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THE ROLE OF THE EXPERIMENTAL METHOD AND EDUCATIONAL EXPERIMENTS IN TEACHING PHYSICS

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Abstract: This article examines the role and importance of the experimental method and educational experiments in teaching physics. It emphasizes that teaching physics should not rely solely on theoretical knowledge but also connect with natural phenomena and everyday life. Educational experiments allow students to observe physical processes directly, develop practical skills, and understand the laws and principles of physics through hands-on activities. The article also discusses different types of laboratory work, demonstration experiments, and practical tasks that enhance students' experimental competencies, critical thinking, and problem-solving abilities. Overall, integrating theory with experimental practice significantly improves the effectiveness of physics education and fosters students' scientific curiosity.

Keywords: Physics education, Experimental method, Educational experiments, Laboratory work, Demonstration experiments, Practical skills, Scientific observation.

INTRODUCTION

Physics is the science of nature. It studies the structure of objective reality, phenomena and processes, the quantities that characterize them, the relationships between these quantities, as well as natural laws and principles. Physical experiments can be divided into research experiments and educational experiments. Experiments aimed at educational objectives are called educational experiments. Physical laws, rules, and theories are accepted only after they have been proven through experiments. Therefore, an educational experiment simultaneously serves as a source of knowledge, a teaching method, and a type of visual aid. An educational experiment (EE) is used to discover phenomena and laws that are subjectively new.

The experimental nature of physics as a science is expressed in the school curriculum through the extensive use of various types of experiments—such as demonstration experiments (DE), frontal laboratory work, physics practical sessions, experimental problems, and extracurricular as well as home-based experiments—in studying the fundamental physical theories. These theories are composed of core elements of knowledge, including facts, physical quantities, concepts, idealized objects, and general and specific laws. This demonstrates that educational experimentation in physics is an integral part of the physics course.

LITERATURE REVIEW AND METHODOLOGY

Experimental teaching is instruction based on experimentation.

The word *experiment* is derived from the Latin term *experimentum*, meaning "to test." In modern literature, it is understood as "trying out" or "conducting an experiment," and in simple terms, it is accepted as meaning "experiment." An experiment is a process that

makes it possible to observe the course of a physical phenomenon, to examine and analyze the phenomenon under study, and to reproduce it repeatedly under specified conditions at any desired time.

During the performance of frontal and simple laboratory work, as well as practical sessions within educational experiments, students learn scientific research methods, the structure of the equipment used, its operating principles, and how to handle it properly. They also carry out measurements using these tools, obtain results, analyze them, and draw conclusions. This activity develops and enhances students' experiment-based skills. Such skills play a particularly important role in the professional development of a physics teacher.

DISCUSSION AND RESULTS

It is necessary to learn to analyze phenomena occurring in nature and the processes taking place, and to strive to explain them on the basis of the laws of physics. In laboratory classes, students become practically acquainted with the physics course.

The role and importance of educational experiments in teaching physics are very significant. In the process of learning physics, students directly observe natural phenomena, see them with their own eyes, or vividly visualize them. Teaching physics also develops the skills of preparing and demonstrating experiments. Laboratory and practical work play a special role in the formation of practical skills and competencies. Since physics experiments are closely related to production and real-life applications, they help to implement the principles of consciousness, visual demonstration, and polytechnic education in students' cognitive activity.

The importance of experiments in the physics course is invaluable, as they:

- ✓ develop students' practical skills and competencies;
- ✓ teach students to observe physical phenomena in nature, carry out measurements, calculate results, and draw conclusions;
- ✓ train students to use various instruments and prepare them to conduct independent experiments;
- ✓ help students clearly recall the learned material and achieve a deeper understanding of the essence of physical phenomena [1].

A physics laboratory experiment is the reproduction or occurrence of an observed physical phenomenon under specified conditions using appropriate instruments, taking into account the fundamental relationships involved. From a technical standpoint, laboratory experiments are divided into three types: frontal (whole-class) laboratory experiments, simple laboratory experiments, and laboratory experiments in the form of practicums (practical training).

Frontal and simple laboratory experiments are organized after the completion of a particular topic or section, in accordance with the lesson schedule and calendar plan. The apparatus and equipment for laboratory work are prepared in advance before the lesson. In a frontal laboratory experiment, all students in the class perform the same experiment. In a simple laboratory experiment, the teacher first demonstrates the experiment to the students, after which the students are divided into groups and carry out the experiment independently.

In practicum experiments, different groups organize and perform different laboratory experiments.

Frontal and simple laboratory experiments are conducted in secondary schools, colleges, and lyceums at lower grades and courses. Practicum experiments are organized in higher education institutions, as well as in the upper grades and courses of schools, colleges, and lyceums [2].

The laboratory method plays an important role in the educational process by providing students with new knowledge about objects and phenomena in nature—their form, size, composition, structure, changes, and laws of development—while also reinforcing this knowledge and developing relevant skills and competencies. The direct study of objects and phenomena by students in the physics classroom using special equipment (such as measuring instruments, experimental apparatus, and tools required for conducting experiments) is referred to as laboratory work.

The laboratory method is applied in teaching physics, chemistry, biology, and physical geography in Grades VI–IX, as well as in the I, II, and III courses of academic lyceums and vocational colleges. Laboratory classes are conducted in specially equipped laboratory rooms, as well as in regular classrooms provided with appropriate apparatus and instruments, microscopes, magnifying glasses, flasks, measuring cylinders, and measuring devices, and also in school experimental plots.

Typically, laboratory classes are carried out to clarify, verify, and consolidate the material previously presented by the teacher through oral explanation, narration, school lectures, and the discussion method. Sometimes, especially in higher grades, such classes are also used for the purpose of introducing new knowledge. Depending on the nature of the lesson, laboratory classes are usually conducted in three forms: observation; conducting experiments or experimental investigations; and measuring or examining specific objects using appropriate instruments and equipment. In a single laboratory session, two or three methods may be applied simultaneously. Before students begin their independent work, the teacher may provide appropriate guidance to ensure the successful completion of the experiment [3].

During the teaching of a subject, students may be shown simple experiments, and, if necessary, they may be assigned experiments that they can perform independently at home or with the assistance of their parents. For example, at the initial stages, students may be given observation-based tasks such as observing the motion of automobiles, bicycles, clocks, or the movement of attractions in children's playgrounds. Afterward, it is essential to check whether these tasks have been completed and to listen to the students' opinions regarding each of the observed processes.

At subsequent stages, after gradually explaining how to perform simple experiments, students are given tasks that require them to carry out experiments independently and draw conclusions.

For example:

• **Experiments related to the phenomenon of diffusion:** investigating why the mixing of water and oil occurs faster at higher temperatures (as observed during cooking);

explaining why oil spreads on the surface of water without mixing (due to its lower density); and exploring why it takes a certain amount of time for the smell of burning *isiriq* (harmal) to travel from one corner of a room to another (as a result of Brownian motion).

• **Experiments related to electrical phenomena:** observing how a stream of water flowing from a tap is attracted toward an inflated balloon; noticing how strands of hair repel each other when combed with a metal comb (due to becoming electrically charged); and observing the crackling sound and the appearance of sparks caused by charging through friction when removing knitted clothing.

• **Optical observations and experiments:** observing the formation of a shadow in a room illuminated by a single light source, and the formation of both penumbra and shadow in a room illuminated by two or more light sources; explaining the apparent change in the appearance of fingers when they are placed in water; observing why the surfaces of pools and lakes appear shiny; and seeing that it is possible to relight a candle by holding a burning match in its smoke after the candle has been extinguished.

Providing information about the mechanisms used and instruments created by our great scholars in the past helps to instill a sense of national pride in students. Selecting the instructive sayings of our ancestors as lesson mottos in accordance with the topics, and explaining the everyday applications of physical laws, are of great practical importance.

CONCLUSION

In teaching a subject, it is important not to rely solely on theoretical knowledge, but to connect it with natural phenomena and everyday life, and to correctly analyze these phenomena in order to derive formulas and rules. All experimental lessons organized on the basis of an optimal combination of theoretical and experimental knowledge in physics are particularly valuable, as they contribute to the formation of students' knowledge, experimental skills, and competencies.

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