MATHEMATICAL ANALYSIS AND ITS ROLE IN THE TRAINING OF FUTURE TEACHERS

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Abstract

The study is dedicated to the identification and justification of the role (value and place) of mathematical analysis in the training of future teachers. In connection with the emerging tendency to reduce the number of hours spent on studying mathematics at school, introducing into the school curriculum the elements of discrete mathematics, in particular combinatorics, the fundamentals of probability theory, elements of statistics and appeals to exclude from school education elements of mathematical analysis, as well as geometry as an independent discipline (Ryzhik, 2014) raises the question of justifying the need to study the elements of analysis in school education, enhancing the role of mathematical analysis in teacher education, and also the resolution of contradictions between the fundamental principles of education: accessibility and rigor (scientific) of education.

In view of the decrease in the level of mathematical training of applicants (Toktarova, Fedorovova, 2017), there is also the question of increasing the level of motivation to study mathematics at school and university (Senashenko, 2017).

The study examines the continuity of teaching mathematics in school and university, the practical significance of studying analysis, and the readiness to apply it both in practice and when studying specialized disciplines (Aslanov, Li, Matrosov, 2013).

The future teacher should be well versed in the curriculum for discipline in school, know the standards of school education. The study analyzes standards and content on the analysis in school textbooks of the basic and specialized levels, including those recommended by the Ministry of Education of the Russian Federation. Special attention is paid to the study of practice-oriented analysis tasks at school and university. The study suggests possible ways to resolve these negative tendencies, improve the quality of training future teachers of mathematics and the role of analysis in this process.

Keywords: Mathematical analysis, school, university, standards, teacher education.

1. INTRODUCTION

The study of the feasibility of studying the elements of mathematical analysis in school education and its place and importance in the training of future teachers becomes relevant for several reasons:

1) Introduction to the school curriculum of elements of discrete mathematics, including combinatorics, ele-

ments of probability theory and statistics and, as a consequence, a reduction in the number of hours for studying mathematics;

2) Occasional calls to exclude elements of mathematical analysis from the school curriculum, and therefore, as noted (Ryzhik, 2014), the connection between theory and practice is destroyed.

3) Decrease in the level of mathematical training of applicants (Toktarova, Fedorova, 2017).

The question is: what to teach and how to teach?

In such conditions, the continuity of school and university education (Aslanov, Li, Matrosov, 2013), increasing motivation in teaching (Senashenko, 2017), applied learning orientation (Tugulchieva, Vasilyeva, 2019) seem important. The use of modern educational technologies, for example, project activities, also contributes to the connection of mathematics with natural science disciplines.

Analyzing the Federal State Educational Institution Standard (Math Section), we see that the student should be able to apply knowledge in practice: in everyday life and in the study of natural sciences, in economics, to be able to interpret this knowledge.

It should be noted that motivation is of great importance in learning. If we analyze the syllabus on mathematical analysis, for example, on the major “Mathematics and Informatics” (Bachelor’s degree), then 324 hours are allocated for independent work, with the amount of classroom hours being 268. Only an interested attitude of students to the replenishment of knowledge can contribute to the successful learning of the subject. The similar situation on the major “Mathematics and Physics”: 272 is allocated for classroom work, 304 hours is devoted to independent work.

2. MATERIALS AND METHODS

The experimental part of the study were carried out during teaching practice on the base of educational institutions Municipal Budget Educational Establishment “Gymnasium № 14”, Municipal Educational Establishment “Lyceum № 11”, State Budget Educational Establishment “Lyceum named after M.V. Lomonosov”. The experiments were carried out during the study of mathematical analysis, while writing the coursework and final qualifying works at the Faculty of General and Vocational Education, Mari State University.

When studying the topics “Function”, “Derivative” at school and university, project activities were organized. This activity was preceded by diagnostic work to identify the level of knowledge and assess the effectiveness of the chosen type of activity. After the end of the project activity, diagnostic work was also carried out and a comparative analysis of the results of implementation before and after the project activity. Also summarizing lessons were conducted on the topics “Derivative in Natural Science and Economics”, “Integral in Natural Science and Economics”. They analyzed practically-oriented tasks.

3. RESULTS

The project activity was organized according to the themes “Function”, “Derivative”, “Functions in Physics”, was short-term and was carried out in accordance with the requirements for this type of activity in the 9^{th} and 10^{th} grades in 2018 and for the 1^{st} and 2^{nd} years on the major “Mathematics and Physics ”,“Mathematics and Computer Science” in 2019. The themes of the projects on elementary functions, derivative and their application were announced.

The project involved the preparation of the theoretical part (analytical expression, properties, a graph, and, in addition, for a university, decomposition of a function into a series), the practical part (problem solving, including an increased level of complexity, the State General Examinations, the State Unified Examination), consideration of the use of a function derived in natural sciences, economics and human life.

Project activities completed the lesson-conference. The diagnostic work carried out (before and after the project activity) showed a positive trend, for example, the results of the assignment to ascertain the existence of an inverse function to this - up to 60%, after 80%.

Consideration of practically oriented analysis tasks also contributes to an increase in the level of students’ knowledge and motivation to study the subject.

The following topics were offered for the university research “Derivative in Problems of Natural Science", “Integral in Problems of Natural Science", “Differential Equations in Tasks on Natural Science”. It was supposed to include the tasks of the school course of Mathematics. For example, the average score for the performance of independent work before and after final lessons on the topic “Derivative in the Tasks on Natural Science” is 3.68 before and 4.0 after.

The organization of an elective course on the subject of “Differential Equations” in school also motivates students to study the topics “Derivative”, “Integral”. The derivative, integral, differential equations are mathematical models for describing many processes of natural science.

Thus, the study of mathematical analysis puts into practice the applied orientation of learning.

4. DISCUSSIONS

При изучении анализа хорошо прослеживается цепочка: школа – вуз – школа. Так, знакомясь с элементами анализа в школе, в вузе происходит уже обогащение этих знаний, их систематизация, обоснование основных утверждений, а затем при выполнении исследовательской работы, во время педагогической практики идёт обратный процесс.

When analyzing the chain “school – university – school”, you should take into consideration the fact that pupils get acquainted with the elements of analysis at school, at the university they enrich this knowledge, they make up the system, formulate the main statements, and then they undergo the reverse process during the performance of research work and during the pedagogical practice.

So, doing research work on the topic “Methodological Features of Studying a Derivative in a School Mathematics Course”, students become familiar with the program, curriculum, content of material in textbooks of different majors, didactic materials, teaching materials in the school course on Mathematics.

When considering the topic “Methodical Features of Studying the Integral in the School Course of Mathematics”, the applied tasks on the topic “Integral” are examined in school textbooks , in which the integral is usually presented in the appendix.

When studying the analysis at the university and then, returning to the school textbooks, we draw attention of students to a combination of rigor (science) and accessibility (understanding) while explaining the material.

5. CONCLUSION

Mathematical analysis plays an important role in the process of knowledge of the surrounding world, it binds theory and practice.

The combination of rigor and availability of presentation of the material, continuity of school and university analysis courses, use of modern educational technologies in teaching (for example, project activities), consideration of practically oriented analysis tasks all contribute to the successful study of mathematical analysis by future teachers in the university and at school.

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