Use of Problem-Based Educational Technology in Teaching Physics

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A B S T R A C T
The article deals with the ideas about effective methods of using problem-based learning educational technology in physics lessons in secondary schools.

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It is well-known that there is a growing interest in the implementation of innovative technologies and interactive methods in the educational process. The concept for the development of the education system in the Republic of Uzbekistan until 2030 outlines tasks such as "...improving teaching methodologies and gradually applying the principles of individualization in the education and training process."

Such priority tasks place significant responsibilities on all subject teachers, including physics teachers. This, of course, requires physics teachers to adopt a creative approach to their profession and to teach students to learn actively, with observant skills. There are various methods and techniques to achieve this, but regardless of which methods a teacher chooses to apply, it is essential to follow the methodology that enables students to perform assigned tasks independently and accurately.

The application of educational methods enhances the effectiveness and impact of teaching and develops students' learning methods. If we pay attention to the meaning of the word "innovation" (from English - innovation), it refers to creating something new. This means using strategies that increase the effectiveness of the educational process based on new ideas rather than relying on the same systems of traditional education.

Relying on pedagogical technologies in education and striving for innovation through various interactive methods aimed at student engagement can effectively help achieve educational goals.

When planning a lesson, the teacher must clearly define their work forms and the scope of students' activities in mastering skills. Furthermore, the choice of teaching methods used is also of significant importance. Focusing more on interactive methods will enhance the effectiveness of education.

The term "interactive" encompasses the notions of "inter" (meaning mutual) and "active" (meaning action) in English. Interactive methods refer to teaching based on mutual interaction and collaboration. In all such methods, collaboration between the teacher and students, as well as the active participation of students in the educational process, is envisioned. For instance, when assimilating a certain topic during the modeling phase, the teacher might use brainstorming techniques before demonstrating a model to the students. This allows students to reflect on how they have acquired the skills, and their ideas can be summarized.

In the practical management aspect, the teacher can employ the "teach your partner" method. This method teaches students to critically monitor their activities and to eliminate mistakes.

The teacher first explains the model parts to those who wish using knowledge methods, and then shows them. Although conducting lessons in an interactive way requires a lot of work from teachers, it encourages students to be enthusiastic and creates a basis for quickly, clearly, and concisely expressing their thoughts, using their time productively.

The main goal of using interactive methods in education is to involve students in the active learning process, develop their knowledge and research skills and abilities, and increase their activity in thoroughly mastering educational materials in physics in secondary schools.

Interactive methods are based on the active interaction of the teacher and the student, their complete understanding of each other. The main goal of introducing interactive methods into the educational process is to organize the cooperation of the teacher and the student in the lesson, regardless of the form in which the lesson is held and where it is taught. The teacher must engage students in relevant problems in the lesson, activate their actions, and ultimately ensure their mastery.

In the educational process, the formulation of cognitive tasks is primarily influenced by problem-oriented questions. These questions are related to any methods of creating problematic situations. A cognitive question may be challenging for students to some extent, indicating the limitations of their existing knowledge while simultaneously being achievable. It is essential to consider that their understanding is linked to how well they have acquired practical experience and theoretical knowledge.

In our experience, we have frequently observed that using the "Problematic Situations" technology effectively helps develop students' critical thinking abilities in physics classes. This is because every topic in physics, whether theoretical or practical, can present problematic questions.

The purpose of the "Problem-Based Learning" technology is to teach students to find correct solutions to various problem situations arising from the subject matter; to help them develop skills in identifying the essence of problems; to familiarize them with certain methods of problem-solving, and to teach them how to choose appropriate strategies for solving problems. Additionally, it instructs them on how to correctly identify the causes of problems and the actions needed to address them.

After dividing the students into groups and placing them in appropriate places, the teacher explains the rules for conducting the lesson, that is, he says that the lesson will be staged and that each stage requires attention from the students, and that they will work in groups and in groups during the lesson. Such an environment helps the students to be ready to complete the assigned tasks and arouses interest. After that, the lesson process begins.

Problem-based learning technology largely depends on the content of the educational material. This can be seen in the example of studying physical phenomena, laws, practical experiments and theories.

Problem-based teaching of physical phenomena. Problem-based teaching of physical phenomena in higher grades can be organized as follows (Figure 1):

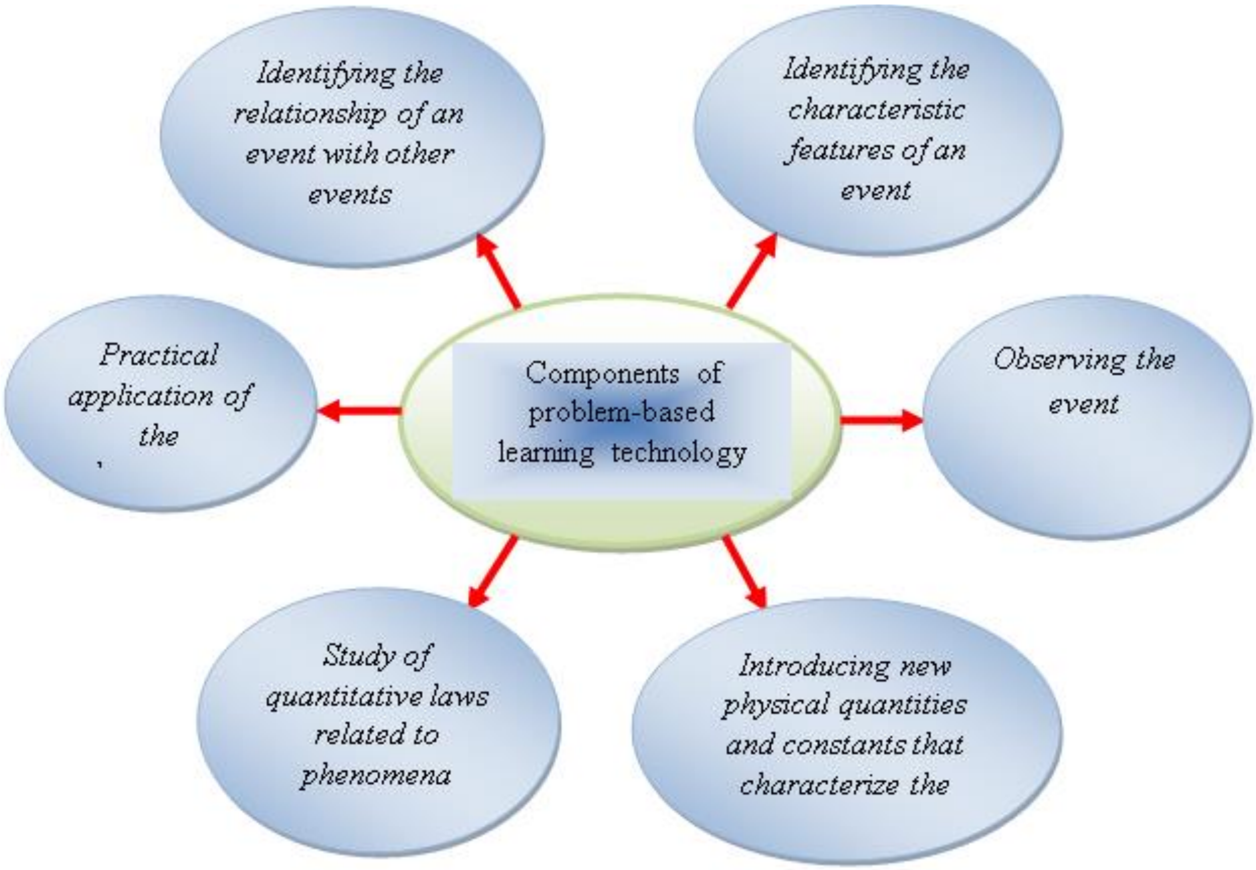

Figure 1.

1. Observing the event;

2. Identifying the characteristic properties of the event;

3. Determining the relationship of the current event with other previously studied events and explaining the nature of the event;

4. Introducing new physical quantities and constants that characterize the studied event;

5. Establishing quantitative laws related to the observed event;

6. Practical application of the event.

In the initial stages of studying a physical event, it is possible to apply the Problem-Based Learning method to some extent. However, the potential of Problem-Based Learning is particularly revealed in determining the nature of the event.

Creating a problematic situation and setting a learning task has significant advantages over simply explaining the lesson's objective. In this case, a "difficult situation" arises before the students, prompting them to consciously assimilate the material during the learning process. However, in certain situations, the teacher's description of the lesson's objective can also generate vivid and free imaginations about a specific scenario. These imaginations serve as a starting point for setting particular tasks for the students, and they actively accept the teacher's presentation of the problem.

Setting a learning problem at the beginning of the lesson through the creation of a problematic situation does not yet determine how the teacher will present the subsequent learning material. If there is no opportunity to define the problem or the problematic issue arising from this situation, and if the students possess sufficient knowledge to resolve it, then it is appropriate to present new material in a problematic format.

In the subject of physics, Problem-Based Learning is categorized into theoretical, practical, and mixed types of problems. (Figure 2).

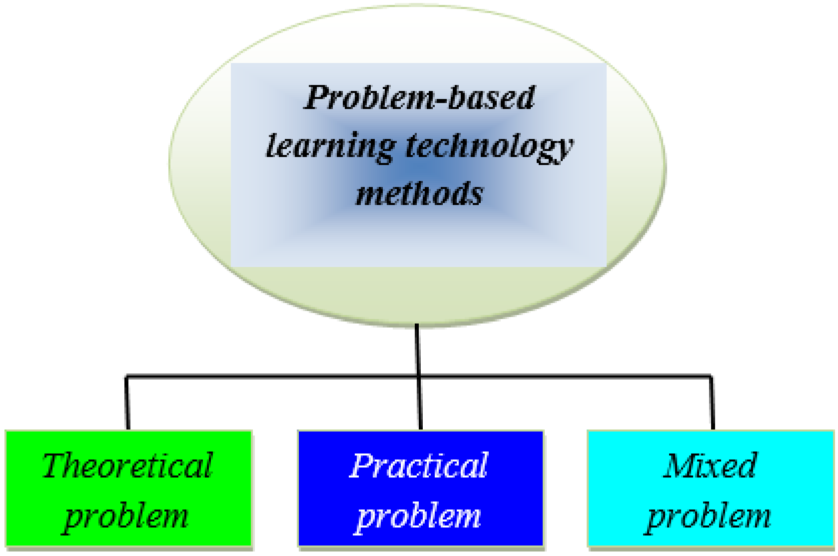

Figure 2.

Theoretical problems are used to summarize new laws, to theoretically substantiate experimental results, and to work on research problems. The methods for solving various practical problems and the theory behind the execution of practical tasks are implemented through the type of practical problems in Problem-Based Learning. However, even if the problem is solved practically, it is concluded through theoretical knowledge. In solving mixed types of problems, students are required to synthesize their theoretical and practical knowledge.

For example, let's consider the topic "Electric Current in Electrolytes." The main objective of studying this topic is to make students aware of the nature of electric current in electrolytes. Starting with a problematic question arising from the observation that electric current does not pass through pure distilled water, but after mixing table salt solution with water, the liquid possesses the property to conduct electric current, one might ask: “What is the nature of electric current in an electrolyte? What carries electric current within it?” During the process of solving the problem, students’ reasoning is presented in the following sequence: “What do I know about electric current?” Electric current is the orderly movement of charged particles. Thus, there are charged particles in the electrolyte, and they are in orderly motion. (image 1).

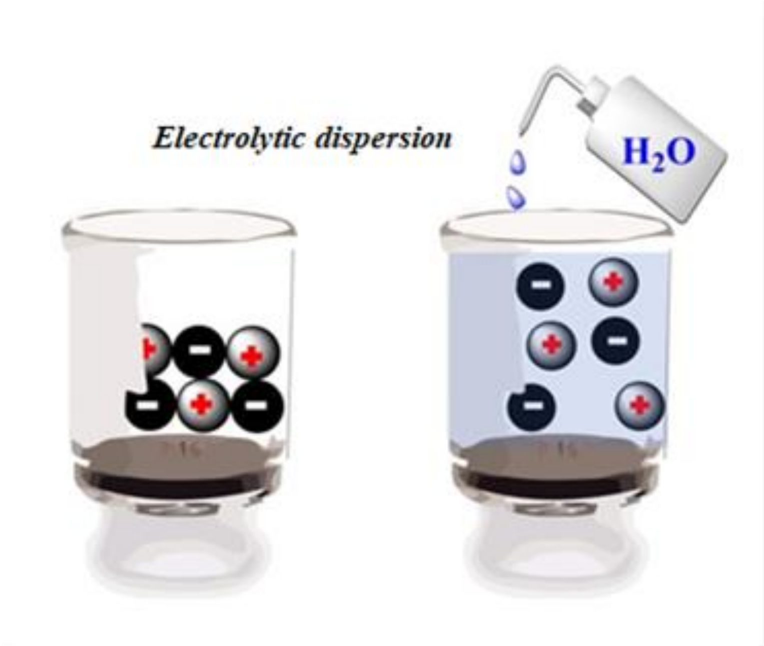

image 1.

Students' reasoning is reinforced through an experiment that proves the flow of current through the solution of copper sulfate. Following this, they ask the question: “What are the charge carriers in an electrolyte?” Students may reason as follows: “In metals, these charge carriers are electrons. What about in electrolytes?” In this case, we can say that a problematic situation has arisen. They attempt to understand the essence of the problem that has surfaced and manage to find a solution, which could be the following: “Besides electrons, what other particles can carry charges? Protons? No, those are located in the nucleus of the atom. What about ions? How do they appear in the water solution of copper sulfate?” To answer these questions, new information is needed. For this purpose, students rationally think independently to find a solution to this problem and choose the content of the learning material. They realize that understanding the new material is related to the chemical composition of the substance and focus on the internal structure of the material[3-20].

The sequence of thoughts accumulates and identifies the elements of new knowledge that students will acquire, as well as the foundational knowledge required for their assimilation. Information about auxiliary concepts and definitions is studied theoretically in order to understand the learning material. During this process, plans are devised to activate students' foundational knowledge, understand the problem, and search for a way to solve it. Independent reasoning using previously covered material is required for mastering the new topic.

In conclusion, it should be noted that applying Problem-Based Learning technology in teaching physics in secondary general education schools enhances students' logical thinking skills and improves their ability to grasp scientific concepts such as interdisciplinary connections and relevance[3-20].

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