PROBLEM-BASED METHODOLOGY FOR TEACHING PHYSICS

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Abstract. *This paper uses a partially exploratory problem-based learning method to demonstrate the motivated acceptance of certain concepts of physical knowledge by physics and astronomy students. It explains how to achieve this motivation through the problems and tasks used in practical classes.*

Keywords*: problem-based learning, physics, creativity, scientific worldview, motivation, modeling, thinking, energy, measurement, mass defect, nuclear reaction.*

Nowadays existing textbooks on sections of the course “General Physics” included as a subject for students of physics and astronomy in pedagogical universities have been systematically described with the inclusion of modern information. Rational thinking in physics is always based on experimental data. The structure of practical classes in a physics course should be focused on highlighting the educational task and involving students in its active solution. The solution to an educational task is expressed in the form of a problem, question or assignment that cannot be obtained from a ready-made sample. Here students are required to show independence and originality.

Problem-based learning serves not only to develop students’ thinking and creative abilities, but also to shape their scientific worldview. The use of examples from the history of science fosters responsibility, scientific courage, the pursuit of truth and other qualities, introduces ethical standards associated with the development of science and the application of its achievements, and provides an incomparable moral lesson. In the context of the growing influence of high technologies on people’s lives, this becomes especially relevant [1]. In this case, teaching a physics course helps students develop basic qualifications: understanding the natural science nature of problems within the framework of their professional activities, the ability to dialogue and collaborate with other specialists, technology transfer (transfer of technologies from one state to another). enters.

The workshop on the general physics course is conducted using a problem-based teaching method according to the following scheme:

1. Motivation in setting and solving problems. The motivational aspect in posing a scientific ideological question is the arousal of interest in the process of posing a problem, the solution of which goes beyond ordinary experience, which makes it possible to explain the strangeness. The organization of unexpected situations can become the basis for explaining many miraculous phenomena that occur in nature. A situation of inconsistency occurs when everyday life experiences and concepts contradict scientific evidence. For example: Aristotle’s idea of the nature of motion under the influence of a constant force. If in a given problem there is not enough information to obtain an exact solution, a situation of uncertainty is created, forcing students to think about what additional conditions are necessary to select a solution. The motivational aspect

of production-technological or social-managerial issues lies in revealing the connection of the problem under consideration with the object and subject of future creative activity of students.

2. Look for a solution. The goal that can be achieved here is to teach the student to think analytically, generalize existing knowledge, and understand the exemplary language of writing nature.

3. Discussion. In the classical concept of measurement, the measuring device is external to the object of study. It affects the change in certain characteristics of the object and cannot affect their state. By selecting instruments with higher sensitivity, measurements can be made absolutely accurate, and all deviations can be reduced to zero. Reasoned adoption of these concepts can be achieved by addressing the following questions.

Using the gravitational constant measured by Henry Cavendish, find the mass of the Earth taking into account $G = 6{,}67 \cdot 10^{-11} m^3 / \hat{e}\tilde{a} \cdot c^2$ the radius of the Earth's orbit - the mass of the Sun [2]. In what studies were the masses of the Earth and the Sun determined using this method?

Determining the masses of the Earth and the Sun on a "rotation scale" is the motivation of the Porodox. Here, students are interested in how this is possible, and a motivation to learn arises: during the discussion, it should be emphasized that what is said in theory is confirmed by studies of the seismic activity of the Earth and processes on the Sun. The most important factors in creating a mechanical model of the Solar System were the masses of the objects included in it and the distance from the Sun. It is useful to discuss the effectiveness of using the point model to explain planetary motion.

Based on the concept of the integral unity of an object, each natural object is considered as a unique independent whole, a whole that has qualitative accuracy thanks to special “mechanisms” of internal connections between its parts. Motivated acceptance of the concept of object integrity can be achieved by solving the following problem.

1. Future energy may depend on the following reaction:

$^{2}H+^{3}H=^{4}_{2}He+^{1}_{0}n+17.6$ MeV. Find the percentage of mass that is converted to energy. How many tons of coal can be replaced by one gram of deuterium-tritium mixture in terms of the amount of energy released [3]?

The motivation for posing the question is the development of energy, that is, the opening of prospects for the entire civilization, on which the future professional activities of students depend. During the discussion, it is necessary to emphasize that the atomic nucleus as an integral system has structures that are not characteristic of its constituent elements (protons and neutrons) (mass defect, participation in nuclear reactions).

The motivational adoption of the non-classical concept of limiting the effect at the micro level, which is determined by the quantum size and related to the possible minimum limit of the effect, can be achieved by solving the following problem.

1. The lower limit of photosensitivity of the human eye at a wavelength of λ =510 nm is E = 4.1017 W of light energy. What is the minimum number of photons per second that the human eye can detect at a given wavelength? What are the structural features of an animal’s eye, which is more sensitive to light compared to the human eye [4]?

The motive here is that the phenomena under consideration are relevant to each of us personally, that is, in the process of observing nature, situations of everyday life are used. During the discussion, it is important to note that the limit of photosensitivity of even the most advanced optical devices is limited to one quantum of energy.

In the method of problem-based learning, the motivation for setting problems and solving them serves not only the development of students' thinking and creative abilities, but also the formation of their scientific worldview.

REFERENCES

1. Dubnischeva T.Ya., Rozhkovsky A.D. Concepts of natural science in modern education // Philosophy of education for the XXI century - 2001. - No. 2 - pp. 75-82.
2. Volkenshtein V.S. Collection of problems for the general course of physics. Moscow, "Science", 1992.
3. T.M.Mominov, A.B.Kholikulov, Sh.Khushmurodov Atomic nucleus and physics of elementary particles. Tashkent, "National Society of Philosophers of Uzbekistan" 2009.
4. Rasulov E.N., Begimkulov U.H., Akhmadzhanova Sh.M. Collection of problems of quantum physics. Tashkent, 2005.