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Ways of Students Training Aimed at Analytical Skills Development while Solving Learning Tasks

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Abstract

The article considers the problems of students training to solve learning tasks in technical universities, as well as training of high-school students, who are going to enter technical universities. The functions of tasks, causing the importance of their application in learning process, are specified. The system of methods is given which allows a successful development of analytical skills of students during solving physics and chemical problems. The features of analysis during solving physics and chemical problems are demonstrated. Results of experimental work, supporting the effectiveness of the stated methods, are given herein.

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Keywords: Activity approach; generalized plan; analysis; method of actions; orientation in the problem structure.

1. Introduction

Physics and chemistry are the basis of natural sciences. Here the main component of learning process, not only for physics and chemistry, but for exact sciences learning in general, is the problem solving.

During solving various problems a student performs thinking actions, going from knowledge of law formulations and initial conditions of the researched process to establishing the interrelations between the known and unknown characteristics of the process, explanation and quantitative evaluation of the result.

Thus, the problem solving process facilitates the deeper comprehension of obtained knowledge and formation of a comprehensive idea of reality. The skill of problem solving is a professional quality required for any engineer and

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the best criterion for evaluation of degree of material learning and mastering.

Problem solving allows: - understanding and learning the basic laws and equations, forming of the idea about their peculiarities and boundaries of application; - developing the skills and ability to use general laws for solving specific and practical tasks.

2. Subject and method of research

Many researchers, not only in Russia, but also foreign authors devoted their researches to the problem of formation of thinking activity and methods during learning problems solving (Gavrin, 2008; Redish, 2003; Schmitt & Lattery, 2004).

Analysis of tasks application for studying natural science disciplines allows specifying their main functions: - cognitive, it allows expanding the student minds, using the facts about life and activity of scientists, interesting facts, related to physical phenomena and chemical objects; - developmental, it consists in improvement of skills of working with various types of information display (tables, figures, graphs, diagrams, etc.), as well as development of logical thinking, as problem solving involves such logical operations as analysis, synthesis, comparison, abstraction and generalization; - function of theory and practice unity, expressed in developing skills to apply laws of physics and chemistry to solving practical tasks in professional activity, as well as in everyday life; - function of demonstration of interdisciplinary connections of physics, chemistry, mathematics and professional disciplines; - function of knowledge quality evaluation. Correctness of problem solving allows reflecting the objective level of material learning and testing how well it had been mastered.

The given functions show how important the problem solving process is for natural sciences learning.

3. Survey Results Analysis

In our view, training of both school and university students to solve problems in physics and chemistry should be based on activity approach. As Atanov (2001, p. 25) writes, namely this approach, based on "… problem solving, … allows organizing the student activity clearly and effectively". The process of problem solving is the process where methods of actions are mastered, and knowledge is learnt by the students in the process of applying the knowledge, that is during the process of problem solving. The method of teaching the physics problems solving, based on activity approach, developed for high school students and pre-entry course trainees is successfully used for students as well, and what is important – it helps obtaining good results during training (Politsinsky, 2007).

This method includes the following stages: 1) preparatory; 2) algorithm development for this type of problems; 3) diagnostics and teaching of undeveloped actions; 4) solving of problems; 5) testing and reflexive (Politsinsky, 2007).

During the researches the learning activity design was based on diagnostics of difficulties experienced by the students during problem solving and performing independent actions and operations. Here the conclusion was made that students were more successful in problem solving when the expanded operational basis for solving was available, and subgoals were sorted and formulated during solving with support of "key features" in the considered problem structure.

One of the main goals of solving activity, particularly of physics problems, is development of algorithms for solving problems in specific cases with further generalization and systematization of experience – obtaining of a detailed plan for solving a random physics problem. This detailed plan of a random physics problem solving is systematized and presented as the diagram (Politsinsky, et al., 2011). The diagram reflects the sequence of specific logical steps at every of the three stages: physical, mathematical, analysis and check of solution. The physics stage of problem solving can be conventionally divided into preliminary and basic, mathematical into obtaining of calculating formulae in general and obtaining of numerical answer.

In addition, during solving the certain type of problems, besides finding the peculiarities of their solution and practicing the specific operations for their solving, their folding in generalized actions is performed. Learning of content of general methods of actions, aimed at problem solving, is very important as mastering of these very operations and methods should be the goal of student learning activity. With support of key features, students explain the purpose and content of each step in solution that results in free orientation in the problem structure.