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**METHODOLOGICAL SYSTEM OF TEACHING THE COURSE OF
MATHEMATICAL ANALYSIS AT SCHOOL AND IN A PEDAGOGICAL
UNIVERSITY**

ABSTRACT

Of the PhD dissertation submitted, in the sphere of Mathematics on specialty 6D010900 – Mathematics

Usefulness of the research. Mathematical analysis is the basic course in the system of math education of a higher education institution students, since when investigating and solving many Higher Mathematics problems, the methods and laws studied in this course are applied. The course of Mathematical analysis is an important subject for first-year students, since it supposes the ability to think, the quest for knowledge and creation in the professional activity. The course of Mathematical analysis has been of a particular interest for researchers, since:

- 1) beginning of analysis are taught at senior school;
- 2) the course of Mathematical analysis studied is effectively applied to further scientific research;
- 3) a good knowledge of the course of Mathematical analysis helps achieve a high level of knowledge of the courses somehow connected with Mathematical analysis theories.

As a result, scientists in the sphere of methodology continue to take interest in developing methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university. When teaching Beginning of analysis at school, Mathematics teachers try to develop school students' analytical abilities, which have to be developed further when they enter a university and study the university course of Mathematical analysis. However, the experiences of working with first-year students show that there is a difference between the school knowledge and initial requirements for students' knowledge for the further study of Mathematical analysis. Hence there arises a necessity to improve the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university, with which the **problem** of this research and its **usefulness** is connected.

The purpose of the study is the development of the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university.

The object of the study is training future Mathematics teachers at a pedagogical university.

The subject of the study is methodological approaches to teaching the course of Mathematical analysis to future Mathematics teachers.

In accordance with the purpose and subject, the following **objectives of the study** are set:

- to analyze the condition of the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university;
- to define the role and place of Mathematical analysis in training a future professional teacher and to provide continuity in teaching the course of Mathematical analysis at school and in a pedagogical university;
- to determine methods and organizational forms of teaching the course of Mathematical analysis to future Mathematics teachers;
- to develop the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university;
- to check the efficiency of the developed methodological system of teaching the course of Mathematical analysis.

For solving the problems set, it is supposed to apply such **research methods** as study and analysis of popular scientific and training literature in the sphere under study, analysis of the programs, teaching materials and methodological recommendations on the course of Mathematical analysis; study of existing methodological systems of teaching the course of Math analysis; conducting lecture and practical lessons; experimental work aimed at determining whether the methods suggested are effective.

The novelty of the study is that a new methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university is developed.

The size and structure of the dissertation. The thesis consists of the introduction, two chapters and conclusion. The work is typed in 101 computer-based pages; it contains one Figure, 12 Tables and a Reference list.

Basic results. In Chapter I, the author analyzed the condition of the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university, defined the role and place of Mathematical analysis in training a future professional teacher. In higher education institutions of Kazakhstan, according to the classification of specialties of undergraduate and postgraduate education, introduced by the Ministry of Education and Science, learning process is carried out in the two courses: general education and natural scientific. What is the difference of teaching the course of Mathematical analysis in general education course of “Mathematics” specialty and that of natural scientific course? There should be different levels of teaching: the level of “familiarizing” with Mathematical analysis and teaching advanced Mathematical analysis, respectively. The general course of Mathematical analysis is to cover the most important aspects, and the rest sections can be included in the courses of elective disciplines. The knowledge gained in the process of studying Mathematical analysis is a basis for teaching such disciplines as differential equations, equations of mathematical Physics, theory of functions, which are of narrower specialization, but which are

important courses of practical value. Teaching math disciplines implies teaching to be able to analyze, to make conclusions, and to think logically. That is why the role of math analysis as a basic course of higher Mathematics is very important.

Described the methods of continuity in teaching the course of Mathematical analysis at school and in a pedagogical university and suggested solution to the problem of continuity. The linear and concentric structure of the school course of Mathematics provides with defining the two courses of realizing continuity (succession) in teaching the subject:

- 1) continuity between consecutive teaching stages;
- 2) continuity within each teaching stage:
 - a) continuity within each mathematical course (Arithmetic, Algebra, Algebra and beginning of analysis, Geometry);
 - б) continuity between mathematical courses, in particular, between propaedeutical and systematical courses (for instance, between Algebra and Geometry, Arithmetic and Algebra, Arithmetic and Geometry, etc.).

As to continuity in teaching the course of Algebra and beginning of analysis at school and teaching Mathematical analysis at a pedagogical university, there arise many problems connected with the contents of these courses. Before switching to a new system of training Mathematics teachers, students used to study the course of Mathematical analysis for 5 – 6 semesters, and methodological training used to begin in the fifth semester, when students were still studying this course. But now students study the course of Mathematical analysis only for three semesters, therefore it is very important to plan both mathematical and methodological training of future Mathematics teachers properly. This can be realized through improving a methodological system.

In order to maintain continuity in teaching the course of Mathematical analysis at school and at university, it is necessary to introduce new disciplines for first-year students, which help “adjust” their knowledge gained at school and “adapt” it so that they could continue to study Mathematical analysis at more advanced level. This is due to the fact that first-year students come from different schools and, therefore, have different levels of knowledge of Mathematics and Mathematical analysis. In addition, there are different-type schools: simple schools, schools-lyceums, schools-gymnasiums, magnet schools (with arts or science streams), etc. The programs of such schools are different. For instance, the program of specialized physical and mathematical schools is quite different, learners of such schools have much more Mathematics lessons than learners of other schools, therefore, it is easier for them to adapt to university mathematical subjects. As to learners of schools with arts stream, they face a lot of problems with university courses, since school lessons and university lessons, which are divided into lectures and seminars, are quite

different. That is why all students first need to study introductory courses. After studying introductory courses, all the students are ready to continue studying Mathematical analysis.

This kind of solution to the problem of continuity and succession in teaching and learning at school and a pedagogical university implies improving of the whole educational process. It is very important to lessen differences between teaching senior school learners and first-year university students.

Besides, the author undertook a comparative analysis of the content of the educational program on Algebra and beginning of analysis for senior school and the Standard educational program on Mathematical analysis for the specialty 5B010900 – Mathematics of a pedagogical university.

In Chapter II, the author determined the methods and organizational forms of teaching the course of Mathematical analysis to future Mathematics teachers, developed the methodological system of teaching the course of Mathematical analysis at school and in a pedagogical university, and formulated the following objectives in the methodological system of teaching the course of Mathematical analysis:

1. Acquiring the system of knowledge, abilities and skills giving an idea of the subject of Mathematical analysis, its language and symbolic, math modeling, special methods, algorithms, and periods of development of this branch of science;
2. Acquiring fundamental general scientific cognition methods and special heuristics used in the course of Mathematical analysis;
3. Developing students' attitude, logical and heuristic constituents of thinking, algorithmic thinking, and abilities to analyze;
4. Promoting ethics, communication culture, independence, activity, diligence, responsibility for making decisions, desire for self-realization, and aesthetic education of school students;
5. Developing abilities to build and investigate given math models, and construct applications to them; familiarizing with the role of Mathematical analysis in scientific and technological progress, and modern production.

As to the content of the methodological system of teaching the course of math analysis at school and at a university, according to the approved standard curriculum, the university course of Mathematical analysis contains the schools course of Algebra and beginning of analysis. Further, in order to maintain continuity, in the first semester it is important to introduce a new subject, "Fundamentals of Mathematical analysis", one of objectives of which is preparing learners for further study of the course of Mathematical analysis, and on completing it, in the second semester, to begin teaching more advanced course of Mathematical analysis.

The discipline "Fundamentals of Mathematical analysis" is an introductory course for further study of Mathematical analysis at a higher

education institution. The discipline provides with a complete idea of concepts of Mathematical analysis and their definitions taught at school in the course of Algebra and beginning of analysis. Such important concepts as “function”, the limit of a function, remarkable limits, “derivative function”, its applications, its physical and geometrical meanings, “indefinite integral”, some methods of finding indefinite integrals, “definite integral” and its geometrical meaning, are studied in greater depth. The knowledge gained as a result of studying this course is used for studying the university course of Mathematical analysis further.

Besides, in this chapter the author demonstrates methods of teaching the course of Mathematical analysis using the example of teaching students to find indefinite integrals. The author shows how to organize teaching the course of Mathematical analysis at school and at a university in conditions of differentiation of the pedagogical process.

In the experimental part of the work, the author checked the efficiency of the developed methodological system of teaching the course of Mathematical analysis. The lessons on Mathematical analysis were conducted according to the teaching methods specially developed for this aim.

The results of the experimental pedagogical work have shown that the developed methods are effective and contribute to enhance students’ learning on Mathematical analysis. Further, the students applied the knowledge gained to the work during their pedagogical training practice at school. At lessons they felt much more confident applying various methods of presenting teaching material on Algebra and beginning of analysis.

Application area. The proposed methodological development and the research results can be used when developing educational programs, teaching and methodological manuals. They can be used by school and university teachers in their pedagogical activities. Besides, Bachelor, Master and PhD students can use them, as well.

Level of implementation. 8 papers have been published on the materials of the dissertation thesis, one of which can be found in the journal included in Scopus database, three of which are published in the journals recommended by the Committee on Control in the sphere of Education of the Ministry of Education and Science of the Republic of Kazakhstan, and four papers can be found in the materials of International conferences in Kazakhstan and abroad.