

PEDAGOGICAL CONDITIONS FOR TEACHING DIFFERENTIAL AND INTEGRAL CALCULUS TO MATHEMATICS STUDENTS

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Annotation. This study focuses on the development of methodological competence in students majoring in mathematics through the teaching of differential and integral calculus. The relevance of the research lies in the insufficient integration of pedagogical and methodological training in university-level mathematics education. The purpose of the study is to design and justify a model for methodological training and to identify pedagogical conditions that enhance its effectiveness. The research methods include literature analysis, observation, surveys, pedagogical experiments, and statistical analysis. The implementation of the proposed model demonstrated positive results in improving students' methodological thinking, preparing them for future professional activities in the educational field. The results of the control work and the test give approximately the same percentage distribution of students by the levels of formation of the content-procedural component of the subject competence of the future mathematics teacher. The conducted research does not exhaust the whole variety of the problem of the formation of methodological readiness of a future mathematics teacher in the process of studying at a university.

Keywords: model, innovative methods, methodological training, mathematics student, differential and integral calculus of functions, pedagogical conditions.

Introduction. In modern higher education, the preparation of future specialists in mathematics requires not only mastery of theoretical knowledge but also the development of strong methodological competencies. The ongoing transformation of the educational landscape, driven by digitalization, interdisciplinary integration, and the increasing demand for innovative teaching strategies, necessitates a reevaluation of how core mathematical subjects—such as differential and integral calculus—are taught to students majoring in mathematics. In this context, the methodological training of mathematics students becomes a crucial component in shaping their readiness for professional practice, especially in educational and research environments.

Relevance of the Research: The relevance of this study arises from the growing need to fundamentalize the content of university-level mathematical disciplines and to align them with the professional tasks that future mathematics graduates are expected to perform. One of the key issues is the insufficient theoretical and practical development related to the formation of methodological competence among mathematics students. While differential and integral calculus forms the foundation for many applied and theoretical branches of mathematics, its effective teaching requires not only mathematical rigor but also a pedagogical framework that promotes methodological thinking and reflective practice. This gap highlights the need to design a pedagogically sound model that supports the development of students' methodological training through the process of learning calculus. The challenge is further compounded by the observed disconnect between the abstract nature of higher mathematics and the practical skills necessary for applying mathematical knowledge in real-world or teaching contexts. To bridge this gap, there is a pressing need for models that integrate both content and pedagogy—models that equip students not only to understand calculus deeply but also to convey that understanding to others with clarity and methodological precision.

Purpose of the Research: The primary objective of this study is to develop and theoretically justify a comprehensive model for the formation of methodological training in students majoring in mathematics. The research also aims to identify and define the pedagogical conditions that enhance the effectiveness of this model, particularly within the framework of teaching

differential and integral calculus. The model seeks to serve as a bridge between mathematical theory and teaching practice, thereby contributing to the formation of a new generation of mathematics specialists who are not only knowledgeable but also methodologically competent.

Research Methods: To achieve these goals, the research employs a combination of qualitative and quantitative methodologies. These include the study and critical analysis of psychological, pedagogical, mathematical, and methodological literature; direct observation of student learning processes; surveys and structured interviews; formative and summative testing; and the implementation of a pedagogical experiment. For statistical analysis and validation of results, tools such as Spearman's rank correlation coefficient, the chi-square test, and the Wilcoxon-Mann-Whitney criterion are used. These methods ensure the reliability of the findings and support the empirical validation of the proposed model.

Research Results: The study presents a scientifically grounded model for the formation of methodological training among mathematics students. This model is designed to be implemented within the structure of a core mathematics curriculum, specifically targeting the units of differential and integral calculus, as well as elements of differential equations. The introduction of the model is expected to enhance the pedagogical effectiveness of instruction and contribute to the development of critical thinking and analytical skills among students.

Practical Significance: The proposed model carries substantial practical value, as it is geared toward helping students adapt to the evolving demands of professional activity in the field of education. It also supports the creation of scientific and methodological frameworks for evaluating and improving the quality of mathematics education. Furthermore, the model can serve as a reference point for curriculum developers, teacher educators, and academic researchers interested in aligning content knowledge with methodological expertise in mathematics education.

Relevance of the study. The sustainable development of our country in the XXI century, its innovative economy, defense capability depend on the level of mathematical education received by a student from school. It is from the mathematics student, who is not only a source of new subject knowledge for the student at school, but also a conductor of modern ideas, methods, technologies that ensure the formation and development of competencies among students, orienting them to more effective ways of activity in the calculus of differential and integral functions, ultimately depends on the training of qualified personnel for modern societies [1].

In this regard, the mathematical education of a mathematics student currently requires qualitative changes. These changes should take into account current trends in education – changes in methods and methods of providing educational services and organizing training in the system of higher professional education.

In the system of priorities of pedagogical education, scientists highlight the personal potential of the teacher, his ability to be a competent subject of professional activity. The main goal of pedagogical education is to reveal the essential forces, the activity abilities of a person, his capabilities of competent and responsible performance of professional and social roles, the production of new ideas, solutions, the creation of real prerequisites for the self-development of the personality of the mathematics student [2].

All of the above about the current state of affairs in the field of professional pedagogical education is also characteristic of the training of future teachers of mathematics. Their education does not fully correspond to the new trends in the improvement and development of modern mathematical education, which is manifested, for example, in the inability of many graduates of the pedagogical university to work productively in conditions of level and profile differentiation, variability of programs and textbooks, the development of new information and educational technologies. The current requirements do not meet the level of knowledge of students and graduates of pedagogical institutes and universities of the school course of mathematics, methods of its teaching, connections of school mathematics with university mathematical courses. They are characterized by insufficient knowledge of that part of the mathematical content that provides confidence in solving non-standard problems in elementary mathematics and teaching schoolchildren to find approaches to solving difficult mathematical problems [3].

We can also talk about the low general and mathematical culture of graduates of pedagogical universities, about the insufficient development of their mathematical and heuristic thinking, about the lack of proper experience in mathematical activity, about the prescription of methodological knowledge on teaching a school course of mathematics, about weak methodological skills and the formalism of subject knowledge. Students often have a lack of need to comprehend new mathematical facts, criticality in choosing methods and approaches used to prove statements. Almost all of these students have no real experience in finding new scientific information in mathematics.

In a mass secondary school today, the professional level of a mathematics teacher of non-retirement age does not meet the requirements imposed by society and the state on a teacher as a professional [4].

It should be said that in different years, the state of mathematical and methodological training of current teachers of mathematics and students of mathematical specialties has been studied by many authors. However, to date, no systematic research has been conducted in the field of subject training of secondary school mathematics teachers based on the ideas of the fundamentalization of mathematical education and focused on the creation of such methodological systems for teaching higher mathematics disciplines to pedagogical university students, in which students are introduced to real research work from the first courses of their studies at the university [5].

These problems define the scientific problem of research, which consists in the insufficient development of methodological systems for teaching university students mathematical courses based on the ideas of fundamentalization of education. In the study, it is supposed to be solved in relation to the fundamental section of mathematical science and higher mathematical education - differential and integral calculus of functions. The solution of the problem aims at conducting a holistic pedagogical research devoted to the study of the influence of the ideas of the fundamentalization of mathematical education on teaching students the basics of analysis, developing a course of differential and integral calculus of functions based on these ideas, identifying the role of students' research in the areas of mathematical analysis in their mathematical and professional training. It is important to note that the main section of mathematical analysis "Differential and integral calculus of functions" is the most important component in the professional education of a mathematics teacher, it determines the entire mathematical training of a student of the Faculty of Mathematics of a pedagogical university. This section finds many directions of its application, since it studies mathematical structures that model the real processes of the world around us; its development is objectively important. The course of differential and integral calculus implements deep interdisciplinary connections of the disciplines of the natural science cycle, plays an essential role in the methodological training of teachers, has a general cultural significance in the education of students. In addition, representing a developing field of mathematical science, differential and integral calculus has rich potential opportunities for organizing student scientific research.

The object of the research is the process of teaching mathematical disciplines to university students, in particular mathematical analysis, and its subject is a methodological system for teaching future mathematics teachers differential and integral calculus of functions in the conditions of fundamentalization of education, including goals, content, methods, forms and means of teaching.

Literature Review. The essence and basic concepts of the competence approach in the education system are disclosed in detail in general pedagogical and psychological studies Brauer, (2021) [6]. The issues of improving the professional training of a future mathematics teacher at a pedagogical university have been the subject of research by many leading scientists in the field of methods of teaching mathematics throughout the history of the development of mathematical education [7-8].

There are various approaches to improving the professional training of a future mathematics teacher, we will consider two areas closest to our research.

The first direction (methodological) is associated with the implementation of a coordinated interaction of the fundamental and professional components in the general structure of teacher training through: the foundation of the basic educational elements of school and university mathematics, followed by a theoretical generalization of structural units in the direction of professionalization of knowledge and the formation of the teacher's personality [9]; professional and pedagogical orientation of teaching basic fundamental mathematical disciplines, establishing their links with the relevant courses of school mathematics in all components of the methodical system of teaching mathematics and increasing the volume of mathematical courses, special courses, elective courses [10].

The second direction (technological) is associated with the qualitative transformation of all components of the methodological system of training a future mathematics teacher at a pedagogical university through electives [11].

The basis of many studies that raise issues of improving the special, methodological training of a future mathematics teacher is a holistic and comprehensive concept of the professional and pedagogical orientation of the special training of a future mathematics teacher, based on the principles of rational fundamentality, binary, continuity and the leading idea. Questions of the professional orientation of teaching mathematics to future teachers are considered in the works of Appova & Taylor, (2019) [12].

Ideas and approaches in the formation of individual components of methodological knowledge and skills in the system of professional, subject and methodological training of future teachers and teachers of mathematics were considered in the works of Toibazarov et al., (2021); Ovchinnikova et al., (2020) [13-14].

Al-Mahdi, (2019) to clarify the content and set of methodological training of a mathematics teacher uses the concept of "professional teacher action" and defines three levels of formation of these actions. In accordance with the selected levels, their subject complexity and the specifics of their application in the practice of teaching mathematics, the author defines the types of methodological skills and divides them into three groups, respectively, describing the content of skills in each group, without assigning a name to these groups [15].

Corredor-García & Bailey-Moreno, (2020) defines methodical skills as "the conscious application of students' existing knowledge and skills necessary to perform more complex activities in various conditions of teaching students mathematics" [16].

Methodological training and competence of a future mathematics teacher is the readiness of a student on the basis of his methodological (theoretical and practical) training to independently and effectively solve professional and methodological tasks formulated by himself or by the educational and methodological situation of the educational process in conditions of uncertainty and unpredictability. The methodological competence of a future mathematics teacher is considered by us as a complex dynamic system, and its research is carried out in two planes: subject and functional.

The studies of these scientists make a significant contribution to the training of secondary school mathematics teachers, solve many problems of improving professional pedagogical education through the formation and introduction of new advanced psychological and pedagogical concepts, the use of productive methods of knowledge transfer, the design of innovative methodological systems and teaching technologies.

Despite a wide range of studies devoted to the preparation of future mathematics teachers at the university, the least studied are the issues of updating the goals, content, forms, methods and means of teaching mathematics in the context of widespread new methods, in particular, the study of methodological aspects of the introduction of innovative technologies in the process of mathematical training of future teachers and the formation of their methodological literacy when teaching differential and integral calculus of functions.

These arguments and the need to eliminate the above contradictions through the development of a methodological system for teaching students of the pedagogical university

differential and integral calculus in the context of the fundamentalization of mathematical education confirm the relevance of the research topic.

The goals and main methods of research.

To solve the tasks, the following research methods were used: - theoretical: study and analysis of psychological and pedagogical, mathematical, methodological literature on the subject of research; - empirical: observation, questioning, testing, analysis of the results of control work by students; pedagogical experiment; - mathematical methods: Spearman rank correlation, x-square criterion, the Wilcoxon-Mann-Whitney criterion, et al.

The study was conceived as the construction of a new experience in experimental conditions. The following types of analysis were used in the study: complex - identification and tracking of the formation and development of components included in the structure of the subject competence of a future mathematics teacher; level - identification of the formation of each structural component; comparative - identification of the levels of formation of components in the conditions of traditional and experimental learning.

Experimental base of the study and the stages of the study

The study was conducted in three stages. In order to test the formulated hypothesis, a pedagogical experiment was conducted on the basis of the Kyzylorda Uiversity named after Korkyt ata (2023-2025), which included three stages: ascertaining, searching and forming. A total of 63 students participated in the experiment. The ascertaining stage of the experiment was conducted during the 2023-2025 academic year. The purpose of this stage was to determine the content and structure of methodological training of a future mathematics teacher; to identify criteria, indicators characterizing the levels of formation of methodological training of a future mathematics teacher; to develop a model for the formation of methodological training of a future mathematics teacher. For this purpose, the analysis of scientific, psychological and pedagogical literature, normative documentation was carried out, observation was carried out, regular conversations were held between students and teachers of mathematical and methodological disciplines.

The search and formative stage of the experiment was conducted in the 2023-2024 and 2024-2025 academic years. The purpose of the search stage of the experiment was to establish the levels of formation of the methodological preparation of the future mathematics teacher; to determine the pedagogical conditions for the formation of the methodological readiness of the future mathematics teacher.

The purpose of the formative stage was to check the effectiveness of pedagogical conditions for the formation of methodological training of a future mathematics teacher; to establish the levels, the formation of methodological readiness of a future mathematics teacher.

At the formative stage of the experiment, the implementation of a certain set of necessary pedagogical conditions for the formation of methodological readiness of a future mathematics teacher was carried out. The experiment was carried out on two streams of students (2023-2024 academic year - 33 students, 2024-2025 academic year - 30 students), who made up two experimental groups. At the formative stage of the experiment, statistical processing of the results of the survey, control work and testing was carried out, the results obtained in the control and experimental groups were compared.

Pedagogical conditions and the model of the formation of methodological training of a future mathematics teacher

For the effective implementation of the model of the formation of methodological training of the future mathematics teacher, a set of pedagogical conditions was determined.

Under the pedagogical conditions of the formation of the methodological training of the future mathematics teacher, we will understand the subjective and objective requirements and prerequisites, the implementation of which ensures the formation of the methodological training of the future mathematics teacher with the most rational use of forces and means.

We have identified the following set of pedagogical conditions for the formation of methodological training of a future mathematics teacher: integration of the content of mathematical courses; development of a positive motivational sphere of the personality of a future mathematics

teacher based on pedagogical values; ensuring the assimilation of mathematical knowledge in the unity of their subject and operational aspects; ensuring regular monitoring and evaluation of learning outcomes by both the teacher and the student.

The proposed set of pedagogical conditions is necessary and sufficient for the formation of methodological readiness of a future mathematics teacher. The sufficiency of the proposed set of pedagogical conditions will be checked during the pedagogical experiment conducted within the framework of this study. The criteria and indicators of formation and the model of formation of methodological readiness of the future mathematics teacher of the future mathematics teacher are given in Table 1 and in Figure 1.

Table 1 – Criteria and indicators of the formation of methodological readiness of a future mathematics teacher

Criteria	Indicators (by levels)
Motivational and value	Threshold: the presence of a social attitude to the study of mathematics; the presence of a social attitude to teaching mathematics.
	Standard: having an interest in mathematics; having an interest in learning mathematics.
	Reference: the need to study mathematics; the need to teach mathematics.
Substantive and procedural	Threshold: to know and understand the basic terms of mathematics; Be able to find the necessary information in mathematics; Ready to use mathematical knowledge in professional activities.
	Standard: to know and understand the interdisciplinary foundations of mathematics; To be able to analyze and synthesize the information received in mathematics; Ready to use mathematical methods outside of mathematics.
	Reference: to know the ways and methods of conducting mathematically reasoned scientific discussion; To be able to critically evaluate and interpret scientific mathematical experience; Ready to build mathematical models of various processes occurring in modern society and nature.
Reflexive	Threshold: the ability to exercise self-control and self-assessment of mathematical knowledge and skills.
	Standard: periodic self-monitoring and self-assessment of mathematical knowledge and skills.
	Reference: regular exercise of self-control and self-assessment of mathematical knowledge and skills.

The learning process in the conditions of the developed model of formation.

In the conditions of the fundamentalization of mathematical education, in our opinion, when teaching students of mathematics differential and integral calculus of functions, it is important to pay due attention to their heuristic training. A teacher of mathematical analysis working with such students should not only acquaint students with facts important for a mathematician, but also take care of the development of mathematical intuition of the wards, instilling in them the skills of independently finding solutions to a difficult problem, proving a new theorem, discovering an unknown mathematical fact or some kind of regularity.

One of the most common heuristics in mathematics is the likelihood test, which, in particular, includes:

- a) checking for compliance with the properties of a mathematical object;
- b) construction of counterexamples;
- c) checking for symmetry;
- c) checking by dimension, etc.

Possession of such a technique allows you to reject erroneous hypotheses that arise when solving a difficult problem or when conducting research, to detect erroneous and incorrect formulations of statements, incorrect answers to solved problems. Here are some examples.

1. It is required to calculate the integral.

$$\int_{-\ln 2}^{\ln 2} \frac{\sqrt{x^2+1}+x-1}{\sqrt{x^2+1}+x+1} dx \quad (1)$$

Note that the definite integral proposed for calculation is the integral of the irrational function $f(x) = \frac{\sqrt{x^2+1}+x-1}{\sqrt{x^2+1}+x+1}$ but along a segment symmetrical with respect to the beginning. The latter circumstance prompts the problem solver to "take a risk" — to check the function $f(x)$ for parity-odd. Since,

$$\begin{aligned} f(x)+f(-x) &= \frac{\sqrt{x^2+1}+x-1}{\sqrt{x^2+1}+x+1} + \frac{\sqrt{x^2+1}-x-1}{\sqrt{x^2+1}-x+1} = \frac{(\sqrt{x^2+1})^2-(x-1)^2+(\sqrt{x^2+1}+x-1)^2-(x+1)^2}{(\sqrt{x^2+1}+1)^2-x^2} = \\ &= \frac{x^2+1-x^2+2x-1+x^2+1-x^2-2x-1}{(\sqrt{x^2+1}+1)^2-x^2} = 0 \end{aligned} \quad (2)$$

we conclude that the function $f(x)$ is odd. Therefore, the integral in question is zero.

Thus, we were helped to calculate the original integral by referring to the properties of certain integrals from even and odd functions.

The considered integral, of course, could be tried to calculate using the Newton-Leibniz formula, which would require finding the primitive function $f(x)$. Such, obviously, would have to be found either with the help of a suitable Euler substitution, or with the help of a trigonometric substitution. Any of the substitutions mentioned would lead to cumbersome calculations.

Consider the heuristics associated with the use of induction. "Induction is the process of cognition of general laws by observing the comparison of particular cases." In Latin, "induction" is "guidance". It often happens that considering particular cases of a problem leads to obtaining a solution in the general case. First, the problem solver can consider the simplest particular cases, then — more complicated particular situations, and so on, until the solution of the problem is found in the original formulation.

To illustrate the application of induction in the proof of inequalities, we reproduce the inequality from:

$$\frac{\overline{F(s)}}{F(s)} \leq \frac{A_n}{A'_n} \leq \frac{\overline{F(t)}}{F(t)} \quad (3)$$

Where $F(x)$ is the weighted power — law average of positive numbers $a_1, \dots, a_n$ from the interval $(0; 0.5)$ with weights, $\rho_1, \dots, \rho_n$, $\sum_{i=1}^n \rho_i = 1$, is the analogous power - law average of numbers

In the cited paper, we present two ways to prove this inequality by means of differential and integral calculus of functions of one variable, but we emphasize that they did not appear immediately. Previously, we carried out many checks on the fulfillment of the inequality in question for specific sets of numbers $\{a_i\}$ and weights $\{\rho_i\}$, taking a very different number of numbers in such sets and very different values of s and t , until a hypothesis arose: under these conditions, inequality (3) holds. Only then did the mentioned evidence appear. Note that when checking the fairness of inequality (3) in particular cases, we often resorted to using computers. A computer in modern conditions is really a means of studying mathematical problems.

Let us now focus on the heuristics that go back to the transition from a given problem (a given statement) to a more general problem (a more general statement). The mentioned transition sometimes allows you to find a solution to the original problem, Let's give examples.

1. To prove the Lagrange formula of finite increments.

$$f(b) - f(a) = f(\xi)(b-a) \quad (4)$$

it is enough to establish the Cauchy formula of finite increments.

$$\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(\xi)}{g'(\xi)} \quad (5)$$

or the Taylor formula of the function f of the n th order.

$$f(x) = f(a) + f'(a)(x-a) + \dots + \frac{f^{(n)}(a)}{n!}(x-a)^{n-1} \quad (6)$$

Obviously, the Lagrange formula is obtained from the Cauchy formula if in the latter we put $g(x) = x$, it is also obtained from the Taylor formula, if in this formula we take.

As is known, in the course of ordinary differential equations, the proof of the first statement is reduced to the establishment of the second, while using the fundamental theorem of the theory of metric spaces — the Banach principle of the compressive mapping of the complete metric space into itself.

When solving problems of differential and integral calculus of functions, the heuristic method of replacing the original problem with an equivalent one has to be used very, very often. This is especially true for integral calculus problems.

Calculate the integral.

$$\int_0^1 \frac{\sin x}{\cos \frac{2x-1}{2}} dx \quad (7)$$

Decision. Integrand function

in the integral under consideration, it has a non-standard (for integration) form, so we will replace the variable, assuming. $y = x - \frac{1}{2}$, Then the original integral will be reduced to the integral

$$j = \int_{-\frac{1}{2}}^{\frac{1}{2}} \frac{\sin(y+\frac{1}{2})}{\cos y} dy \quad (8)$$

We have obtained an equivalent problem that is successfully solved

$$j = \int_{-\frac{1}{2}}^{\frac{1}{2}} \cos \frac{1}{2} tgy dy + \int_{-\frac{1}{2}}^{\frac{1}{2}} \sin \frac{1}{2} dy - \sin \frac{1}{2} \quad (9)$$

because,

$$\int_{-\frac{1}{2}}^{\frac{1}{2}} \cos \frac{1}{2} tgy dy = 0 \quad (10)$$

due to the odd function $\operatorname{tg} x$ and the symmetry of the segment $[-\frac{1}{2}; \frac{1}{2}]$ regarding the beginning.

When solving problems of differential and integral calculus, when establishing the validity of any fact of this section of analysis, it is necessary to use not only geometric or graphical considerations, but also physical, mechanical, economic, etc. The latter should also be attributed to the appropriate heuristics in teaching analysis.

Describing the analogy above, we mentioned the approach in substantiating the formula for calculating the triple integral, based precisely on mechanical considerations. In this case, we consider the integrand function as a quantity expressing density. But especially often we use the affected heuristics when solving problems in the course of mathematical analysis. The above applies to many tasks with physical, mechanical, economic, etc. content.

Describing the above-mentioned basic heuristics separately, we must remember that in some specific situations we sometimes have to use several at once. It often happens that when solving a problem, several heuristic techniques are involved. As a matter of fact, what is being noted can even be traced in a number of illustrative examples discussed above. So, in the problem with a parameter about two equations, in addition to varying the parameter, we, of course, attracted geometric (graphical) considerations, properties of the corresponding classes of functions (bounded, monotonic), and general methods for solving problems with parameters.

We have considered a number of heuristics that can be useful and effective in solving problems and establishing theoretical facts in the course of differential and integral calculus of

functions for students of mathematical specialties. Naturally, we have not exhausted the full list of possible heuristic techniques, but the ones presented, we think, are the main ones. Once again, we emphasize that heuristics in teaching university students differential and integral calculus of functions should be included in the content of training, since the skills of using heuristics will be useful to future specialists in their professional activities.

Results of the pedagogical experiment. The level of formation of the motivational and value component of the methodological readiness of the future mathematics teacher among students of control and experimental groups was assessed based on the results of a survey of expert teachers. The results obtained are presented in the table (Table 2).

Table 2-Survey results (in control and experimental groups)

Group	Survey period	Percentage of students with a threshold level	Percentage of students with a standard level	Percentage of students with a reference level	The motivation coefficient of the group
K1	Before studying the discipline	44	49	7	63
	After studying the discipline	28	58	14	86
K2	Before studying the discipline	42	50	8	66
	After studying the discipline	35	46	19	84
E1	Before studying the discipline	55	39	6	51
	After studying the discipline	24	49	27	103
E2	Before studying the discipline	43	50	7	64
	After studying the discipline	23	50	27	104

The results of the survey before studying the disciplines of "Differential and integral calculus of functions" and after studying it in control and experimental groups are presented in Figures 1, 2.

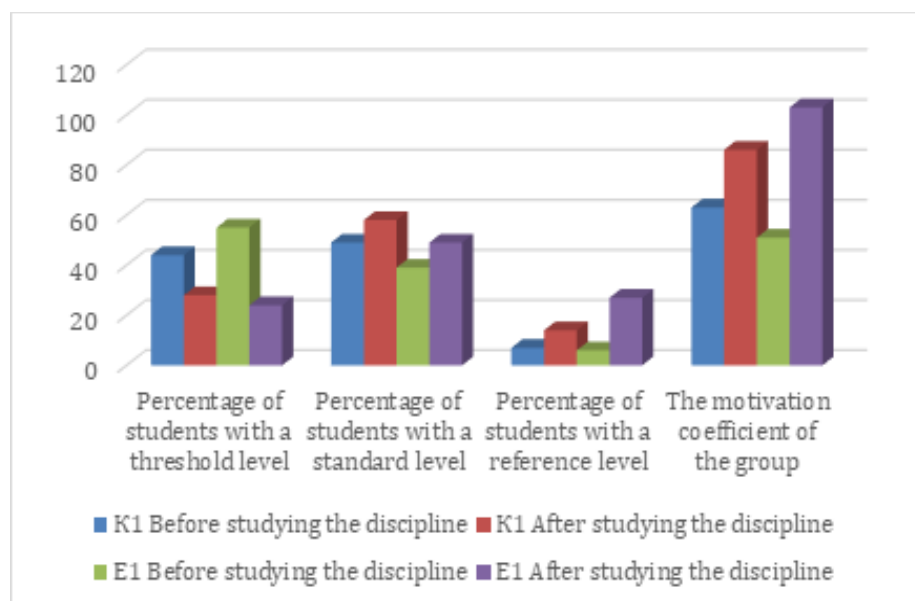


Fig. 1 – The results of the survey before and after studying the discipline "Differential and integral calculus of functions" in the first control and experimental groups

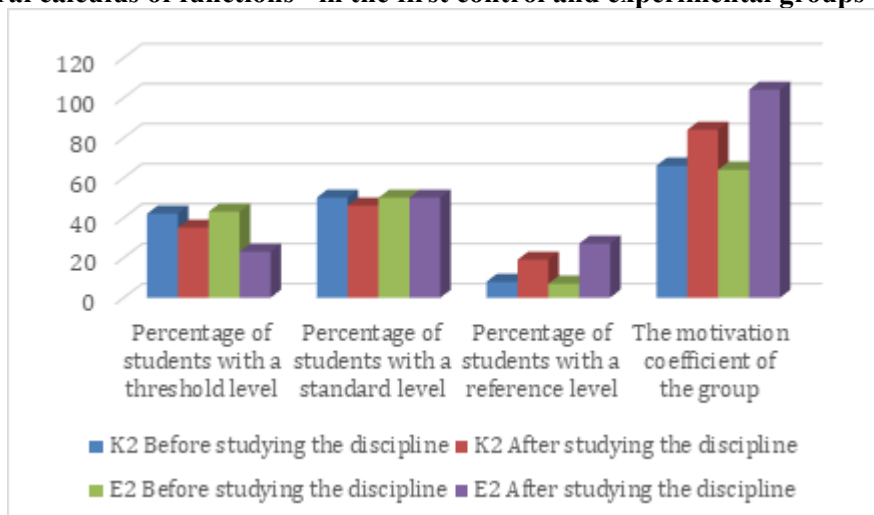


Fig. 2 – The results of the survey before and after studying the discipline "Differential and integral calculus of functions" in thesecond control and experimental groups

The analysis of the results showed that before studying the discipline "Differential and integral calculus of functions", the motivation coefficients of the three groups (K1, K2 and E2) are almost the same (63, 66 and 64), only the motivation coefficient of the first experimental group is significantly lower (51). After studying the discipline "Numerical Systems", the motivation coefficient of the control groups increases by one third, and the experimental groups - almost twice. At the same time, students with a standard level of formation of the motivational and value component make up about half both before studying the discipline "Differential and integral calculus of functions " and after studying it. The motivation coefficient of groups increases due to a change in the ratio between the number of students with a threshold level of formation of the motivational and value component and the reference one. Students with a threshold level before studying the discipline make up from 43 to 55 percent. After studying the discipline "Differential and integral calculus of functions" in the control groups K1 and K2, such students become 28% and 35%, respectively, and in the experimental groups E1 and E2 - 24% and 23%, respectively.

Students with a reference level before studying the discipline make up from 6 to 8 percent. After studying the discipline "Differential and integral calculus of functions" in the control groups K1 and K2, such students become 14% and 19%, respectively, and in the experimental groups E1 and E2 - 27%. Thus, in the control groups before and after studying the discipline "Differential and integral calculus of functions", there are more students with a threshold level of formation of a motivational and value component than students with a reference level, and in experimental groups after studying the discipline, there are more students with a reference level than students with a threshold level.

The analysis of the obtained results allowed us to conclude that the majority of students by the fourth year of study have a reflexive component of the subject competence of a future mathematics teacher formed at a standard level. After studying the discipline "Differential and integral calculus of functions", the number of students with a standard level of formation of the reflexive component increased. During repeated questioning, both in control and experimental groups, the number of choices of the answer "I find it difficult to answer" decreased, which indicates the formation of self-assessment skills within the discipline "Differential and integral calculus of functions".

To assess the level of formation of the content-procedural component of the subject competence of the future mathematics teacher in the control and experimental groups and further compare the data obtained, as indicated above, an input control was carried out. The results of the input control are presented in an ordinal scale (Table 3).

Table 3 – The average score of exam grades in mathematical disciplines studied by students in 1-3 courses

Average scores	K1		K2		E1		E2	
	frequency (number of students)	relates, frequency	frequency (number of students)	relates, frequency	frequency (number of students)	relates, frequency	frequency (number of students)	relates, frequency
33-3,5	12	0,28	4	0,15	17	0,52	11	0,37
33,6-4	12	0,28	11	0,42	7	0,21	7	0,23
44,1-4,5	11	0,26	7	0,27	6	0,18	10	0,33
44,6-5	8	0,19	4	0,15	3	0,09	2	0,07
Total students	43		26		33		30	

To assess the reliability of the coincidences and differences of the results obtained from the results of the input control in the control and experimental groups, we used a nonparametric statistical criterion χ^2 . The empirical value of the criterion is calculated using the following

formula:

$$\chi^2 = NM \sum_{i=1}^k \frac{\left(\frac{n_i}{N} - \frac{m_i}{M} \right)^2}{\frac{n_i}{N} + \frac{m_i}{M}}$$

Here N, M are the number of students in the groups being compared, n_i, m_i are the relative frequencies in the corresponding groups. The empirical values of the criterion for each of the cases are presented in the table (Table 4).

Table 4 – Empirical values of the criterion χ^2

Group	E1	E2
K1	4,6865	2,7800
K2	8,4447	5,0919

The empirical values of the criterion in three cases were lower than the critical value of the criterion χ^2 , which for a significance level of 0.05 and a given number of degrees of freedom 3 is equal to - 7.82. Thus; the characteristics of the compared samples coincide with the significance level of 0.05. Only in one case (groups K2 and E1) the empirical value of the criterion is higher than the critical value. Thus, the reliability of the differences in the characteristics of these groups of students according to the statistical criterion χ^2 is 95%.

The test results are measured in a scale of relationships. To visualize qualitative changes in the preparation of students, we have translated the data obtained at the school of relations into an ordinal scale. The results are presented in the table (Table 5).

The proportion of students who received an "unsatisfactory" grade for the test in the control groups K1 and K2 is 16% and 12%, respectively, whereas in the experimental groups E1 and E2 it is only 6% and 3%, respectively. The proportion of students who received a grade of "satisfactory", which corresponds to the threshold level of formation of the content-process component of the subject competence of a future mathematics teacher, in the control groups is 37% and 31%, while in the experimental groups it is only 12% and 23%, that is, the percentage of students with a threshold level in the experimental groups is insignificant, in contrast to control groups, where such students make up a third of the group. The proportion of students who received a "good" grade, which corresponds to the standard level of formation of the content-procedural component of the subject competence of a future mathematics teacher, in the control groups is 37% and 46%, in the experimental groups — 48% and 43%.

Table 5 – Test results conducted in control and experimental groups

EEvaluation	SScores	K1		K2		E1		E2	
		Frequency (number of students)	relates, frequency	frequency (number of students)	relates, frequen-cy	frequency (num-ber of students)	relates, frequen-cy	frequency (number of students)	relates, frequency
2	00-14	7	0,16	3	00,12	2	0,06	1	0,03
3	15-19	16	0,37	8	00,31	4	0,12	7	0,23
4	20-24	16	0,37	12	00,46	16	0,48	13	0,43
5	25-30	4	0,09	3	00,12	11	0,33	9	0,30
Total students	.	43		26		33		30	

Thus, it can be concluded that the percentage of students with a standard level in the control and experimental groups is almost the same. The proportion of students who received an excellent grade, which corresponds to the reference level of the content-process component of the subject competence of the future mathematics teacher, in the control groups is 9% and 12%, in the experimental groups - 33% and 30%, that is, the percentage of students with a reference level in the experimental groups has increased significantly and began to make up a third of the group.

To assess the reliability of the differences in the test results in the control and experimental groups, we applied the nonparametric statistical Wilcoxon-Mann-Whitney criterion. There are two criteria - Wilcoxon and Mann-Whitney. These criteria are uniquely related, so they are often called the Wilcoxon-Mann-Whitney criterion.

The empirical value of the Mann-Whitney criterion for each of the tested cases is calculated

$$U = \sum_{i=1}^N a_i$$

using the following formula:

Here N is the number of students in the first group to be compared. The obtained values are given in the table 6.

Table 6 – Empirical values of the Mann-Whitney criterion

Group	E1	E2
K1	952	865
K2	599	527

The empirical value of the Wilcoxon criterion is determined by the following formula:

$$W_{\text{Wilcoxon}} = \frac{\left| \frac{N \cdot M}{2} - U \right|}{\sqrt{\frac{N \cdot M (N + M + 1)}{12}}}$$

Here N, M is the number of students in the groups being compared. The empirical values of the criterion for each of the cases are presented in the table (Table 7).

Table 7-Empirical values of the Wilcoxon criterion

Group	E1	E2
K1	2,541358	2,466622
K2	2,595495	2,250746

The empirical values of the Wilcoxon criterion turned out to be higher than the critical value of the criterion, which for a significance level of 0.05 is equal to 1.96. Thus, the reliability of differences in the characteristics of experimental and control groups of students according to the Wilcoxon-Mann-Whitney statistical criterion is 95%.

The results of the control work and the test give approximately the same percentage distribution of students by the levels of formation of the content-procedural component of the subject competence of the future mathematics teacher. Thus, students who have reached the standard level make up about half of both the control and experimental groups. In the control groups, one third of the group has a threshold level and only a few students have a reference level. In the experimental groups, one third of the group has a reference level and only a few students have a threshold level.

Discussions. Analyzing the works of many authors considering the competence approach in education [17-18], it can be assumed that the meaning of the words "readiness" and "ability" is embedded in the content of the concept of "competence", to apply a person's personal qualities, knowledge, skills, skills, experience to solve the problems that have arisen in a new situation. Brady, (2020) interprets readiness for action as a state of mobilization of all psychophysical systems of the body, ensuring the effective performance of certain actions [19].

Matiash et al., (2021) identifies subject and metasubject components in the structure of methodological competence of a mathematics teacher, where the subject consists of subject-oriented competence, metasubject - professionally oriented competence [20]. The measure of the formation of the components of methodological competence of a mathematics teacher is the functional components of pedagogical activity: gnostic, design, constructive, communicative, organizational.

Alfaro-carvajal et al., (2018) holds the thought: "... the training of engineers and physicists in differential and integral calculus could be significantly improved if the nature of heuristic reasoning was better understood, their advantages and limitations were openly recognized and textbooks would openly state heuristic arguments. A heuristic argument, formulated skillfully and directly, can be useful, it can prepare an accurate proof, the individual elements of which it contains." I think this should be borne in mind by teachers of mathematical analysis of pedagogical colleges and universities, teaching future teachers of mathematics, future specialists of applied mathematics and engineers, school teachers when submitting the principles of mathematical analysis to their wards [21].

In contrast to the listed works, our study presents a model for the formation of methodological training of a future mathematics teacher, the introduction of which will allow the implementation of the basic mathematical program "Integral Calculus and differential equations".

At the formative stage of the experiment, the effectiveness of the set of pedagogical conditions defined by us for the formation of methodological readiness of a future mathematics teacher was tested and thus the sufficiency of these pedagogical conditions was established.

Conclusion. For the effective implementation of the developed model, we have identified the following set of necessary and sufficient pedagogical conditions for the formation of methodological readiness of a future mathematics teacher: integration of the content of mathematical courses; development of a positive motivational sphere of the personality of a future mathematics teacher based on pedagogical values; ensuring the assimilation of mathematical knowledge in the unity of their subject and operational aspects; ensuring regular monitoring and evaluation of learning outcomes as a from the teacher's side, and from the student's side.

The conducted research does not exhaust the whole variety of the problem of the formation of methodological readiness of a future mathematics teacher in the process of studying at a university. Further development of the problem may be related to the content, methodological and didactic support of the process of formation of the subject and methodological competence of the future mathematics teacher in the study of other mathematical disciplines.

Literatures:

- [1] **Григораш, О. В.**, Петренко, Т. В. Методика оценки потенциала вуза по подготовке квалифицированных кадров. *Alma Mater. – Вестник высшей школы*, 2022. – № 3. – С.80–84. <https://doi.org/10.20339/am.03-22.080>
- [2] **Артемчук, М.** (2016). Проблема личностно ориентированной подготовки будущего учителя математики к самообразовательной деятельности в историческом развитии педагогики. *Эстетика и этика педагогического действия*, 2016. – № 14. – С. 91–98. <https://doi.org/10.33989/2226-4051.2016.14.171591>
- [3] **Novita, R.**, Herman, T., Suryadi, D., Dasari, D., & Putra, M. (2022). How Pre-Service Elementary Teachers Deal with Mathematical Literacy Problems? A Case Study. In *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)* (Vol. 627). Atlantis Press. <https://doi.org/10.2991/assehr.k.211229.022>
- [4] **Park, J. H.**, Lee, I. H., & Cooc, N. (2019). The Role of School-Level Mechanisms: How Principal Support, Professional Learning Communities, Collective Responsibility, and Group-Level Teacher Expectations Affect Student Achievement. *Educational Administration Quarterly*, 55(5), 742–780. <https://doi.org/10.1177/0013161X18821355>
- [5] **Ovchinnikova, M. V.**, Linnik, E. P., & Zinenko, I. N. (2021). Research work culture as an important part of the research activities of undergraduates of the program “Mathematics in professional education.” *SHS Web of Conferences*, 113, 00020. <https://doi.org/10.1051/shsconf/202111300020>
- [6] **Brauer, S.** (2021). Towards competence-oriented higher education: a systematic literature review of the different perspectives on successful exit profiles. *Education and Training*, 63(9), 1376–1390. <https://doi.org/10.1108/ET-07-2020-0216>
- [7] **Gerasimova, E. N.**, Shcherbatykh, S. V., Savvina, O. A., Simonovskaya, G. A., Masina, O. N., Trofimova, E. I., & Tarasova, O. V. (2017). Coexistence of theory and practice in training the future mathematics teacher: The experience of the Russian education system. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(12), 7695–7705. <https://doi.org/10.12973/ejmste/80359>
- [8] **Blanco, T. F.**, Gorgal-Romaris, A., Núñez-García, C., & Sequeiros, P. G. (2022). Prospective Primary Teachers’ Didactic-Mathematical Knowledge in a Service-Learning Project for Inclusion. *Mathematics*, 10(4). <https://doi.org/10.3390/math10040652>
- [9] **Faizin, Moh.** (2021). Penguatan Profesionalisme Guru Pendidikan Agama Islam berbasis Nilai-nilai Profetik. *EL-BANAT: Jurnal Pemikiran Dan Pendidikan Islam*, 11(1), 109–129. <https://doi.org/10.54180/elbanat.2021.11.1.109-129>
- [10] **Özcan, B.**, & Kültür, Y. Z. (2021). The Relationship Between Sources of Mathematics Self-Efficacy and Mathematics Test and Course Achievement in High School Seniors. *SAGE Open*, 11(3). <https://doi.org/10.1177/21582440211040124>
- [11] **Gambini, A.**, & Lénárt, I. (2021). Basic geometric concepts in the thinking of in-service and pre-service mathematics teachers. *Education Sciences*, 11(7). <https://doi.org/10.3390/educsci11070350>
- [12] **Appova, A.**, & Taylor, C. E. (2019). Expert mathematics teacher educators’ purposes and practices for providing prospective teachers with opportunities to develop pedagogical content knowledge in content courses. *Journal of Mathematics Teacher Education*, 22(2), 179–204. <https://doi.org/10.1007/s10857-017-9385-z>
- [13] **Toibazarov, D. B.**, Seitova, S. M., Tasbolatova, R., Omarov, Z. A., & Ibrayeva, S. N. (2021). The role of applied problems in the training of future mathematics teachers in the 21st century. *Thinking Skills and Creativity*, 42. <https://doi.org/10.1016/j.tsc.2021.100945>
- [14] **Ovchinnikova, M.**, Linnik, E., & Shilova, L. (2020). The system of development of the methodological-mathematical competence within future mathematics teachers to be (theoretical-methodological aspect). *SHS Web of Conferences*, 87, 00087. <https://doi.org/10.1051/shsconf/20208700087>

- [15] **Al-Mahdi, O.** (2019). Action Research and Teachers' Professional Development: Examples and Reflections. *International Educational Research*, 2(3), p37. <https://doi.org/10.30560/ier.v2n3p37>
- [16] **Corredor-García, M. S., & Bailey-Moreno, J.** (2020). Motivation and conceptions that elementary education students attribute to their academic performance in mathematics. *Revista Fuentes*, 22(1), 127–141. <https://doi.org/10.12795/revistafuentes.2020.v22.i1.10>
- [17] **Romanova, O. A.** (2021). Competence-based approach in vocational education and training: Systematic review of the Russian literature. *Education and Self Development*, 16(2), 105–123. <https://doi.org/10.26907/esd16.2.06>
- [18] **Sequeira, A. H.** (2017). Competence-Based Approach for Improved Education and Learning. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2111029>
- [19] **Brady, A. M.** (2020). From the reflective to the post-personal teacher. *Teoria de La Educacion*. Ediciones Universidad de Salamanca. <https://doi.org/10.14201/teri.21438>
- [20] **Matiash, O., Mykhailenko, L., Milian, R., & Olshevskyi, V.** (2021). Monitoring of methodical competence of mathematics teachers' indicators and levels in the conditions of the partnership of pedagogical university and school. *Journal of Higher Education Theory and Practice*, 21(10), 77–93. <https://doi.org/10.33423/jhetp.v21i10.4627>
- [21] **Alfaro-carvajal, C., Rica, C., Fonseca-castro, J., & Rica, C.** (2018). Problem solving in the teaching of single variable differential and integral calculus: Perspective of mathematics teachers. *Uniciencia*, 32, 42–56.

References:

- [1] **Grigoraş, O. V., Petrenko, T.V.** Metodika osenki potensiala vuza po podgotovke kvalifisirovannyh kadrov. Alma Mater. – Vestnik vysşei şkoly, 2022. – №3. – С. 80–84. <https://doi.org/10.20339/am.03-22.080> [in Russian].
- [2] **Artemchuk, M.** (2016). Problema lichnostno orientoivannoi podgotovki buduşego uchitelâ matematiki k samoobrazovatelnoi deiatelnosti v istoricheskom razvitii pedagogiki. Estetika i etika pedagogicheskogo deistvia, 2016. – № 14. – С. 91–98. <https://doi.org/10.33989/2226-4051.2016.14.171591> [in Russian].
- [3] **Novita, R., Herman, T., Suryadi, D., Dasari, D., & Putra, M.** (2022). How Pre-Service Elementary Teachers Deal with Mathematical Literacy Problems? A Case Study. In *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)* (Vol. 627). Atlantis Press. <https://doi.org/10.2991/assehr.k.211229.022>
- [4] **Park, J. H., Lee, I. H., & Cooc, N.** (2019). The Role of School-Level Mechanisms: How Principal Support, Professional Learning Communities, Collective Responsibility, and Group-Level Teacher Expectations Affect Student Achievement. *Educational Administration Quarterly*, 55(5), 742–780. <https://doi.org/10.1177/0013161X18821355>
- [5] **Ovchinnikova, M. V., Linnik, E. P., & Zinenko, I. N.** (2021). Research work culture as an important part of the research activities of undergraduates of the program “Mathematics in professional education.” *SHS Web of Conferences*, 113, 00020. <https://doi.org/10.1051/shsconf/202111300020>
- [6] **Brauer, S.** (2021). Towards competence-oriented higher education: a systematic literature review of the different perspectives on successful exit profiles. *Education and Training*, 63(9), 1376–1390. <https://doi.org/10.1108/ET-07-2020-0216>
- [7] **Gerasimova, E. N., Shcherbatykh, S. V., Savvina, O. A., Simonovskaya, G. A., Masina, O. N., Trofimova, E. I., & Tarasova, O. V.** (2017). Coexistence of theory and practice in training the future mathematics teacher: The experience of the Russian education system. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(12), 7695–7705. <https://doi.org/10.12973/ejmste/80359>
- [8] **Blanco, T. F., Gorgal-Romaris, A., Núñez-García, C., & Sequeiros, P. G.** (2022). Prospective Primary Teachers' Didactic-Mathematical Knowledge in a Service-Learning Project for Inclusion. *Mathematics*, 10(4). <https://doi.org/10.3390/math10040652>
- [9] **Faizin, Moh.** (2021). Penguatan Profesionalisme Guru Pendidikan Agama Islam berbasis Nilai-nilai Profetik. *EL-BANAT: Jurnal Pemikiran Dan Pendidikan Islam*, 11(1), 109–129. <https://doi.org/10.54180/elbanat.2021.11.1.109-129>
- [10] **Özcan, B., & Kültür, Y. Z.** (2021). The Relationship Between Sources of Mathematics Self-Efficacy and Mathematics Test and Course Achievement in High School Seniors. *SAGE Open*, 11(3). <https://doi.org/10.1177/21582440211040124>

- [11] **Gambini, A., & Lénárt, I.** (2021). Basic geometric concepts in the thinking of in-service and pre-service mathematics teachers. *Education Sciences*, 11(7). <https://doi.org/10.3390/educsci11070350>
- [12] **Appova, A., & Taylor, C. E.** (2019). Expert mathematics teacher educators' purposes and practices for providing prospective teachers with opportunities to develop pedagogical content knowledge in content courses. *Journal of Mathematics Teacher Education*, 22(2), 179–204. <https://doi.org/10.1007/s10857-017-9385-z>
- [13] **Toibazarov, D. B.,** Seitova, S. M., Tasbolatova, R., Omarov, Z. A., & Ibrayeva, S. N. (2021). The role of applied problems in the training of future mathematics teachers in the 21st century. *Thinking Skills and Creativity*, 42. <https://doi.org/10.1016/j.tsc.2021.100945>
- [14] **Ovchinnikova, M.,** Linnik, E., & Shilova, L. (2020). The system of development of the methodological-mathematical competence within future mathematics teachers to be (theoretical-methodological aspect). *SHS Web of Conferences*, 87, 00087. <https://doi.org/10.1051/shsconf/20208700087>
- [15] **Al-Mahdi, O.** (2019). Action Research and Teachers' Professional Development: Examples and Reflections. *International Educational Research*, 2(3), p37. <https://doi.org/10.30560/ier.v2n3p37>
- [16] **Corredor-García, M. S., & Bailey-Moreno, J.** (2020). Motivation and conceptions that elementary education students attribute to their academic performance in mathematics. *Revista Fuentes*, 22(1), 127–141. <https://doi.org/10.12795/revistafuentes.2020.v22.i1.10>
- [17] **Romanova, O. A.** (2021). Competence-based approach in vocational education and training: Systematic review of the Russian literature. *Education and Self Development*, 16(2), 105–123. <https://doi.org/10.26907/esd16.2.06>
- [18] **Sequeira, A. H.** (2017). Competence-Based Approach for Improved Education and Learning. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2111029>
- [19] **Brady, A. M.** (2020). From the reflective to the post-personal teacher. *Teoria de La Educacion*. Ediciones Universidad de Salamanca. <https://doi.org/10.14201/teri.21438>
- [20] **Matias, O.,** Mykhailenko, L., Milian, R., & Olshevskiy, V. (2021). Monitoring of methodical competence of mathematics teachers' indicators and levels in the conditions of the partnership of pedagogical university and school. *Journal of Higher Education Theory and Practice*, 21(10), 77–93. <https://doi.org/10.33423/jhetp.v21i10.4627>
- [21] **Alfaro-carvajal, C.,** Rica, C., Fonseca-castro, J., & Rica, C. (2018). Problem solving in the teaching of single variable differential and integral calculus: Perspective of mathematics teachers. *Uniciencia*, 32, 42–56.

МАТЕМАТИКА МАМАНДЫҒЫ СТУДЕНТТЕРІНЕ ДИФФЕРЕНЦИАЛДЫҚ ЖӘНЕ ИНТЕГРАЛДЫҚ ЕСЕПТЕУЛЕРДІ ОҚЫТУДЫҢ ПЕДАГОГИКАЛЫҚ ШАРТТАРЫ

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Аңдатпа. Бұл зерттеу математика мамандығы бойынша білім алып жатқан студенттердің дифференциалдық және интегралдық есептеулерді оқыту арқылы әдістемелік құзыреттілігін дамытуға бағытталған. Зерттеудің өзектілігі – жоғары оқу орындарындағы математика пәнін оқытуда педагогикалық және әдістемелік дайындықтың жеткіліксіз ықпалдастырылуымен байланысты. Зерттеудің мақсаты – әдістемелік дайындық моделін әзірлеу және оның тиімділігін арттыратын педагогикалық шарттарды айқындау. Зерттеу әдістеріне әдебиеттерге шолу жасау, бақылау, сауалнама жүргізу, педагогикалық эксперименттер және статистикалық талдау жатады. Ұсынылған модельді жүзеге асыру студенттердің әдістемелік ойлау қабілетін дамытып, олардың болашақ кәсіби педагогикалық қызметке дайындығын жақсартуға оң ықпал етті.

Тірек сөздер: модель, инновациялық әдістер, әдістемелік дайындық, математика студенті, функциялардың дифференциалдық және интегралдық есептеулері.

ПЕДАГОГИЧЕСКИЕ УСЛОВИЯ ОБУЧЕНИЯ ДИФФЕРЕНЦИАЛЬНОМУ И ИНТЕГРАЛЬНОМУ ИСЧИСЛЕНИЮ СТУДЕНТОВ МАТЕМАТИЧЕСКИХ СПЕЦИАЛЬНОСТЕЙ

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Аннотация. Данное исследование направлено на развитие методической компетентности студентов математических специальностей посредством преподавания дифференциального и интегрального исчисления. Актуальность исследования обусловлена недостаточной интеграцией педагогической и методической подготовки в системе высшего математического образования. Цель исследования – разработать и обосновать модель методической подготовки, а также определить педагогические условия, способствующие повышению её эффективности. Методы исследования включают анализ литературы, наблюдение, анкетирование, педагогический эксперимент и статистический анализ. Реализация предложенной модели показала положительные результаты в формировании методического мышления студентов и их подготовке к будущей профессиональной деятельности в образовательной сфере.

Ключевые слова: модель, инновационные методы, методическая подготовка, студент-математик, дифференциальное и интегральное исчисление функций.