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FORMATION AND DEVELOPMENT OF INDEPENDENCE IN SOLVING PROBLEMS IN PHYSICS

Yakubova Shokhidakhon Kadirovna,
associate professor, Fergana State University
sh.k.yakubova@pf.fdu.uz
ORSID ID 0009-0007-3932-0350

Annotation

This article observes the development of independent activity skills in students - one of the current tasks of modern education. Instilling in students the ability to work independently with educational material is one of the mandatory conditions for successful learning.

Key words: function, independence, thinking in physics, problem solving.

Introduction

Developing students' independence is a key aspect of modern physics education. It is a fundamental skill for successful mastery of the subject. Independence in learning physics plays a key role in developing deep knowledge, critical thinking, and problem-solving skills. Unlike traditional methods, where students passively perceive information, independent study promotes active search for solutions, experimentation, and understanding of phenomena of physics. Physics requires not just memorizing formulas, but their conscious understanding. One of the important skills developed during independent study of physics is the ability to apply knowledge in new conditions. Solving problems of different levels of complexity promotes the development of analytical thinking and adaptation to unexpected situations.

METHODS

Independence in physics education is considered as a subjective activity carried out by the student from beginning to end. The embodiment of this activity in physics education occurs on the basis of the means, norms and standards of cognitive and practical activity created by physics as a science. Solving problems in physics is a complex creative process that requires certain efforts.

In the process of solving the problem, the student studies theoretical material, develops physical thinking, acquires knowledge and experience. In fact, this is scientific work, which includes studying the initial data, analyzing them and understanding the physical meaning of the

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problem being studied. This takes time and can happen either very quickly or, on the contrary, for a long time, from several hours to several days.

Solving problems in physics, students master concepts and terms, learn to work with formulas, learn to predict, build diagrams, tables, and apply knowledge from mathematics in calculations.

It is known that the main goal of independent activity in lessons is to teach students to think, analyze, generalize, and learn educational material. The effectiveness of students' independent work in the learning process directly depends on the conditions that ensure its organization, that is, on its planning, management, and control. The organization of independent work means the actions of the teacher and students aimed at creating the pedagogical conditions necessary for the timely and successful completion of the task. The creation of such conditions requires the teacher to have knowledge of the psychological and pedagogical specifics of methods for managing students' cognitive activity, the ability to promptly and correctly formulate and transform goals, motives, guidelines, and value attitudes for educational activities.

One of the most common types of independent work in physics lessons is problem solving. Students should be taught to solve problems independently gradually, starting with performing individual simple operations, then moving on to performing more difficult operations, and only then to independently solving problems. The inclusion of elements of independent work on solving problems should be carried out in a sequence corresponding to the gradual increase in difficulty.

By content, all problems are divided into abstract and concrete. Abstract problems are those that do not have specific numerical values and are solved in a general form. An abstract problems, reveals the physical essence of phenomena more deeply, without distracting students with specific, unimportant details. Concrete problems are easier for students because specific numbers bring the problem closer to the level of development of students who have not yet learned to abstract.

According to the level of complexity, problems are divided into simple, complex, and advanced problems. Simple problems use one formula. They are of a training nature and are usually solved immediately to consolidate new material. Complex problems use several formulas. These formulas can be from different topics.

According to the main method of expression, the conditions of the problem are divided into text, experimental, graphic and drawing problems.

According to the solution method, problems are divided into qualitative, quantitative, and experimental.

ISSN: 2775-5118 VOL.4 NO.6 (2025) I.F. 9.1

A qualitative physics problem contains a solvable problem related to the qualitative side of a physical phenomenon. To solve it, you do not need to apply mathematical operations; you need logical conclusions based on the laws of physics. The answer to a qualitative problem must be composed by synthesizing the given conditions of the problem with the existing knowledge on the subject. Solving qualitative problems includes three stages: reading the conditions, analyzing the task, and solving.

Picture 1. Metal and wooden spoons.

Problem. **Why does a metal spoon left in hot tea heat up, but a wooden one does not (Pic. 1)?**

Solution

Analysis of physical phenomena. In this case, heat transfer occurs, namely *thermal conductivity*. Metal and wood are materials that differ in structure and thermal conductivity.
1. Justification from the point of view of physics

***Metals* have *high thermal conductivity* due to free electrons, which quickly transfer thermal energy throughout the volume of the spoon.**

***Wood*, on the other hand, *is a heat insulator* because it consists of fibers and pores filled with air. The substance does not contain free electrons that could effectively transfer heat.**

Conclusion

A metal spoon gets hot because it quickly transfers heat from the tea to its handle.

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A wooden spoon stays cold because it conducts heat poorly.

Quantitative problems are problems in which the answer to a constant question cannot be obtained without calculations. In order to develop in students the skill of a conscious approach to solving quantitative problems, a certain system of work and a well-thought-out teaching methodology are needed.

Problem: **Equation of state of an ideal gas**

Condition: **Determine the volume of 3 moles of an ideal gas at a temperature of 300 K and a pressure of 100 kPa.**

Solution

To, solve the problem we use the equation of state of an ideal gas:

$PV=n\,RT$, Expressing volume: V = n RT/P

Substitute the data (R = 8.31 1 J / (mol · K)

$V = (3mol) \cdot (8.31\ J / (mol \cdot K)) \cdot (300K)/100 \cdot 10^3$ Pa

Calculate: The volume of gas is approximately 0·0748m3 or 74·8 liters.

Experimental problems are problems that can be solved using a graph or an experiment.

Problem. **Determination of the specific heat capacity of a solid by the mixing method.**

A student conducts an experiment to determine the specific heat capacity of a metal sample. He heats a piece of metal with a mass of m_1 = 200 g to temperature $T_1 = 100^0$C and then places it in a calorimeter with water with a mass of m_2 = 500 g, which has an initial temperature of $T_2 = 20^0$C (Pic. 2). After heat exchange, the temperature of the system becomes $T = 25^0$C. The specific heat capacity of water c_2 = 4.18 J/(g·°C). Determine the specific heat capacity of the metal c_1.

ISSN: 2775-5118 VOL.4 NO.6 (2025) I.F. 9.1

Picture 2. Calorimeter.

Solution

To solve this problem we use the law of conservation of energy:

$Q_{\text{metal}} = Q_{\text{water}}$,

where: $m_1c_1(T_1 - T) = m_2c_2(T - T_2)$

Solve the problem for c_1: $c_1 = m_2c_2(T - T_2) / m_1(T_1 - T)$

We substitute the values and calculate:

The specific heat capacity of the metal is approximately 0.697 J/(g·°C).

This method can be used to experimentally determine the heat capacity of various materials.

The tasks offered for independent work should be of interest to students. Interest in the work stimulates the development of students' creative activity. It is useful to offer students tasks that conceal the practical application of the meaning of a particular phenomenon.

RESULT AND DISCUSSION

Finding the most rational way to solve a problem requires students to be more independent. Therefore, it is useful to systematically offer them several options for solving the same problem so that they learn to independently find new ways to solve it. This is especially important to practice when solving complex problems. It should be borne in mind that solving the same problem in several ways serves as one of the methods for checking the correctness of the solution. It is very important to teach students to use this method.

CONCLUSION

Thus, solving problems in physics acts as both a goal and a means of learning. Taking this into account, a teacher, offering students a particular problem to solve, must clearly understand the main goal of its solution, the function in learning and personal development that the solution of this problem should play, independence in studying physics not only contributes to a deep understanding of the subject, but also develops the skills necessary for a successful scientific and engineering career.

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ISSN: 2775-5118 VOL.4 NO.6 (2025) I.F. 9.1

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