baggage of knowledge and improve the specialists' qualifications; consistent development of new technological equipment; fostering the activity of students and the creative professional qualities of teachers; development of students' creative initiative [1].

The high quality of teaching mathematics in higher educational institutions can be achieved by combining methodological and substantive approaches and organizing the educational process. Careful selection of the

subject's content in combination with creating a clear structure of the educational process, the definition of the primary forms, methods and means of teaching are determined by a specific system of didactic principles of pedagogy. These principles are essentially a synthesis of the current achievements of modern pedagogy, and they are systematically updated. It explains the consistent transformation and expansion of the existing system of didactic principles.

In general, improving the professional orientation of students' education is among the main ones in the modern higher education modernization, particularly in teaching mathematics [2]. This set of issues can be solved by applying a competency-based approach and introducing unique, professionally-oriented mathematical disciplines into the training program for specialists in higher educational institutions. The professional orientation of teaching a mathematics course presupposes the consistent formation of the psychological and social orientation of future specialists, taking into account their subsequent professional activities and the creation of interdisciplinary ties in organizing the learning process in higher educational institutions. At the same time, attention should be paid to the professional orientation of training, which presupposes a mandatory and close connection between training and science and practice [3, 4].

The consistent implementation of interdisciplinary connections of various disciplines, both unique and fundamental, obliges to include specialized material in the teaching process, with the presentation of program courses so that there is no disruption of connections between disciplines. In addition, attention should be paid to the observance of the logical structure of the taught discipline, prevention of its transformation into a complex of different scientific problems that do not have a logical connection with each other. The principle of the professional orientation of teaching a discipline in the higher education system presupposes a precise regulation of the specific and general in education. Also, it determines the characteristic features of the dialectic of the interaction of the integral and the particular, aimed at forming a modern personality, including its professional development. This circumstance predetermines the choice of a unique, didactic meaning of the principle of professional orientation in modern education [5].

The main task of our work was to study the theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions. This is essential from the point of view of the prospects for improving the future specialists training at the stage of their training in higher educational institutions and creating the necessary conditions for improving the quality of mastering the course of higher mathematics by students with their focus on further professional activity.

Materials and research methods

The basis of the methodological approach in our work is a combination of system analysis methods of the basic concepts of teaching higher mathematics in higher educational institutions with the study of the prospects for activating and strengthening the professional orientation in its teaching. In the course of the research, we analyzed the main features of teaching higher mathematics in the system of higher education.

The theoretical basis of the research is the scientific developments of several Kazakhstani and foreign scientists dedicated to studying the basic concepts of teaching mathematics in educational institutions and determining the place and significance of this discipline in the general system of scientific knowledge.

The entire complex of scientific research within the framework of the stated topic was carried out in three stages.

At the first stage, a theoretical study of the basic concepts of teaching mathematics in higher educational institutions was carried out and the determination of the place and significance of this discipline in the system of scientific knowledge. A systematic analysis of these concepts was also carried out, which, combined with a preliminary theoretical study of the existing problems, constitutes a fundamental basis for subsequent scientific developments.

At the second stage, an analytical study was carried out to determine further prospects for activating and improving the professional orientation of teaching mathematics in higher educational institutions. In addition, the preliminary practical results obtained were compared with the results and conclusions of other researchers, which contributed to obtaining a more objective picture for the completion of our study.

At the final stage of the work, conclusions are formulated based on the results obtained, which are limited by the framework of studying the features of the formation of the theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions. In general, the results obtained in the course of the study and the conclusions formulated on their basis can serve as a methodological and theoretical basis for further scientific research, which is essential for improving the quality of training of future graduates of higher educational institutions and the development of their professional competencies in their chosen profession.

Results and Discussion

Our study of the theoretical foundations of the professional orientation of mathematics course teaching in higher educational institutions has yielded specific results, in which it is necessary for the future to take into account the following main aspects:

1. Determine the mathematics course content according to the rules for forming professional competencies of future specialists and the current curricula of higher educational institutions.
2. Display the relationship of mathematics in the teaching process with highly specialized disciplines taught in training programs in higher educational institutions.
3. Focus on the acquisition by students of specific skills necessary for the further practical application of the knowledge gained in their subsequent life of graduates.
4. Develop students' ability to independently analyze the studied mathematical disciplines' content to improve the quality of assimilation when they receive new knowledge.

5. To use the method of analogies in teaching from the future professional activity of the graduate in order to improve the quality of students perception of the available educational information.

The analogy method allows you to get a visual idea of the possibilities of the practical knowledge application gained in studying a course in mathematics as part of a training program in higher educational institutions. Analogies should be built under the basic mathematical laws outlined in the curriculum and various aspects of their practical application for solving a wide range of problematic issues in their future professional activities [6].

The qualitative construction of the educational process following the requirements of today is of fundamental importance. Thanks to this, the level of professional training of future specialists and their knowledge of mathematics within the framework of the training program in higher educational institutions is determined. In this context, it is necessary to pay serious attention to the advanced mathematical training of students. This preparation is intended to focus on the following aspects:

1. Basic, i.e. fundamental training based on the assimilation of special knowledge in the field of mathematics, transmitted to students directly in teaching them basic mathematical disciplines - algebra, descriptive geometry, mathematical analysis, the foundations of the theory of integral and differential equations.

2. Pedagogical and vocational training, the qualitative basis of which is methodological and psychological knowledge. Their development guarantees the practical organization of the graduate's professional activity in his future work.

3. Preparation of a general cultural nature, based on humanitarian disciplines, the acquisition of knowledge of social and economic nature, necessary for the upbringing of intellectually developed individuals, adapted to the realities of today and the requirements of future professional activities of students.

In the process of analyzing the theoretical foundations of the professional orientation of teaching a mathematics course, special attention should be paid to the issues of the historicization of mathematical teaching of students from the point of view of their acquisition of historical and mathematical knowledge, which is an integral part of the general culture of a future specialist. The specificity of this kind of education is such that it largely determines the characteristics of the professional activity of graduates in the future [7, 8].

The qualitative formation of the theoretical foundations of a professional orientation when teaching a mathematics course at certain stages of its study within the framework of a higher education program involves introducing an effective system for testing the intermediate knowledge of students. This intermediate control allows assessing the correspondence of students' level of knowledge to the curriculum's requirements and their understanding of the relationship between mathematics and related disciplines. Concerning the professional training of students of non-mathematical specialities, it should be noted that it is advisable to develop and implement a differentiated approach to the formation of their professional orientation when teaching a course in mathematics.

The differentiated approach involves a more detailed study of those sections of the mathematics course where there is an apparent connection with related disciplines, which is essential for the qualitative formation of students' professional competencies. For example, for students of technical specialties of higher educational institutions, such a connection can be in the context of the parallel teaching of physics and mathematics, taking into account their mutual influence. Such changes in the structure of teaching a mathematics course will contribute to more efficient use of the academic hours allocated for teaching mathematics, which should positively affect the professional orientation of students within the chosen speciality [9].

Currently, the main problems of the theoretical foundations' formation of teaching mathematics in higher education institutions should be considered:

1. Weakness of the methodological base, expressed in the absence of the proper amount of educational and methodological materials necessary for the high-quality organization of teaching a mathematics course.

2. Insufficient mathematical training of secondary educational institutions graduates, especially students of non-mathematical specialties, causes specific difficulties in studying the primary program material.

3. A gradual reduction in the total number of academic hours allocated to study mathematics in non-mathematical higher educational institutions.

4. Insufficient coordination of interaction between the departments of higher mathematics and departments of related narrow professional disciplines, which negatively affects the formation of the general professional orientation of teaching mathematics in some higher educational institutions.

The latter circumstance has a significant negative impact on training students in non-mathematical specialties. Resolving the gap problem between the content of the mathematics course and the real needs of the educational process requires a systematic approach, covering all aspects of the problem that has arisen and taking into account the main limitations in education due to the characteristics of a particular educational institution. The solution to this and some other problems should include a consistent change in the curriculum with the organization of the educational process in the context of a didactic system typical for a particular higher education institution. In this case, we are talking about the teaching methodology, the goals pursued, the teaching methods and means used by the teacher and the principles of predicting students' achievements at a specific level of professional training. The complex of such actions and software solutions requires the joint efforts of the entire teaching staff of a higher educational institution, taking into account the peculiarities of teaching mathematics and related narrowly professional academic disciplines.

Thus, the issues of forming the theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions are complex and imply the need to take into account many interrelated factors, taking into account both the individual characteristics of each higher educational institution and the personal interest of teachers and students in achieving a high level of professional orientation in the process of studying mathematics.

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The main task solved in this direction is the formation of the required level of professional competencies in students, which imply the compulsory acquisition of knowledge in mathematics and the ability to apply them in the practical sphere, which they need in the future for the full implementation of their professional activities in the chosen speciality. The professionalism level of higher educational institutions graduates and the quality of their professional tasks largely depend on this problemsolution.

The use of modern information systems in the educational process contributes to increased student activity in higher mathematics. The principle of informatization, computerization and practical application of new information technologies determines the prospects for expanding the scope of using computer systems at various educationstages. Computerization of studying mathematics involves the creation and subsequent implementation of new principles of teaching using modern computing technology [10, 11].

The higher education system in the world requires constant improvement of approaches to teaching higher mathematics since the assimilation of theoretical knowledge without its practical application in everyday activities often negates all the efforts spent on students in the learning process. Therefore, it is advisable to direct teaching mathematics in higher educational institutions towards its practical orientation. Together, this will contribute to achieving optimal results in the training of future specialists already at the stage of training in higher educational institutions [12].

In the process of mastering the program of a higher educational institution, graduates of mathematics specialities, be they future teachers of mathematics or mathematics scientists, must become well-rounded professionals. A specialist's high-quality professional training should be understood as a combination of several factors: verified scientific training based on special mathematical knowledge; special vocational and pedagogical training, built into account the basic methodological and psychological knowledge and competencies required in the future to conduct professional activities. Also, when preparing mathematics students, attention should be paid to their mathematics and history training, which can only be revealed through the presentation of professional-value and mathematical-historical knowledge, which form the basis of the professional and personal competence of a mathematics teacher [8, 13].

Mathematics has always been considered the basis for any state's technical and material development and an integral part of the general populationculture. The development of the material security of the society itself largely depends on the spread of mathematical knowledge in society and the degree of depth of knowledge acquired by the country's citizens in the field of mathematics. At the same time, mathematics is considered an expression of the culture of any people, being in close relationship with its general culture. Accurate knowledge is reflected in all aspects of modern life, significantly impacting their formation and development. Each state's need for the qualitative development of the exact sciences is clearly expressed, while the higher the country's material wealth, the more accurate the need for mathematical education of citizens [14].

Teaching a course in higher mathematics in programs of higher educational institutions must correspond to its professional orientation, and

this applies, first of all, to technical higher educational institutions. A full-fledged implementation of teaching mathematics pursues the goal of creating the mathematical readiness of the future professional to carry out his main activity. The content of this concept should include the development of students' thinking and the creation of practical techniques to improve their mental activity in order to ensure the high quality of the mathematical apparatus used to improve students' understanding of particular disciplines, as well as their professional and methodological training [15].

The consistent reform of the higher education system, caused by profound socio-economic and socio-political changes in the life of society, associated with the rapid growth of information flows and an increase in the number of disciplines studied, set new challenges for society in the process of training specialists in higher educational institutions. It led to the transition of the training of students in them to a higher one, i.e. the current level, taking into account the increased requirements for the quality of higher education and the level of professional competence of graduates, as well as bringing the education system in line with the new legislatively established standards [16, 17].

Among the main tasks of the higher education system in the modern world, one should single out the moral and intellectual development of a future specialist in a particular area of professional activity, which is based on the need to involve students in various aspects of the future profession at the stage of their education in a higher educational institution. It is required to form an interaction model between teachers and students within the framework of a competency-based approach to education to solve this problem, i.e. through the transition to a student-centred learning model, the main task of which is to reveal the individual abilities of students directly in the process of their learning. In this sense, nonlinear technologies are becoming increasingly important since they contribute to the best implementation of the basic principles of student-centred learning [18].

The higher education system in any country reflects the main trends, state and prospects of the society development, exerting a significant impact since there is a close relationship between the higher education system and various spheres of public life. Therefore, mathematics teaching in higher education institutions should be given special attention since mathematics is the basis of all exact sciences. Without knowledge and understanding, it is impossible to achieve any tangible progress in the state and society. Improvement of teaching mathematics methodology contributes to a high-quality professional orientation of education and an increase in future specialist training, whose mandatory professional competencies include acquiring knowledge in the exact sciences.

The professional orientation of modern education and its fundamental nature presupposes a reasonable balance between some mutually exclusive aspects. Thus, the training of a future specialist in the study of program disciplines should not be isolated from the profession's needs being acquired [19].

On the other hand, mathematics course content should be determined not only from the standpoint of necessity and the level of knowledge acquired by students in the field of a future profession but also from the point of view of its fundamental nature.

It should be borne in mind that in addition to mathematics, the higher education curriculum contains other disciplines that also contribute to the formation of professional competencies of future specialists. The consistent integration of these disciplines with higher mathematics further develops the theoretical foundations of teaching mathematics in higher educational institutions. It increases the professional competence of graduates in terms of improving the general level of their education [20, 21].

The system of educating students of patriotic and moral and ethical values, introduced into higher educational institutions, has a significant positive effect on the process of forming the necessary level of professional competencies in them, contributes to the development of logical thinking in young people, as well as the ability to solve practical problems that are daily encountered in their professional activities. In part, this is facilitated by teaching the development history of Russian science, reflecting the degree of influence of specific historical figures on the development of mathematics in the past. At the same time, mathematicians believe that up to now, the world has not developed and implemented a systemic methodology for teaching the history of mathematics, which could contribute to the development and expansion of the theoretical foundations of professional orientation in teaching mathematics in higher educational institutions [8, 22].

Teachers of mathematics, to improve the methods of teaching the discipline they use in order to make it more harmonious and complete, often do not attach importance to the fact that students of many technical specialities have not correctly formed a logical connection between the theoretical knowledge obtained in the course of studying mathematics and their practical application. Thus, the distance education method does not provide the desired effect in forming the professional teaching orientation since there is no direct contact between the student and the teacher. Therefore, the theoretical development and practical implementation of effective distance learning methods in higher mathematics, which can satisfy the needs of students in high-quality education with the creation of an appropriate level of professional orientation of the entire educational process [23], is becoming an urgent task.

Implementing the requirements for compliance with the professional orientation of the higher mathematics course also presupposes direct contact of teachers of higher mathematics with teachers of other special disciplines. A full-fledged and comprehensive mathematical education requires consistent alignment of teaching courses in these disciplines under the peculiarities of teaching a course in higher mathematics in a particular higher education institution. This course must include the study of natural phenomena, the analysis of their basic laws using fundamental mathematical laws, and the study and analysis of the main technological processes in which mathematical laws are applicable. Such a sequence in teaching contributes to students' complex ideas about the essence of the studied natural phenomena and their relationship with mathematics, which influences the formation of their professional worldview and the necessary competencies for future professional activity [24].

The exceptional engineering and economic disciplines curriculum presentation should also include establishing a relationship with fundamental mathematical laws. Neglecting the coverage of the connection between

mathematics and other disciplines in educational programs at higher educational institutions forms a little idea of the essence of the surrounding natural phenomena and their laws. Subsequently, it causes them difficulties understanding the essence of economic and social phenomena in society [25].

In many situations, the teaching of individual engineering disciplines can be carried out at a high-quality level. However, without the necessary mathematical proofs, their integrity is lost. It does not contribute to the proper professional competencies among students since it does not imply a professional orientation of the teaching process due to the emasculation of the mathematical principles of teaching and the construction of the educational process. In this regard, students' interest in the study of mathematics plays a decisive role since the preservation of students' cognitive activity at all stages of the educational process directly impacts its effectiveness. At the same time, the importance of mathematics and the quality of its teaching is of great importance for creating the necessary theoretical foundations of a professional orientation when teaching a course in higher mathematics in higher educational institutions.

Conclusion

Based on our research, the following conclusions can be drawn.

The theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions include several fundamental concepts related to various aspects of the formation and development of professional competencies of future specialists at the stage of their training. In particular, when presenting a course in mathematics in higher educational institutions, special attention should be paid to the issues of assimilation by students of the basic theoretical premises outlined in the teaching process, in the context of the possibility of their subsequent practical application in real life in the course of fulfilling their professional duties by already trained specialists. Such knowledge and skills are widely in demand when performing various technological operations that require deep knowledge in the field of mathematics, as well as when organizing the activities of any organization that requires a deep understanding of mathematics for practical application of the knowledge gained, including from the field of organization theory and methods of mathematical accounting and statistics.

Of particular importance in higher education programs is the integration of mathematics with other highly specialized disciplines, in order to form the professional orientation of the acquired knowledge, acquired skills and special professional competencies among students of higher educational institutions, necessary for future specialists in solving real practical problems in the implementation of their professional activities.

It is necessary to expand further the special disciplines' professional orientation in their relationship with mathematics taught in a separate course. The establishment of the basic laws that determine the peculiarities of mathematics relationship with other special disciplines allows expanding the theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions, and also contributes to the development of a wide range of professional competencies of future

specialists, which they need in the future in the performance of their professional duties.

In general, the results obtained by us in the course of our study of the theoretical foundations of the professional orientation of teaching a mathematics course in higher educational institutions, as well as the conclusions formulated based on these results, can be used as a methodological basis for further research in this direction.

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