Designing professionally oriented tasks in teaching higher mathematics

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Abstract. The introduction of new high technology in the development of the oil and gas complex significantly increases the requirements in the field of basic sciences for graduates of higher educational institutions of engineering profile. Therefore, consideration of a set of professionally oriented tasks in a mathematics course should not only establish connections with special disciplines and illustrate the effectiveness of mathematical methods, but also accumulate mathematical knowledge into a single whole, and correspond to the process of forming the basic personality characteristics of a future engineer. In this regard, this article is aimed at revealing the creative activity of students in teaching mathematics in the study and solution of professionally oriented problems and examples are given. To solve the tasks, the following methods were used: theoretical (analysis of psychological, pedagogical, scientific, methodological, scientific and technical literature on the problem of research); empirical (observation of students 'activities in the educational process; analysis of students' independent, control work; questionnaires); statistical (processing the results of a pedagogical experiment, their quantitative and qualitative analysis). The selection criteria and the functions of the POP in teaching mathematics of future engineers as a means of promoting the formation of students' creative activity have been developed and justified. The main stages, conditions and means of research and solutions of the postgraduate study have been identified in order to form students' creative activity. The materials presented in the article make it possible to develop and justify models and pedagogical conditions for the formation of creative activity of future engineers, to use in practice the methods of selection and research of postgraduate courses in teaching mathematics students of engineering specialties; The above technology helps to determine the features of the formation of creative activity of future engineers in solving the POT (professionally oriented tasks) in the study of technical processes and real phenomena as a means of integrating mathematical knowledge.

Keyword. Higher mathematics, creative activity of students, designing professionally oriented tasks.

1. INTRODUCTION.

Currently, throughout the world attention is mainly paid on modernizing the sphere of world mathematical education, improving the content of educational materials based on scientific facts and theories, training highly qualified, conscious, highly efficient specialists who are able to meet the requirements of rapidly changing times, ready in every way to compete. Many foreign research centers, in particular the USA, Great Britain, Germany, Spain, Italy and Russia, Singapore and South Korea, are considering ongoing work to improve the quality of teaching mathematics in support of modern education and digital technologies in leading scientific camps in developed countries.

The growing need of society for engineers who are able to creatively approach changes in the technologies of modern production, effectively and efficiently solve professional problems is due to the need to quickly and adequately respond to rapidly changing conditions of development of modern society.

As an academic discipline, mathematics has a huge humanitarian and applied potential, allowing not only its methods and means to identify the essential connections of real phenomena and processes in industrial activity, but also to develop the skills of future engineers in the mathematical study of applied issues, skills build and analyze mathematical models of engineering problems, develop intuition and reflection in the processes of forecasting and decision-making in conditions of uncertainty. This, in particular, is the basis for understanding the unity of mathematics, improving the quality of mastering its contents by future engineers, developing motivation and interest in mastering a future profession, and the need for engineering-oriented mathematical knowledge and methods [Zubova, 2009].

Observations during the experiment and the results of the questionnaire at the beginning of the first year of training of future engineers confirmed the fact that students at this stage are not yet convinced of the need for mathematical knowledge in their future professional activities. At the same time, teaching mathematics of future engineers carries a professional context: on the one hand, through the solution of applied problems by means of mathematics, mathematical knowledge is integrated, subject visualization of mathematical methods, on the other hand, natural science and special disciplines really interact with mathematics in the process of creative search for an adequate solution to problems.

G.A. assumes that the essence of the concept of “task” is used to refer to objects belonging to three categories:

1) to the category of the goal of action of the subject, the requirements set in front of the subject;

2) to the category of situation, which includes, along with the purpose of the condition, which it should be achieved;

3) to the category of verbal formulation of this situation [Ball, 1985, p.21].

G.A. Ball says that the concept of a “task” in the second category is prevalent in literature. For the objects of the first category, the wording “goal of action” or “task requirement” is more suitable. Definition A.N. Leontiev fits into the second category. For the designation of objects of the third category with reference to the "formulation" of the problem [Trofimova, 2000, S. 52].

From the foregoing, we can conclude that there is no single interpretation of the concept of “task”, and it is not possible to identify the general essence of the concept of “task” due to the different approaches of the relationship between the student and the task.

L.M. Friedman says that in the process of solving the problem "to find such a sequence of general principles of mathematics (definitions, axioms, theorems ...), applying which to the conditions of the problem, we get what is required in the problem - its answer" [Friedman, 1970, p..153].

A.M. Matyushkin, by solving a problem, means a system of transformations of the conditions of the problem to achieve the desired desired [Matyushkin, 1972, p.20].

In the process of solving, the main structures (stages) should be distinguished. To resolve this issue, there are various approaches to this problem. A.M. Matyushkin in solving the problem identifies four main stages in solving the problem:

1) a “closed” solution, i.e. the use of known methods of solution;
2) the stage of "open" decision - the search for new ways to solve the problem, the principle of action;
3) implementation of this principle;
4) checking the correctness of the obtained solution [Matyushkin].

P.M. Erdniev identifies the following interconnected and sequential stages:

1) drawing up a mathematical problem;
2) performance;
3) verification (control) of the response;
4) the transition to the next task [Erdniev, 1970, p. 54].

D. Poia identifies his structure in the process of solving the problem:

1) understand the proposed task;
2) find the path from the unknown to the data, if necessary, by considering intermediate tasks (“analysis”);
3) realize the found idea of a solution (“synthesis”);
4) the decision to check and critically evaluate [Poia, 1991, p.21].

Almost all authors propose to verify the correctness of the obtained solution as the solution structure, and this is precisely the specificity of the engineers: to bring the solution of the problem to the final result and to check the adequacy of the received answer.

G.S. Altshuller considers the simplest methods (methods of solving) inventions: analogy, inversion, empathy, fantasy.

An analogy is the search for an object that is more convenient for study. An analogy, according to G.S. Altshuller, a plentiful source of new ideas, but it cannot be used blindly [Altshuller, 1979, p.30]. An analogy should be used when:

• clarification of the basic principles and design features of the investigated object,

• identifying the leading area of a real phenomenon or process by the function that this object performs,

Inversion means doing something the other way around, for example, swapping, instead of vertically arranging horizontally, etc.

The author considers various types of inversion:

1. Functional inversion means replacing a function or action with the opposite, for example, compress - stretch, etc.
2. Structural inversion consists in changing the structure of a phenomenon, for example, a continuous function - a discrete function, etc.
3. Inversion of form is to change the shape of the studied object, for example, rough - smooth, etc.
4. Parametric inversion, changing the parameters of the studied object to the opposite, for example, long to short, etc.
5. Inverse connections mean a change in the connections of the studied object to the opposite, for example, a positive connection - a negative connection.
6. Inversion of space means a change in position in space, for example, a change in position in space by 90 °, etc.
7. Time inversion means a change in the process time, for example, a fast process to a slow one, etc.

D. Poia proposes to use a “fluid” rather than a “hard” solution plan when solving a problem, to use plausible reasoning rather than rigorous evidence to prove it. He believes that one must learn to guess, draw analogies [Poia, 1991, p.85].

Functions of tasks: teaching, developing and educating are determined by the goals of mathematical education. The leading goal of the tasks is

"The expansion and complication of individual intellectual resources of the individual by means of mathematics" [Lebedev, 1984, p.45].

As a rule, when teaching mathematics, we solve not one, but a whole complex of problems, which happened in our case. Classifications of tasks are relative. Many methodologists and psychologists dealt with the problem qualification problem, each author made his own innovations in the classification of problems, showing various approaches, for example, D. Poia [10], proceeds from the nature of the requirements of the tasks and subdivides them into tasks:

- to find;
- for proof.

Everyone who solved the problems knows that in the process of solving even simple problems, creative activity manifests itself in the fact that various hypotheses are put forward, various ideas are generated, analyzed, which, in essence, represent the formulation of tasks. They are not the goal in solving the original problem, they do not follow from the statement of the original problem, however, most often, you can not do without the tasks compiled. The simplest example is provided by the stereometry, which is studied in high school: each stereometric problem consists of several planimetric problems, which the student himself invents and solves them himself.

Other authors classify tasks according to their location in the learning process, for example, Yu.K. Considering educational activities, Babansky shows the existence of the following components: organizationally-effective, stimulating, and control-evaluative [Babansky, 1978, p.40].

Summing up the question of various approaches to the essence of the concept of “task”, classifications and functions of tasks, we can conclude that the main role of tasks is to develop logical creative thinking, and in our case, it is an effective tool for shaping students ’creative activity.

In this regard, we agree with the statement of M.N. Skatkina "... problem solving is one of the means of mastering the system of knowledge and skills in a particular academic subject and, at the same time, promotes the development of independent creative thinking" [Skatkin, 1980, p.20]. However, in our work we consider not just tasks, but tasks, the plot of which contains a focus on future professional activities.

- Next, consider professionally oriented tasks. What are the approaches to the essence of the concepts of “professionally oriented task”, “applied task” and “practical task”.
- A.A. Under the “applied problem”, a joiner considers a problem posed outside mathematics and solved by mathematical means [Stolyar, 1986, p. 89].
- N.R. Kolmakova and R.A. Meyer classifies applied problems that differ in the requirements for students during the solution of a problem:
- At the first level, students are given a mathematical model of the applied problem and contain all the values of the conditions included in it. Students need to research the resulting mathematical model and interpret the results obtained in the context of the original problem.
- At the second level, students are given in the condition a mathematical model in which it is necessary to calculate the parameters available in it.
- At the third level, students are tasks in which it is necessary to transform the mathematical model in order to get a convenient view for its study.
- At the fourth level, students themselves need to build a mathematical model of the applied problem, which lists all the necessary data that can be found in this problem.
- At the fifth level, students need to independently build a mathematical model of the

applied problem, in which all the necessary data is presented, but what the student must think of in this problem.

• At the sixth level, students need to build a mathematical model themselves, deal with the condition and question of the problem, how accurately it is necessary to get the result, interpret it in the language of the original problem [Kolmakov].

Analyzing the levels of N.R. Kolmakova and R.A. Mayer, we can say that in this work, the teacher presented requirements for the formation of students 'creative activity at all six levels, but only the last four give the student a way out of the" regular "situation, which the teacher focused on students.

When solving the applied problem Yu.M. Kolyagina offers three components:

1) building a mathematical model (drawing up an equation) of a real situation;
2) study of the constructed model by means of mathematics (solution of the equation);
3) interpretation of the result with the original problem [Kolyagin, 1977, p.70].

A different scheme for solving the applied problem is proposed by Yu.F. Fomin:

1) the study of the conditions, requirements, characteristics of the real process;
2) building a mathematical model of the original problem;
3) building a new model, different from the mathematical one, using numerical methods;
4) the study of this model, i.e. obtaining a numerical result of a mathematical model;
5) interpretation of the result, verification of the adequacy of the real initial process [Fomin, 1990, p.7].

To summarize the analysis of the concepts of applied and professional orientation. Thus, using the term "applied orientation", as a rule, they mean "professional orientation" [Khudyakova, S. 43]. We distinguish between these concepts, because an applied problem, uses a mathematical apparatus in its solution, but it may not have any application in future professional activity, unlike a professionally oriented one.

In our work, we use professionally oriented tasks when teaching the course "Higher Mathematics", which are a means of shaping the creative activity of students. By the term "professionally oriented task" we mean some abstract model of a real situation that arises in professional activity and is solved by means of mathematics, in the plot of which lies the possibility of varying the conditions, procedures, and result.

■ Varying the conditions, results and procedures of a professionally oriented task activates the students' mental activity.

■ To distinguish our tasks from the whole variety of professionally oriented tasks, it is necessary to determine their functions of professionally oriented tasks:

■ development of professional motivation;

■ identification and updating of mechanisms for integrating mathematical and specialized knowledge;

■ improving the skills of self-control and reflection of behavior;

■ the formation of intellectual susceptibility, flexibility, mobility of thought as manifestations of students' creative thinking;

• Carrying out the analysis of the above functions, we also identified the criteria of professionally oriented tasks:

• the presence of an engineering and technical (natural science) plot of the problem in the context of a professional orientation;

• the mathematical tools and methods for solving REF mainly should be in the field of the actual experience of the personality of the future engineer;

• the complexity of the applied mathematical knowledge, methods and procedures based on "analysis through synthesis";

• reproducibility in sufficient variability of the content, means and methods of solving REF to ensure the work of students in small groups;

• the presence of elements of novelty and amusement in the plot of the problem as favorable factors for awakening students' interest in mathematics and motivating their creativity.

For the formation of students' creative activity during the resource interaction, in our methodology, as already mentioned, at the initial stage there should be student presentations with research projects. Students are given the topics of reports in advance, they prepare material on this topic, and make a presentation at the beginning of the resource lesson. The research project examines great discoveries in historical aspects that have a connection and influence on the future professional activities of students, and how the mathematical apparatus was used to discover them. The essence of research projects is as follows: together with students, samples of creative activity are analyzed, i.e. examples of how prominent scientists “made discoveries”, what preceded and contributed to this discovery, etc. With the independent development of a research project, creativity is a link and a mechanism that integrates mathematically and special knowledge of students substantively, motivates students to be creative.

Thus, the development of a complex of professionally oriented tasks in resource classes in the process of teaching mathematics will be an effective means for the formation of creative activity of future engineers.

The objectives of the test experiment will be as follows:

-show the significance of the essence of the design of teaching materials in higher mathematics taught in oil and gas specialties.

-integration of pedagogical, psychological, didactic and methodological foundations for designing professionally oriented problems in higher mathematics in the minds of professors, teachers and students.

- a study of the views of professors and teachers on improving the design algorithm of professionally oriented tasks in higher mathematics was conducted.

Stages of students' creative activities in the resource lesson.

Consider the stages of students' creative activities in the resource lesson.

At the first stage of creative activity, students come up with research projects prepared in advance (including using information technologies), which show in detail the samples of scientists' creative behavior: as in history and genesis, a discovery was made in engineering technical (natural science) field, as this discovery was justified by means of mathematics. Thus, students get samples of solving problems with analysis and features of creative solutions.

At the second stage, the problem is analyzed together with the students: a plan for solving the problem is built, a mathematical model is built, while isolating what is given and what needs to be found, the condition of the problem is translated into the language of mathematics, the integration of mathematics is updated, ICT capabilities are analyzed - support tools, build a sequence of actions, a reconciliation graph is built, and verification forms are thought out that guarantee exclusion of extraneous decisions. There is an extension of the hypothesis.

The ability to put forward hypotheses is an important skill contributing to the formation of creative activity. When researching and solving a professionally oriented problem, the following processes of thinking arise: abstraction, comparison, analysis and synthesis, generalization, through which the student poses and solves the problem (isolates its conditions and requirements, correlates them with each other, reveals the desired, etc.) An important role is played by question-answer procedures.

At the third stage, students in small groups, having varied the conditions of the problem, solution methods, analyzing the results, get a cycle of new REF. This is how a vision of a new problem occurs in a familiar situation based on the actualization of students' creative potentials. Such a feature of creative activity as a vision of a new problem in a familiar situation includes the ability to reveal new aspects of a familiar object. The solution of new problems proposed by students is built on the basis of the already solved initial problem. The transfer of solutions involves analytical and synthetic activities, which are based on generalization and analogies, visualization and association, revealing significant relationships. In a small group, students, based on the distribution of role functions, update such creative activities as creating non-standard situations using the brainstorming method, the method of control questions, the trial and error method, the method of morphological analysis [Efimovich, I.A., 2004] and etc.

Here, the personal aspect of thinking is the motivation and abilities of a person (i.e., his attitude to the problem being solved, to other people, etc., in which his awakenings to mental activity and his mental abilities are manifested and formed). This corresponds to the approach of DB Epiphany about the three-dimensionality of the creative process: objectivity, sociality and personality.

The fourth stage is the presentation of the decisions made by students in small groups, conclusions are drawn about the results obtained when solving a professionally oriented problem, analysis of generalizations, reflexive control, assessment and correction of results.

V.V. Afanasyev believes that in the formation of creative activity, self-analysis of students' own intellectual actions is necessary. With the help of such an analysis, self-control and self-assessment of the work done are carried out, rational structures of the creative process are fixed. Self-esteem of one’s actions (student’s reflection of one’s actions) is characterized by students' awareness of all components of educational activity:

1. An individual's awareness of REF (What is REF? How can I research and solve REF?).
2. Awareness of the purpose of educational activities (What did you learn today? What goals did you achieve in the lesson? What can you learn by solving and exploring the posture? Evaluation by the student of the results of the activity depending on the implementation of its goals).

Evaluation by students of methods of activity specific and invariant with respect to various academic subjects (understanding of general methods of action; the student’s ability to distinguish the general, invariant in various academic subjects, in the study of posture, awareness of specific operations necessary for solving and research REF.) [Afanasyev, V.V., 1996].

When working with a task, three characteristic features can be distinguished.

The first characteristic feature characterizes the level of formation of a student’s creative activity, his motivation and his own goals. In this case, the student realizes his creative potential if he brings creative content to the process of research and solving a professionally oriented task.

The second characteristic feature is the presence of a problem, because students in groups are invited to change the condition of the problem in order to receive new tasks. Students work in small groups and are based on the principles of autonomy and communication. Autonomy includes an independent statement of the problem for each student in isolation and the way to solve it; initiative in the decision; ability to accept responsibility; self-control, analysis and evaluation of their own creative activity; ability to reason independently; the degree of understanding of the connection of a professionally oriented task with future professional activity. Communicativeness is manifested in the ability to cooperate between students in a group, in the psychological compatibility of students, in the independent resolution of emerging conflicts in a group, etc.

The third characteristic feature is the creation of a student's own educational product (independent solution of a problem new to students, in the process of changing the initial conditions, an original new way to solve the problem, own generalization of this problem, etc.).

With the help of certain conditions and means, prerequisites for the manifestation of creative activity are created, its correction is carried out, the motives of creativity are formed and fixed.

Example: Stages of designing professionally oriented tasks. Theme of the lesson: Differential equations.
Consider a horizontally located beam of constant cross-section, made of a homogeneous material. Suppose that under the influence of forces that act on the beam in a vertical plane containing the axis of symmetry, the beam bends. Find the equation of the elastic line.

Stage 1. The lesson begins with a student's presentation on a research project on the topic "Mathematical and Mechanical Problems in Huygens's Pendulum Clock", including the use of information and communication technologies. Students are discussing a sample of solving engineering, technical and natural science problems with an analysis of the conditions and features of creative solutions, the genesis of the problem, personal experiences and insights of scientists.

Stage 2. Further, the students are updated with the mathematical and special knowledge necessary to solve a professionally oriented problem.

Consider a horizontally located beam AB (Figure 1) of a constant cross-section made of a homogeneous material. The axis of symmetry of the beam is indicated in figure 1 by a dashed line. Suppose that under the influence of forces that act on the beam in a vertical plane containing the axis of symmetry, the beam bends (Figure 2).

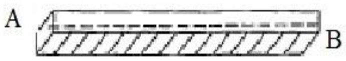

Figure 1.

Figure 2.

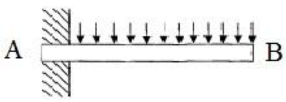

Figure 3.

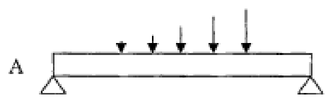

Figure 4.

Acting forces may be due to the weight of the beam, externally applied load, or both forces together. It is clear that under the action of forces the axis of symmetry will be bent. Typically, a curved axis of symmetry is called an elastic line. Determining the shape of this line plays an important role in the theory of elasticity.

Note that there are various types of beams depending on the methods of their fastening or support. For example, Figure 3 shows a beam whose end A is rigidly fixed and the end B is free. Such a beam is called a cantilever beam. Figure 4 shows a beam lying freely on the supports A and B. Another type of beam with supports is shown in Figure 5. There are various ways of applying external loads. For example, Figure 3 shows a uniformly

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distributed load. Of course, the load can be variable along the entire length of the beam or some part of it (Figure 4).
Figure 5 shows the case of concentrated load.

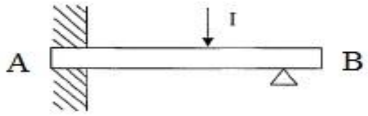

Figure 5.

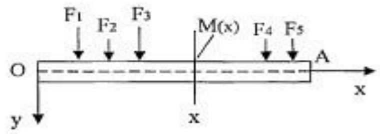

Figure 6.

Consider the horizontal beam OA. Let its axis of symmetry (indicated by the dotted line in the figure) lie on the x axis, where for the positive direction it is chosen to the right of O, which is the origin.

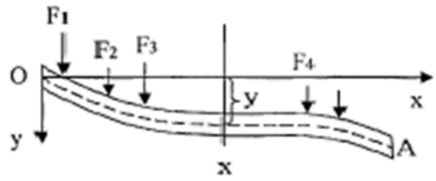

Figure 7.

For the positive direction of the y axis, we choose the downward direction from the point O. Under the action of external forces Ft, F2, ... (and the beam weight, if it is large), the axis of symmetry is bent in the elastic side, which is shown in Figure 8 dotted.

The displacement of the elastic line from the x axis is called the deflection of the beam in x position. Thus, if the equation of elasticity of the line is known, then one can always indicate the deflection of the beam.
We denote by M (x) the bending moment in the vertical cross-section of the beam with the coordinate. A bending moment is defined as the algebraic sum of the moments of forces that act on one side of the beam in position x. When calculating the moments, we assume that the forces that act on the beam from the bottom up give negative moments, and the forces that act from top to bottom give positive moments.

The bending moment in position x is related to the radius of curvature of the elastic line by the relation

$$EJ\frac{y''}{[1+(y')^2]^{3/2}} = M(x) \qquad (1)$$

where E is the Young's modulus of elasticity, which depends on the material, J is the moment of inertia of the beam cross section in position x relative to the horizontal line passing through the center of gravity of this cross section. The product EJ is commonly called bending stiffness; its value in the future will be considered constant.

Now, if we assume that the beam only bends slightly, which is often the case in practice, then the angular coefficient y 'of the elastic line will be very small, and therefore, instead of equation (1), we can consider the approximate equation

$$EJ_{min}y'' = M(x) \qquad (2)$$

Then, students, together with the teacher, are invited to solve the following problem, while setting and finding a solution are updated.

Oriented tasks with fixing the necessary steps: collecting and analyzing data, the emergence of hypotheses, analysis of the capabilities of ICT support tools (solve differential equations in MathCAD).

Problem 1: A horizontal homogeneous steel beam of length, freely lying on two supports, bends under the action of its own weight equal to kgf per unit length. It is required to find the equation of the elastic line.

Analysis of the solution of the problem (the solution is considered with all students):

The mathematical formulation of the problem.

From a mathematical point of view, we have the Cauchy problem

$$\frac{d^2y}{dx^2} = \frac{M(x)}{EJ} \qquad (3)$$

for example, under the following initial conditions:

Solution:

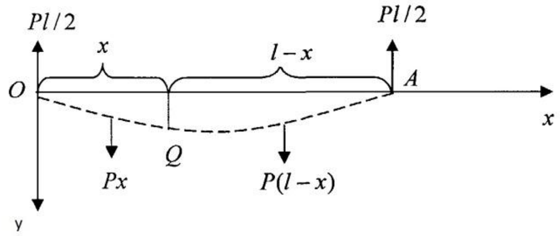

Figure 8.

The differential equation has the form:

$$EJy'' = \frac{px^2}{2} - \frac{plx}{2} \qquad (4)$$

We use the conditions at the ends of the beam:

$$y(0) = 0,\ y'(0) = l \qquad (5)$$

We get the answer:

$$y = \frac{p}{24EJ}(x^4 - 2lx^3 + l^3x) \qquad (6)$$

- Stage 3. The teacher asks the question: what can be changed in the task to obtain a cascade of tasks? This is the third stage of creative activity. Students offer various options and as a result, together with the teacher, it is concluded that there are components in this task:
- objects (beam; 2 supports; acting forces),
  - relations (at the ends of the beam is supported by two supports),
  - properties (stable supports; gravity).

We change one property: the action of external forces. We get the following problem.

Task 2: Determine the curve of the bend of the bar, resting on two supports and subjected to the pressure of water, the level of which falls against the upper support (dam).

Decision:

We get the differential equation:

$$y'' = \frac{-k}{6EJ}(x^3 - l^2x), \qquad (7)$$

Using conditions

$y(0) = 0,\ y(l) = 0$ (8)

Whence finally $y = \frac{-k}{6EJ}(3x^5 - 10l^2x^2 + \frac{7}{4}x)$ (9)

By changing the properties we get several tasks.

Stage 4. At the fourth stage of creative activity, the truth of the hypotheses is evaluated; generating conclusions in accordance with the results of verification; applying conclusions to new data; generalization analysis and reflexive control; verification of results.

3. RESULTS AND DISCUSSIONS.

The hypothesis of the study was that if the process of teaching mathematics in technical specialties will be based on the processes of updating and implementing mechanisms for integrating mathematical knowledge and research of professionally oriented problems, a set of principles for building and implementing a methodological system for teaching mathematics will be updated: accessibility, visibility of modeling, variability, professional orientation, subject-information richness, if the stages of formation and levels of formation and development of the future engineer's creative activity are updated and justified, then the process of forming students ' creative activity will be successfully carried out in the process of teaching mathematics while researching and solving professionally oriented problems.

Experimental verification of the hypothesis of this study was carried out in three stages.

At the first stage, empirical material was accumulated on the basis of generalization of practical experience. The study and analysis of psychological and pedagogical, scientific and methodological literature on the research problem were carried out, the purpose, object, subject, tasks, and working hypothesis of the research were determined.

The second stage was carried out theoretical development of the dissertation problem; identified and justified the key factors, components and levels of creative activity of future engineers; developed criteria for the selection of POT(professionally oriented tasks) and methods of resource interaction mathematics and engineering disciplines cycle; conducted search and ascertaining experiment, which sets the levels of integration of mathematical knowledge; developed and theoretically justified methods of design and research elements of the integrated system in the process of learning mathematics, corrected the methodological sequence of learning identified the didactic elements of the integration line of a course of mathematics and engineering disciplines in the process of formation of creative activity of students.

The third phase comprised a formative experiment, whose main task was the experimental check of pedagogical conditions of model of formation of creative activity of students; analyzed the results of the experimental implementation of the developed set of POT(professionally oriented tasks) in the teaching of mathematics, compared empirical data for the experimental and control groups were made relevant conclusions and analysis statistical methods the results of the experiment, processed the text of the article.

The search-forming experiment was conducted in the first and second years of two groups of the specialty "Launch of oil and gas fields" of Karakalpak state University. The experiment was carried out during the first and second years of study (II — IV semesters), and consisted of the introduction of a cycle of eight resource classes based on expanding the didactic field of mastering the basic concepts and procedures of mathematics. The basis for the application of professionally oriented tasks is the method developed and described by the author in the second chapter for designing and researching POT in the process of teaching mathematics in order to form the creative activity of future engineers.

4. CONCLUSION.

In the course of the scientific and methodological analysis, the functions and selection criteria of professionally oriented tasks are specified.

Functions of professionally oriented tasks:

■ development of professional motivation;

■ identification and updating of mechanisms for integrating mathematical and specialized knowledge;

■ improving the skills of self-control and reflection of behavior;

■ the formation of intellectual susceptibility, flexibility, mobility of thought as manifestations of students' creative thinking;

• The following selection criteria are highlighted as the main ones:

• the presence of an engineering and technical (natural science) plot of the problem in the context of a professional orientation;

• the mathematical tools and methods for solving REF mainly should be in the field of the actual experience of the personality of the future engineer;

• the complexity of the applied mathematical knowledge, methods and procedures based on “analysis through synthesis”;

• reproducibility in sufficient variability of the content, means and methods of solving REF to ensure the work of students in small groups;

• the presence of elements of novelty and amusement in the plot of the problem as favorable factors for awakening students' interest in mathematics and motivating their creativity.

6. The following pedagogical conditions for the formation of creative activity of future engineers in the process of training topics:

• the presence of a creative environment;

• low degree of regulation of behavior and the availability of subject-information enrichment;

• information and technological support for students' creative activity at all stages of teaching mathematics using the knowledge base.

7. Identified on the basis of constructing a didactic model of creative activity of students, that the formation of creative activity students on the basis of the introduction of the complex POT(professionally oriented tasks) in the design process learning and implementation of resource classes in the framework of mastering the course of higher education subjects passes a series of successive stages of activity:

• motivational value

• preparatory

• substantive research

• estimated.

The level of students in the experimental group after using the POT complex (at the end of the fourth semester) is statistically significantly higher than the level of motivation of students in the control group.

Based on the results of calculations, we can conclude that the complex of POTs statistically significantly positively affected the level of knowledge acquisition by students of the experimental group.

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