

# Task Approach in the Bachelors' Professional Competence Formation

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**Abstract.** The paper reveals the ways and means of improving the quality of training graduates in the field of "Oil and Gas Business" through a competence-based approach implementation to the content of vocational education modernization. The article provides a rationale for the expediency of using the task approach in the formation of professional competencies among students of a technical university and reviews the experience in implementing this approach. The authors emphasize the importance of the "mathematics" discipline as a basis for vocational training, special attention is paid to defining the types of competencies and general of bachelors' professional abilities formation, with an emphasis on reflecting the problems encountered in organizing educational material in accordance with the requirements of the 3rd generation state educational standard. This article analyzes the basic concepts of "task" and proposes the authors' understanding of the term "task". The authors presented the experience of developing practice-oriented tasks for students of a technical university. The experience this technology implementation in the study of "Mathematics" in the oil technical university in accordance with the requirements of third-generation standards is described. Special attention is paid to the technology of professional competencies of students of a technical university formation. This article describes the stages of the learning process organization when implementing the technology of the task-based approach to learning. Specific examples of organizing the methods of the professional competencies formation are considered. The authors reveal the essence of the mathematical task as the main means of forming the competence of technical university students, show the relevance of using task approach in the learning process and suggest a specific method of key competencies forming through technological problems solving.

## 1. Introduction

The need to re-think engineering education called forth by the reforms that have been carried out in the Russian Federation since the last century, especially in the fields of economics, science and education. In V. Putin's article it stated that "We need a new economy": It is understood that the future of Russia is connected primarily with engineering and therefore with engineering education.

The education system has been repeatedly reformed in Russia in the last decade. The subject of change in engineering education is the competence that a graduate with a bachelor's or master's degree should obtain. In Russian educational curricula, competences are divided into general cultural competences (GC), general professional competences (GPC) and professional competences (PC). General cultural competences includes the ability to synthesize, analyze, obtain information; set goals

and choose how to achieve them; to carry out activities on the basis of socially accepted moral and legal norms. Professional competences include both specific knowledge and skills and activities: the ability to collaborate and manage a team, to function in interdisciplinary projects. The structure of higher education in Russia is linear, that is, the courses that the student will study and their sequence are initially known. This approach allows us to answer the question: “What should a student know and be able to do after graduation from a university? And how to form common cultural competence, professional and social skills through the study of specific subjects?”

## **2. Relevance of scientific significance**

The process of mathematical competence of future engineers formation determines the preparation of their technical activities related to the ability to solve real production objectives. The concept of "task" is one of the fundamental concepts of mathematics. Currently, there are different approaches to the interpretation of this concept. In the most general sense of the problem can be interpreted as a goal that must be achieved, as a matter that requires solutions using certain knowledge. Analyzing various interpretations of the definition of “task” we can see that it is largely determined by the relations between the concept of subject and the concept of task. Proponents of the interpretation of the task as a situation in which the subject must act, clearly include it in the very concept of the task. Yu. M. Kolyagin, and G.I. Sarantsev in their works note that there is no task without a subject, that for some people the condition is a task, for others it may not be [1]. L.M. Fridman defines the task as a model of a problem situation, expressed with the help of some artificial and natural language signs, and he considers the problem situation as the source one. A. M. Leontiev considers a problem in which all components are mathematical objects solvable by the mathematical apparatus [3].

Summarizing, we can draw a conclusion that the idea of the tasks depends on the field of knowledge that it reflects. When using this term, it is necessary to indicate what content is attributed to the concept “task”.

The main feature of the task is the temporary absence of ways to solve it, i.e., the lack of a logical sequence of certain operations in the mind of the student that connects the condition of the task with its requirements [4,13,15].

S.F. Dorofeev considers the task as a specific situation of the subject-the object category, which must be resolved taking into account the conditions specified in it.

The authors of this article are of the point of view of Yu.M. Kolyagin, G.I. Sarantseva, L.M. Friedman, S.N. Dorofeev and understand a task as the activity of the subject as a system of problem-solving processes, consisting not only of normative, but also of creative components of activity, not only presented from the outside, but also related to the aspirations of his personality.

Basing on the foregoing, we believe that the formation of professional competence is possible through tasks solving that are a synthesis of subject and professional prerequisites.

We have made a certain contribution to the discussion on the implementation of the competence-based approach principles in bachelors of technical specialties training.

Obvious problems on the basic educational programs of bachelors’ implementation, i.e. of learning process in the language of competencies are:

- lack of methodological tools to form and evaluate the competencies of graduates;
- development and implementation of a system of objective diagnostic educational procedures.

## **3. The objective of the research**

The objective of the research is to propose a solution to the problem associated with the formation and assessment of the acquired competencies level in the implementation when mastering the educational program of a bachelor 21.03.01. “Oil and Gas Business”. Study is conducted on the example of mastering the subject of “Mathematics”. We consider the informative models of the process of forming and evaluating the most significant general cultural and professional competencies GC-1; GC-7; GPC-2; PC-25 [7].

We believe that the methodology of students training of mathematical models of professional problems solving should be implemented in stages; namely:

- in the first stage, algorithmic tasks should be solved;
- in the second stage, it is necessary to consider problems at the heuristic level, aiming at the formation of skills technological problems solving;
- in the third stage, it is necessary to use tasks which are focused on the formation of skills to solve applied, practical problems at a generalized level.

The task approach in the competence approach implementation is combined with a synergistic approach. Synergetic, as noted by V. Milushev, shows that the path to the future for complex non-linearly developing systems, such as future professional activities, is not always the only one [6, 14]. Thus, the organization of training in the context of a synergistic approach leads to the self-learning ability of the “how” type formation. The degree of student’s cognitive independence, his ability to use fundamental knowledge in professional activities depends on whether the following skills are formed:

- 1) to see the problem in the task and be aware of it;
- 2) to formulate ways to solve this problem;
- 3) to justify ways to solve this problem;
- 4) to put the found solution into practice.

Such skills can be mastered in the process of mathematics teaching on the basis of a methodical system aimed at the professionally-oriented skills formation. The mathematical system built by us corresponds to the basic principles of synergy, since along with the characteristics of free self-development, self-organization, viability, the characteristics of imbalance, instability, nonlinearity etc. are necessary for it.

The solution of professionally-oriented tasks pushes the student to the bifurcation point, gives impetus to the search for a way out of the previous, sustainable knowledge to the new, and this is the way of self-development.

In our opinion, it is the task approach in teaching mathematics that contributes to the development of synergistic actions among students due to their desire to improve their knowledge with their own abilities.

Synergetics provides an opportunity to reformulate the issues, redesign the problem, thus allows for the high-quality training of students.

Let us dwell in more detail on the technology of GC-7 competence “to master the methods of solving educational and cognitive problems, making decisions in unusual situations, and the skills of planning one’s cognitive activity” forming.

Process organization: solving a technological problem, for example, after studying theoretical material on probability theory [7, 15], the following tasks are proposed: “6 wells are being drilled simultaneously in the oil-bearing region. Each well opens the fields independently of the others with a probability of 0.1. What is the probability of opening a deposit? How many wells need to be drilled, so that the probability of opening a field exceeds: a) 0.7; b) 0.8; c) 0.5; d) 0.9?”

Training technique:

The main stages of organizing training for the business game scenario “Conditional probability. The likelihood of at least one event from the full group of events”

Stage I Checking and consolidating the level of students’ knowledge on issues related to the content of this topic.

Stage II. The choice of formulas and methods of solution. Group discussion of the problem solution in groups. (The division of participants into small creative groups (3-5 people), each group solves its own version).

Stage III. Solution of the problem in small groups, preparation of speeches for discussion of the solution of the problem. Monitoring the work of each participant with the explanation of grades for individual work.

Stage IV. Solution of the sub problem: to evaluate the influence of one of the criteria for the probability of a deposit discovery. Discussion of results with scoring.

Stage V Summing up the game, the analysis of mistakes, explaining the reasons for issuing incentive and penalty points. Discussion of the resulting final grades.

The formulation of tasks of this type makes it possible, basing on the available theoretical knowledge to find ways of their concrete solution and the competences formation.

Another method of the GPC-4 competence forming “to master the methods of constructing the simplest mathematical models of typical professional” is to carry out laboratory works in the form of technological tasks [7, 8, 11]; using a software package for performing and analyzing the results of computational experiments, such as: “On the basis of the geological data of the Bavly oil field, calculate the oil reserves and changes in the average reservoir pressure within the oil reservoir”.

Training technique:

Stage I: study the results of geological surveys and determine methods for carrying out calculations;

Stage II: solve the problem using the MathCAD package.

Stage III: prepare an analysis of the results and prepare a report of small groups.

The methodological value of performing tasks of this kind lies primarily in the fact that students form not only stable mathematical knowledge, but also the ability to apply problem-solving methods in real situations.

Thus, as our experience and special literature analysis show, in order to form professional technical competence of students by means of the mathematics discipline, it is necessary more actively use the task approach, allowing students to form the ability to solve professional problems through mathematical modeling, the ability to establish links between mathematical knowledge and course content special disciplines.

The implementation of this technology allows us to motivate students in such a way that they are engaged in the subject area not only in the classroom time, but outside as well.

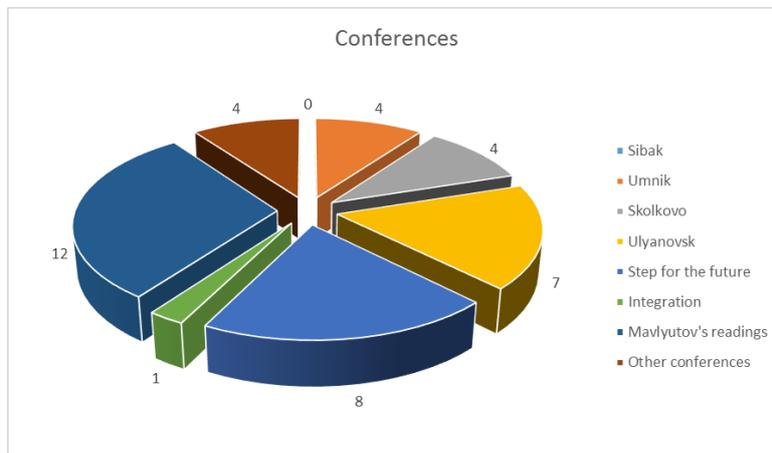
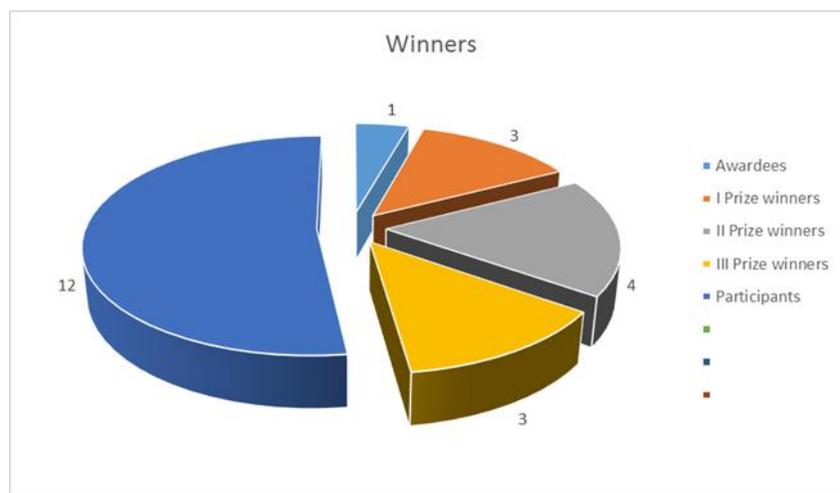


Figure 1. Results of student participation in various competitions.

#### 4. Conclusions

The use of modern technologies in the organization of students’ educational and research activities contribute to increasing the learning motivation and attracting more participants to joint research activities, which is the main factor in the formation of professional competence of a university graduate.



**Figure 2.** The results of student participation in various competitions in 2018-19 academic year.

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