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ФОРМИРОВАНИЕ ИССЛЕДОВАТЕЛЬСКИХ НАВЫКОВ БУДУЩИХ УЧИТЕЛЕЙ МАТЕМАТИКИ С ИСПОЛЬЗОВАНИЕМ СИСТЕМЫ ПРОБЛЕМНО-ПОИСКОВЫХ ЗАДАЧ

Аннотация

Актуальность исследуемой проблемы обусловлена тем, что анализ системы методической подготовки будущих учителей математики показал, что хотя в целом она направлена на формирование у студентов профессионально значимых знаний и умений, однако ни на одном из ее этапов не происходит целенаправленного формирования исследовательских умений, связанных с с внедрением в практику проблемно-ориентированного обучения математике учащихся. Целью статьи является выявление теоретико-методологических основ проблемного решения задач в педагогическом вузе как средства формирования исследовательских навыков будущего учителя математики при проблемном обучении студентов. Методы исследования: анализ психолого-педагогической и научно-методической литературы, учебников по математике для студентов педагогических вузов; опрос преподавателей и студентов педагогических вузов; изучение и обобщение школьной и вузовской практики; анализ собственного опыта работы в школе и в педагогическом вузе; анализ опыта зарубежных школ в проблемно-ориентированном преподавании

математики; различные виды экспериментов для проверки основных положений исследования. В статье выделяются основные блоки исследовательских умений будущих учителей математики, необходимых для реализации проблемно-ориентированного обучения, и разрабатываемые студентами с помощью этих блоков системные и поисковые задачи, а также методы формирования этих умений в технических аспектах. Представлена и используется система проблемно-поисковых заданий по математике для студентов педагогических вузов, примеры организации их учебной и исследовательской деятельности на лекциях, практических занятиях, которые могут быть использованы преподавателями педагогических вузов.

Ключевые слова: методическая подготовка, новые типы заданий, проблемно-поисковые задания, исследовательские навыки, исследовательская деятельность.

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БОЛАШАҚ МАТЕМАТИКА МҰҒАЛІМДЕРІНІҢ ЗЕРТТЕУ ДАҒДЫЛАРЫН ПРОБЛЕМАЛЫҚ-ІЗДЕУ ЕСЕПТЕРІ ЖҮЙЕСІН ҚОЛДАНУ АРҚЫЛЫ ҚАЛЫПТАСТЫРУ

Аннотация

Зерттелетін мәселенің өзектілігі болашақ математика мұғалімдерін әдістемелік даярлау жүйесін талдау көрсеткендей, бұл жалпы студенттерде кәсіби маңызды білім мен дағдыларды қалыптастыруға бағытталған, бірақ оның кез-келген кезеңінде студенттерді математикаға проблемалық-бағдарланған оқытуды практикаға енгізуге байланысты зерттеу дағдыларын мақсатты түрде қалыптастыру мүмкін емес. Мақаланың мақсаты студенттерді проблемалық оқытуда болашақ математика мұғалімінің зерттеу дағдыларын қалыптастыру құралы ретінде педагогикалық университеттегі проблемалық мәселелерді шешудің теориялық және әдіснамалық негіздерін анықтау болып табылады. Зерттеу әдістері: психологиялық-педагогикалық және ғылыми-әдістемелік әдебиеттерді, педагогикалық жоғары оқу орындарының студенттеріне арналған Математика оқулықтарын талдау; педагогикалық жоғары оқу орындарының оқытушылары мен студенттерінен сұхбат алу; мектеп және жоғары оқу орындарының тәжірибесін зерделеу және жалпылау; мектептегі және педагогикалық жоғары оқу орындарындағы өзіндік жұмыс тәжірибесін талдау; математиканы проблемалық-бағдарланған оқытудағы шетелдік мектептердің тәжірибесін талдау; зерттеудің негізгі ережелерін тексеруге арналған эксперименттер. Мақалада проблемалық-бағдарланған оқытуды жүзеге асыру үшін қажетті болашақ математика мұғалімдерінің зерттеу дағдыларының негізгі блоктары және осы блоктардың көмегімен студенттер әзірлейтін жүйелік және іздеу тапсырмалары, сондай-ақ техникалық аспектілерде осы дағдыларды қалыптастыру әдістері көрсетілген. Педагогикалық жоғары оқу орындарының студенттері үшін математикадан проблемалық-іздеу тапсырмаларының жүйесі, олардың оқу және зерттеу қызметін дәрістерде, педагогикалық жоғары оқу орындарының оқытушылары қолдана алатын практикалық сабақтарда ұйымдастыру мысалдары ұсынылған және қолданылады.

Түйін сөздер: әдістемелік даярлық, есептердің жаңа түрлері, проблемалық-іздестіру тапсырмалары, зерттеу дағдылары, зерттеу қызметі.

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FORMATION OF RESEARCH SKILLS OF FUTURE TEACHERS OF MATHEMATICS USING THE SYSTEM OF PROBLEM-SEARCH TASKS

Abstract

The relevance of the problem under study is due to the fact that the analysis of the system of methodological training of future teachers of mathematics has shown that although in general it is aimed at forming students' professionally significant knowledge and skills, however, at none of its stages is the purposeful formation of research skills associated with the implementation in practice of problem-based teaching of mathematics to students. The purpose of the article is to identify the theoretical and

methodological foundations of problem-solving problems in the pedagogical university as a means of forming the research skills of a future mathematics teacher in problem-based learning of students. Research methods: analysis of psychological-pedagogical and scientific-methodological literature, textbooks on mathematics for students of pedagogical universities; survey of teachers and students of pedagogical universities; study and generalization of school and university practice; analysis of their own experience in school and in pedagogical university; analysis of the experience of foreign schools in problem-based teaching of mathematics; various types of experiments to test the main provisions of the study. The article highlights the main blocks of research skills of future teachers of mathematics necessary for the implementation of problem-based learning and high school students developed by these units system problems and search problems, and methods of forming these skills in technicalities. The system of problem-search tasks in mathematics for students of pedagogical universities, examples of the organization of their educational and research activities at lectures, practical classes, which can be used by teachers of pedagogical universities, is presented and used.

Keywords: Methodological training, new types of tasks, problem-search tasks, research skills, research activities.

Basic provisions. The formation of research skills of future mathematics teachers using a system of problem-solving tasks is a key aspect of modern education. This technique focuses on an active, independent and deep understanding of mathematical concepts and processes. It is important to emphasize that the system of problem-search tasks allows students of mathematical fields of study not only to study, but also to learn to learn. It stimulates interest in the subject, making mathematics more accessible and applied. Students, solving complex problems, develop skills of analysis, logical thinking and finding solutions. This technique promotes the development of communication and cooperation skills, as tasks often require discussion and joint solutions. By studying in this way, students are preparing to become not just experts in mathematics, but also excellent teachers who are able to effectively teach children of the future generation. The system of problem-searching tasks in the context of teaching future teachers of mathematics embodies an innovative and multifaceted approach that promotes deeper and more sustainable assimilation of mathematical knowledge, as well as the development of key skills necessary for both students and future teachers.

Introduction. The central place in the methodological training of a mathematics teacher in a pedagogical university is occupied by the course of methods of teaching mathematics (MTM), which is currently undergoing significant changes. These changes are primarily associated with a change in views on the role of MTM in the system of psychological and pedagogical subjects in pedagogical universities, namely, the consideration of the theory and methodology of teaching mathematics as an independent scientific field with its own subject, research methods and concepts for teaching mathematics, both in secondary school and in higher education [1].

One of the most important tasks of the theory and methodology of teaching mathematics was and is the task of forming the research skills of students and future teachers of mathematics.

In General, the problem of the study is to identify problems and search problems as means of formation of research skills of future teachers of mathematics, problem teaching math secondary school students studying methods of teaching mathematics in technicalities. A promising way to solve this problem is to create a scientifically based theoretical concept of using the system of problem-search problems in the course of MTM in a pedagogical university.

This allowed us to reveal a number of contradictions between:

– the need to form specific research skills of the future mathematics teacher for the implementation in practice of problem-based teaching of mathematics to secondary school students;

– the discrepancy between the content, methods and forms of organizing students ' educational activities in the course of teaching methods of mathematics and elementary mathematics, due to the lack of development of the problem under consideration.

The analysis of the psychological-didactic and methodological literature has shown that there are different interpretations of the concept of a problem-search task, which is considered in the framework of a research task, a cognitive task, a creative task, a problem task. We will discuss each of these approaches in more detail.

Research tasks [9, 10, 11].

The main features of the research task:

1) the absence of not only an algorithm, but also various kinds of algorithmic prescriptions;

2) the non-standard formulation of the problem;

3) the non-standard finding of solutions;

4) the possibility of creating new problems arising from the solution of this one;

5) the multivariance of solutions and answers.

To solve a research problem, it is necessary to put forward several powerful ideas, several hypotheses, and the search for a solution to it is not complete without guesses, heuristics.

Cognitive tasks [12,13,14].

The main signs of a cognitive task:

1) the unknown method of solution;

2) the independence of students in obtaining new knowledge or new ways of solving problems;

3) sufficient complexity to cause students difficulty;

4)the feasibility for independent finding an answer by students;

5) the relationship of the task not only with new, but also with the previous knowledge of students;

6) the unknown result with known means of achieving it.

Creative tasks[15,16,17].

The main signs of a creative task:

1)the problem formulated in the problem may not be explicitly defined;

2) the condition does not contain instructions on what knowledge needs to be applied;

3) the condition may contain inaccurate or insufficient data;

4) the problem may have two or more solutions;

5) the result of the problem is unknown, the means of achieving it is unknown.

Problem tasks [18,19].

The main signs of a problem tasks:

1) the task should put the student in a situation in which he should have a surprise and a sense of difficulty; the student intends to overcome this difficulty;

2) the task contains elements that are in contradictory relations both with each other and with the student's available knowledge;

3) the task generates a problem situation in the student's mind;

4) the task requires the discovery (assimilation) of new knowledge;

5) the students must find ways to solve the problem independently.

Hofmann & Mercer identified three main types of problem situations, characterized by a different, structural place of the unknown in the problem situation [2]: 1) when the unknown coincides with the purpose (subject) of the action; 2) when the unknown coincides with the method of action; 3) when the unknown coincides with the conditions for performing the action.

Research skills of a future mathematics teacher.

Research activity is a form of creative activity, the product of which is new knowledge, new methods of obtaining new knowledge, or new methods of studying an object [3].

Under research activity, we will understand all activities that are aimed at obtaining new knowledge and that are carried out without the use of algorithms and various kinds of algorithmic prescriptions.

The formation of students ' research skills in solving problem-search problems requires the teacher to clearly formulate tasks, identify landmarks for recognizing stable connections and relationships between parts of the objects under consideration, and when performing tasks, show typical ways to justify the formulated proposals, methods of logical construction of mathematical proposals, and their possible variants [4].

Y.Poluyanov emphasize the need to achieve independence of students in the performance of research tasks. What is the activity of the teacher? First of all, in the construction of such tasks that would ensure the creative application of students ' basic knowledge (ideas, concepts, methods of cognition) in solving the main problems of the course available to them, mastering the features of creative activity, gradually increasing the complexity of the problems solved by students [5].

The role of problem-search problems in the formation of research skills of a future mathematics teacher.

Any activity is characterized not only by certain knowledge, abilities to perform it, but also by skills. Psychologists note that to form a skill means to master a complex system of actions (practical and mental) that ensure the perception and processing of information, its comparison (correlation, selection) with a specific educational situation in which this information must be applied [6].

The structure of educational and organizational skills includes mastering the methods of performing each component of educational activities, methods of external organization of their educational work.

The composition of educational and intellectual skills includes methods of logical thinking, methods of performing mental activity, setting and solving problems.

The structure of educational and information skills includes methods of independent acquisition of knowledge, new and additional information, methods of semantic processing, memorization and storage of information.

And, finally, the composition of educational and communicative skills includes mastering the methods of constructing oral and written speech.

Psychological peculiarities of mastering academic skills in mathematics is reflected in the works [20,21].

Materials and Methods. In the study the following methods were used: analysis of psychological-pedagogical and scientific-methodical literature, dissertations, programs, textbooks on mathematics for students of high school and the benefits of MTM for students of pedagogical institutes; a survey of teachers and students of teacher training institutions; study and generalization of the school and Universitypractices; analysis of their own experience in school and in technicalities; the analysis of experience of foreign schools on issues of teaching mathematics; different kinds of experiment to test the main provisions of the study.

The methodological basis of the study was the main provisions of the system approach in the field of theory and methodology of teaching mathematics.

For statistical evaluation of the diagnostic results of determining the legal culture of students, the Student's t - test was used with a one-percent confidence level (p=0.01). To identify differences in the distribution of a trait, we used a nonparametric X^2 test with a probability of 0.01 acceptable error. Tables, diagrams, and graphs were used to visualize the experimental data.

Research Stages and Procedures

The study of the problem was conducted in three stages:

The study was conducted in stages.

At the first stage (2017-2018), the study and analysis of the literature on the topic of the study were carried out, and a ascertaining experiment was conducted. The main issues to be investigated and verified were identified.

At this stage, the following research methods were used: observation of mathematics lessons in high school, as well as lectures, practical, laboratory classes on MTM; conversations with students, teachers, teachers of pedagogical universities; their questionnaires. The main focus was on finding answers to the following questions: Questions of a theoretical nature:

– What skills do teachers need to be able to put problem-based math teaching into practice?

– What skills do students need to solve a problem situation?

– What skills do students need to be able to solve a problem-search problem?

Practicalquestions:

– How do the specified research skills of a future mathematics teacher form in the course of the MTM in a pedagogical university?

The main purpose of the survey, firstly, is to establish how students understand the essence of the problem, problem-search problem, problem situation and problem learning, and, secondly, to identify their main difficulties in using these concepts in classes in MTM and elementary mathematics.

At the second stage (2018-2019), the requirements for the system of problem-search problems were developed, a search experiment was conducted to verify individual provisions, and a special course program for students was tested.

The specific tasks of the experiment were:

– approbation of problem-based search tasks in MTM classes;

– approbation of the program and content of the special course and the special seminar "New types of tasks as a means of forming the research skills of the future teacher".

The experiment was conducted in groups 6B015-Math (51 students) in the 4th semester in the MTM classes and in the 6B054 – Math group (15 students) in the 4th semester in the special course.

In the experimental groups, students performed the same diagnostic tests before and at the end of the experiment.

For all these works, the same evaluation criteria were applied for each task: completed completely and correctly; completed partially and correctly; not completed at all and completed incorrectly.

At the third stage (2019-2020), a training experiment was conducted, the results of the study were analyzed, and conclusions were formulated. It was attended by 50 full-time 4th year students and 20 part-time students.

The experiment was educational in nature. Its main goal was a comprehensive implementation of the methodology for the formation of research skills of the future mathematics teacher on the basis of a built system of problem-search tasks that meets certain principles.

Results. *Research skills of the future teacher, necessary for problem-based teaching of mathematics.*

As under problem-based learning we understand the system of problem situations, which is specially created for teacher in the classroom with the help of the corresponding system problems and search problems, hence the need to select individual blocks of basic research skills of teachers in the framework of problem-based learning. Let's focus on each skill block.

I block of skills refers to the concept of "problem situation". Here you can select the following skills.

1. Skills related to the analysis of a problem situation:

1) determine the purpose of creating this problem situation in the lesson (why, for what?);

2) identify the main causes of this situation (why, how?);

3) identify ways to resolve this problem situation with students in the classroom (how?).

2. Skills related to the construction of problem situations:

1) highlight the topics (questions) of the school mathematics course, in the study of which it is advisable to create a problem situation in the lesson;

2) establish ways to create a problem situation using the proposed problem-search problem.

3. Skills related to the organization of educational and research activities of students to resolve problem situations:

1) choose a method (heuristic, research) and implement it in practice;

2) choose the form of educational activity of students (collective, group and individual) and implement it in practice.

The second block of skills refers to the concept of "problem-search tasks".

4. Skills related to the problem-search task:

1) transform the training task into a problem-search task (how?);

2) determine the place of a specific (practical, historical, etc.) task in the educational process in order to create a problem situation for students (where, at what stage of the lesson, when studying what topic?);

The third block of skills is associated with the preparation and conduct of a problem math lesson.

5. Skills related to the problem lesson:

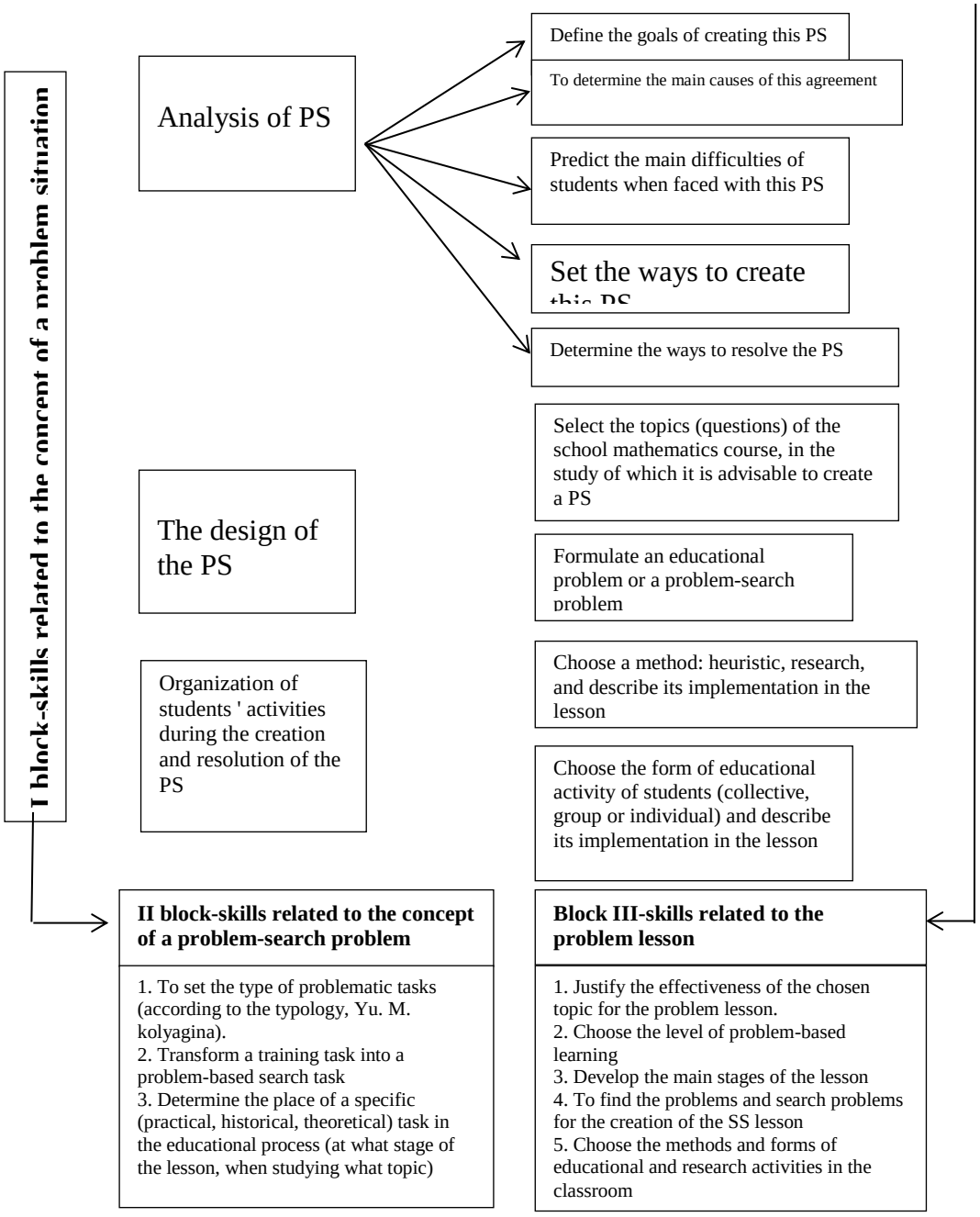
1) justify the effectiveness of the chosen topic for the problem lesson;

2) choose the level of problem-based learning;

3) to find the problematic tasks for the lesson;

So, in this section, we have identified the research skills that underlie the teacher's activity in problem-based teaching of mathematics

Fig.1.*The system of problem-search tasks for students and its implementation in the course of MTM in the pedagogical university*



I block of tasks.

I. Methodological analysis of the problem situation (observed in the lesson or planned):

Perform a methodical analysis of the "observed" problem situation in the math lesson in the class on the topic "Adding two negative numbers", organized in a collective form.

Example 1. Students are given a task: add the numbers -248 and -67. They already know how to add negative numbers using a coordinate line. But here they find themselves in a quandary. Then the teacher himself or one of the students formulates the task (goal): is it possible to find the sum of two negative numbers without the help of a coordinate line? This is already a search problem, since two components are unknown here (conclusion and solution).

By completing a number of auxiliary tasks: -5 + (-3); -4 + (-2) using the coordinate line, students come to the conclusion: 1) as a result of adding two negative numbers, a negative number is always obtained, and 2) the modulus of their sum is equal to the sum of the modules of the summands.

After receiving the rule, students should try to justify it. They then apply the resulting rule to the previously assigned task: - 248 + (- 67) = - 315.

Sample task completion:

1. The developing goal of this problem situation is to form the research skills of students to solve the problem-search problem and find ways to resolve the problem situation that has arisen.

2. The main reason for this situation is that students know how to add two negative numbers (on a coordinate line), but they can't do it right away.

3. The main difficulties of students will be associated with trying to draw these numbers on a coordinate line, as well as with finding another way to add these numbers.

4. To solve the problem situation, the teacher used auxiliary tasks that allowed students to formulate a hypothesis, make appropriate justifications and conclusions.

Instructions:

1. This situation can be offered to students at a lecture on the topic "Forms of organization of educational and research activities of students" or at a lecture on the topic "Positive and negative numbers in a school mathematics course".

2. Written analysis can be performed by each student at home or in practical classes on MTM.

3. This situation may be approved by the student during the period of internship in a school.

Example 2. Determine the place of this problem situation in the school mathematics course. What is the purpose of creating this problem situation in the lesson? What are the main difficulties a student may face in this problem situation.

The teacher writes down the following equalities:

$$\sqrt{\left(\sqrt{5}-1\right)^2}=\sqrt{5}-1 \qquad (1)$$

$$\sqrt{\left(2-\sqrt{2}\right)^2}=2-\sqrt{2}$$

One of the recorded equalities contains an error. Determine which one; explain why?

Instructions:

1. The analysis of this situation can be carried out at a lecture or a practical lesson in the course of a discussion organized in a collective form.

2. This situation may be approved by the student during the period of internship in a school.

Example3. Perform a methodical analysis of the" observed "problem situation in the algebra lesson in the 8th grade on the topic "The formula of the roots of the square equation", organized in a collective form.

Before studying the topic of the formula for the roots of a quadratic equation, the teacher draws the students ' attention to the examples solved in the previous lesson and at home by selecting the square of a binomial, and offers to solve the following equation for comparison: $x^2+8x-10=0$.

Students get to work and complete the task as follows: $x^2+8x+16-16=0$, $(x+4)^2-26=0$.

Instructions:

1. The analysis of this situation can be carried out at a lecture or a practical lesson in the course of a discussion organized in a collective form.

2. This situation may be approved by the student during the period internship in school.

Designing problem situations.

Describe how you will create a problem situation in the lesson when solving problems 1-6?

Task 1. In an equilateral triangle, the height is drawn. What properties do the resulting triangles have?

Task 2. Is there any relationship between the values of the angles and the lengths of the two sides of the triangle?

Task 3. The sum of the internal angles of the triangle is 1800. Is 180 ° equal to the sum of the inner angles of the quadrilateral? a pentagon?

Task 4. The middle line of the triangle is parallel to the base. Does the middle line of the rhombus have the same property? a parallelogram? a quadrilateral?

Task 5. In a triangle, the bisectors intersect at a single point. Can the same be said about the bisectors of the corners of a quadrilateral?

Task 6. Is it possible to apply the trapezoid area formula to calculate the area of a parallelogram? of the rectangle? a rhombus? square?

Note:

These tasks can be offered to students on a test paper or as a differentiated home work.

II block of tasks.

Solve the proposed tasks. Determine the problem level of tasks (1)-(3).

Task 1. One of the adjacent angles is larger than the other by 60° or 2 times. Look for these angles. Is there any extra data in the task? Create a task without unnecessary data (various options are possible). Solve it.

Task 2. One of the adjacent angles is larger than the other by 60° or 3 times. Look for these angles. Is there any extra data in the task? Do they contradict each other? Create a task that does not have these disadvantages (various options are possible). Solve it.

Task 3. One of the adjacent angles is larger than the other by a certain amount. Look for these angles. Is there enough data to solve the problem? Add some data to the problem condition and solve it.

Note:

These tasks can be offered to students on a test paper or as a differentiated home work.

III block of tasks.

Tasks related to the problem lesson.

In accordance with the previously designated skill blocks, we will highlight the following components in the structure of this system::

I. Tasks aimed at developing the skills of a future mathematics teacher related to the concept of "problem situation in the classroom".

II. Tasks aimed at forming the skills of a future mathematics teacher related to the concept of "problem-search tasks".

III. Tasks aimed at forming the skills of a future mathematics teacher related to the preparation and conduct of a problem mathematics lesson.

The effectiveness of the implementation of the methodology developed by us.

The experiment was educational in nature. Its main goal was a comprehensive implementation of the methodology for the formation of research skills of the future mathematics teacher on the basis of a built system of problem-search tasks that meets certain principles.

When choosing the criteria for the effectiveness of teaching, we proceeded from the target purpose of the system of problem-search problems in the conditions of methodological training of the future mathematics teacher in the course of MTM. It consisted not only in the maximum development of the personality of each student, but also in overcoming the weaknesses (shortcomings) in the organization of educational and research activities of students and classes in MTM, the organization of homework, the formation of specific research skills of students.

A concrete expression of the successful implementation of the proposed methodology for the formation of research skills of students was the following indicators that characterize the readiness of the future teacher to implement in practice problem-based teaching of mathematics:

1) students ' understanding of the essence of problem-based learning, the problem situation, the problem-search problem;

2) the level of formation of the skills of the methodology developed by us.

The effectiveness of the implementation of the methodology developed by us was evaluated by the completeness and awareness of knowledge.

The measure for determining the amount of knowledge in the study was the standard of knowledge, which is a set of knowledge that reflects the content of the issue under consideration. The amount of knowledge and skills of students revealed during the experiment characterizes the amount of knowledge formed by students.

Awareness of knowledge was established by analyzing the control works performed individually. The measure to identify the formation of students ' research skills was the amount of time allocated for the performance of control work and the quality of its performance: completely and correctly; partially and correctly; incorrectly and not performed.

To assess the level of formation of skills, in accordance with the selected criteria, we allocated:

1. Low level (possession of a separate skill). It is characterized by the lack of the ability to perform a certain action that is part of this skill. This action is performed intuitively, without relying on special knowledge.

2. The average level, which is characterized by the fact that the action is not performed in full or insufficiently justified.

3. High level of proficiency in a particular skill. It is characterized by the fact that students are clearly aware of the performed action, skillfully operate with special knowledge.

At the beginning and at the end of the training experiment, students were offered a questionnaire.

Table 1. The results of the survey at the beginning were identical to the results of the first stage of the experiment.

Levels of formation ability	At the beginning of the training experiment				After the training experiment			
	Number of students		%		Number of students		%	
Low level	35	15	70	75	5	3	10	15
Average level	13	4	26	20	5	5	10	25
High level	2	1	4	5	40	12	80	60

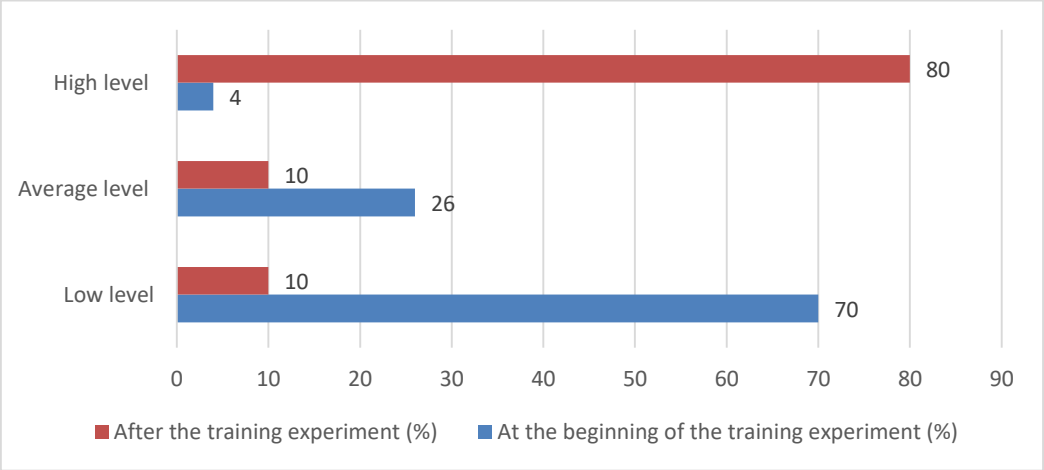


***Fig.1**. The results of the survey at the beginning were identical to the results of the first stage of the experiment.*

At the end of the experiment, the results were quite different. 82% of students answered the theoretical questions of the questionnaire completely and correctly.

68% of students responded positively to the question about their readiness to conduct problematic lessons. However, along with theoretical training, the students lacked practical skills. When organizing problem-based learning, students have the following difficulties: insufficient preparation of students for the perception of educational material in problem-based presentation, for the implementation of heuristic and research methods, lack of training time for the organization of problem-based learning.

The results of the control work indicate that most of the students have mastered a high level of formed individual skills included in research activities. Based on this, it can be concluded that most of the participants in the experiment have mastered the general ability to perform research activities.

Analysis of tests, questionnaires allowed us to conclude that the training developed our method gives better results than the conventional method.

First of all, let's see what changes have occurred in the activities of the future teacher on the organization of problem-based teaching of mathematics. The analysis of mass data at the stage of the ascertaining experiment showed that teachers, university teachers mainly use traditional training. The same was observed in students (during internship), part - time students prior to the beginning of the experiment. After the training experiment, most students began to understand the essence of problem-based learning, its elements, and the essence of the problem-solving task.

The experiment showed that the lessons of part-time students, students in the period of pedagogical practice, became diverse not only in content, but also in the organization of educational and research activities of students due to the use of the relationship between traditional and problem-based learning. All

this contributed to the activation of students ' activities, the formation of their positive motivation for learning activities carried out in the classroom and at home.

Discussion. Speaking about improving the professional training of future teachers of mathematics in the pedagogical university, M.Rodionov notes the need to introduce a new type of teaching - problem-based. The author considers the problem statement to be one of the most important regularities of the process of assimilation of new knowledge. Without this initial stage of problem assimilation, the process of creative thinking does not begin. However, the way of this regularity consists in the fact that problem assimilation develops the student's thinking not because the teacher poses a problem, but because the student solves it himself [7]. The author believes that in school practice, problem-based learning is sometimes reduced to the occasional statement of questions, the answers to which cause difficulties for students, although traditional teaching does not exclude the consideration of such questions. The organization of problem-based learning involves a qualitatively different interaction between the teacher and students and a specific construction of the educational material. The latter is based on the identification of the leading ideas of the course, their development, and the role of the "human factor" in this process. The most important moment of interaction between the teacher and students is the self-mastery of knowledge organized and led by the teacher. Students' cognition is carried out as a study in the process of intellectual educational activity.

J.Sitorus considers the three stages of the creative process from a general philosophical point of view, since they are the basis of any creative activity. The first stage of creative activity is the stage of awareness, formation, and problem statement. The second stage is the stage of the fundamental solution of the problem, during which the "key" to solving the problem must be found. The third stage is the implementation of a fundamental solution to the problem [8]. The author considers the stages of creative activity, which are very similar to the stages of problem-based learning, therefore, we conclude that the author considers problem-based learning as a type of developmental learning.

The study of psychological and pedagogical literature allows to state that traditional training in pedagogical universities do not focus on the formation of specific research skills of future teachers required to implement in practice the problem of teaching mathematics in the middle school, as in the scientific and methodological literature, manuals for teachers and students is not fully allocated to these skills and there is no method of their formation.

Conclusion. In the course of solving the tasks, the following results and conclusions were obtained:

In school textbooks of mathematics and textbooks on MTM, there are practically no problem-search tasks for students and students.

The main blocks of research skills of the future teacher necessary for the implementation of problem-based teaching of mathematics to secondary school students are identified and justified. It is shown that the system of problem-search tasks is the means of forming these skills in the course of MTM.

The basic principles of building a system of tasks focused on the formation of each block and each individual skill we have selected are defined. A system of problem-search problems in mathematics for students and students has been developed.

The method of formation of the selected skills on the basis of the corresponding system of problem-search tasks in the course of MTM is developed. It is experimentally confirmed that the proposed method allows improving the methodological training of the future mathematics teacher in the pedagogical university and improving its quality. Thus, we can assume that all the tasks set in the article have been solved.

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