E CONF SERIES

International Conference on Economics, Finance, Banking and Management
Hosted online from Paris, France
Website: econfseries.com 24th May, 2025

THEORETICAL BASIS OF LABORATORY COURSE IN PHYSICS

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ANNOTATION

In the process of studying physics, laboratory exercises arouse natural interest in students, they are associated with knowing the world around them through their own experience and feelings. When performing laboratory work, students develop an understanding of the role of experiments in life. Experimental skills, which include mental and practical skills, are formed in students through experiments. The purpose of laboratory exercises is, first of all, to independently search for information, methods and techniques for completing assigned tasks, to assess their quality, to develop training, education and personal competencies that allow students to apply the knowledge gained in practical activities. When planning laboratory work, it should be taken into account that, along with the leading didactic goal, students also develop practical skills and qualifications in working with laboratory equipment, as well as research skills. The analysis of these issues is the main content of our article.

Keywords: Physics course, modern information technologies, physical phenomena, teaching of electricity and magnetism course, laboratory work, physical instruments, experiment

1. The role of the physics laboratory in the physics course

Physics cannot be taught only in the form of theoretical lessons. The learning process should include work that students do themselves, including assembling instruments, measuring physical quantities, and conducting experiments. Laboratory activities arouse natural curiosity in students, they learn about the world around them through their own experience and feelings. When performing laboratory work, students develop an understanding of the role of physics in life.

Experimental skills, which include intellectual and practical skills, are formed in students through experiments. Intellectual skills include: determining the purpose of the experiment, putting forward hypotheses, selecting equipment, planning an experiment, calculating errors, analyzing results, and preparing a report on the work performed. Practical skills include the ability to assemble an experimental device, observe, measure, and conduct experiments. During the experiment, as part of laboratory work, students learn to work with laboratory equipment and instruments, study the laws of physical phenomena, and get acquainted with research methods. Practical lessons are conducted both individually and with a group of students.

Laboratory work tasks:

- apply knowledge in practice;
- to form the necessary practical knowledge in life and work, and

skills;

- assist students in career guidance;
- develop personal qualities.

The following functions of laboratory work are distinguished:

1) the educational task is to accelerate the process of mastering the material studied;
2) the developmental function is aimed at developing imagination, memory, attention, creativity and thinking;
3) the educational function affects various character traits;
4) the motivational and stimulating function creates conditions for involving students in cognitive activity;
5) the reflective function helps the student to understand himself in comparison with others in his activities; develop the skills of monitoring and analyzing his own actions, finding and correcting

evaluate mistakes, the results of your actions and make corrections to them;

6) The diagnostic function allows the teacher to determine the characteristics of the student's personality, the level of mastery of knowledge and skills.

These skills can be acquired as a result of purposeful independent work. A distinctive feature of laboratory practical classes is the partial independence of students, which gradually turns into almost complete, active conscious work not only in the process of assembling devices and performing measurements, but also in the process of

performing work, preparing for measurements, processing results and compiling reports. Laboratory work in the physics course can be classified according to the following criteria:

- by content – mechanics, molecular physics, optics, electricity and magnetism, atomic and nuclear physics.
- by methods of implementation - observation, experiment, measurement of quantities and study of their relationships;
- based on independent performance of students - creative, test, heuristic;
- according to their importance in the learning process - illustrative, final;
- in accordance with the didactic purpose - learning new material, repeating and consolidating the material, getting acquainted with the principle of operation of devices, measuring physical quantities, studying phenomena, studying and verifying the relationship between physical quantities;
- by organizational principle - frontal laboratory work, physics laboratory, home experience.

The latest classification allows us to consider experience from the perspective of teaching methods and to correctly determine the place of each type in the education system.

2. Features and approaches to conducting laboratory practical classes in the study of physics

The purpose of laboratory exercises is, first of all, to provide students with training, education and development of personal competencies that allow them to independently search for information methods for completing assigned tasks, assess their quality, and apply the knowledge gained in practical activities. When planning laboratory work, it should be taken into account that, along with the leading didactic goal, students will develop practical skills and qualifications in working with laboratory equipment and research skills. Laboratory exercises should be carried out under the supervision of a teacher and in compliance with all safety rules. Before performing the work, the teacher conducts detailed safety instructions, and each student signs a special journal. The teacher is responsible for ensuring that students comply with the rules. When preparing for the lesson, the teacher must organize the

ideal conduct of laboratory work, take all measures to form students' practical skills and qualifications in working with laboratory equipment. To conduct a laboratory lesson, students must be provided with all the necessary materials in the previous lesson . The materials must be provided in writing and include the following: the name of the work, its purpose, tools and materials, visual aids, the task for the work and the procedure for its implementation, test questions, rules for working with laboratory equipment, technical and fire safety measures. Before starting laboratory work, students must obtain permission to work after checking their understanding of the sequence of work specified in the task and control questions and safety measures. Laboratory work must be performed individually. There are 2-3 students at the table, each of whom is required to independently complete the task and report.

For each completed assignment, the student receives a grade after submitting a report and checking their knowledge.

During laboratory work, students develop the skills to explain the essence of the observed processes and phenomena, to process and analyze the results obtained during the study, and to formulate conclusions necessary for further work and classes. The teacher chooses the method of completing the laboratory work based on the option that is most suitable for him. The following factors influence the choice of the method of completing the work: the correspondence of the chosen method to the purpose of the lesson, the level of readiness of students to master the material being studied at this stage, the content of the experiment being conducted. When choosing the method of completing the work, the teacher is guided by the requirements of the program, that is, the requirements for preparing students must be met based on the abilities of each student. The reproductive method is a method of performing laboratory work in which students must form the skills to perform the work. This method does not ensure the independence of students in performing the work, since already known facts are implemented with the direct assistance of the teacher. Using this method, work begins with a repetition of the material covered and possible methods of measuring the physical quantities used. Then, the progress of the work is discussed, and students begin to collect. The next stage involves making the necessary measurements and processing the results and drawing appropriate conclusions. This method is aimed at repeating existing experiments

according to a clear algorithm, which ensures the independence of students, but at the same time strengthens their skills and qualifications in working with laboratory equipment.

The partial search method involves the teacher guiding the students' practical actions, giving them sequential instructions, and then directing them with questions to analyze the results obtained during the study, which subsequently helps them form conclusions about previously unknown laws. This method helps students to independently acquire knowledge during laboratory work. It is advisable to use this method if students have already mastered all the necessary actions to perform the work and perform them independently. The partial search method is used in work aimed at observing physical phenomena and establishing relationships between physical quantities. The research method is a method that assumes complete independence of students. To use this method, the teacher must correctly formulate the task. Students independently determine the course of the task, and then complete the stages of the research.

The research method of performing laboratory work is used for the most successful students participating in project-research activities. The difference from the previous ones is that before performing laboratory work, students are offered to independently think over and determine the equipment necessary for studying methods of indirect measurement of any quantity. All proposals are discussed by a group of students and the most optimal option for completing the work is determined. All work is performed by students independently; the teacher only controls the actions performed by the students.

3. Results obtained and their analysis

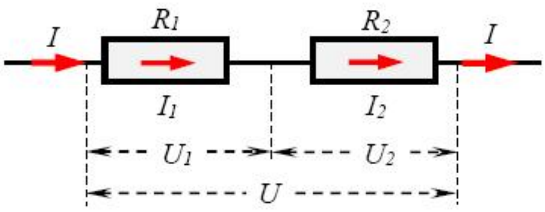
Laboratory work in physics is one of the means of implementing students' educational activities based on the presented educational material . The physics laboratory creates conditions for students to acquire scientific knowledge and skills focused on a specific type of educational activity through understanding and gradual mastering of the content of the educational material. An important point is the effectiveness of these ideas, especially when working remotely. In modern conditions of organizing and implementing the educational process, this connection is largely associated with a number of problems for students and teachers. As for

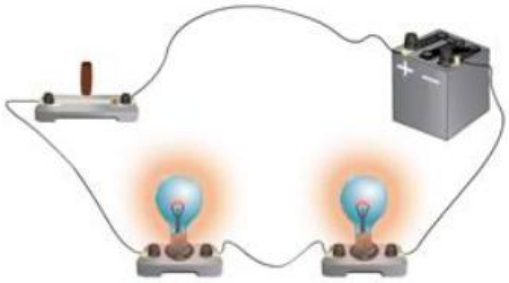
laboratory exercises, this connection is implemented in the form of the student's presentation and defense of a report on laboratory work in the appropriate class, which determines the level of the student's knowledge and the level of his assimilation of the material. A deep understanding of physics can be achieved by studying the theory and applying it to solving various computational, qualitative and experimental problems. If during the lesson the student gets acquainted with theoretical issues, they are also used in laboratory work, but at the same time practical skills in performing physical measurements, processing and presenting the results are also developed. Without prior preparation for laboratory work, students cannot independently perform high-quality calculations and analyze the results of laboratory work. Therefore, to complete each task, students must first study the textbook material corresponding to the topic of the task. It is impossible to start work without knowing the rules for performing the procedure for measuring physical quantities, without knowing how to use the measuring instruments associated with this work, and without understanding its basic theoretical principles. When starting work, the student must formulate the goal of the work and be able to describe the general work plan, that is, the sequence of actions when taking measurements. When studying mechanical vibrations, it is necessary to clearly depict on a graph the time dependence of the quantities characterizing harmonic vibrations. This graph is an effective visual aid for identifying key characteristics of oscillations throughout the lesson and teaching students graphing skills.

4. Description of laboratory exercises (on the example of "Ohm's Law")

In preparation for the lesson, special attention is paid to the preparation and testing of equipment. For practical work, the laboratory set “Electric current” (Figure 1) is used, which includes a digital ammeter, resistors with resistances of 1 Ohm, 2 Ohm, 4 Ohm, a light bulb on a stand, a switch, connecting wires, a current source, and a set of digital current and voltage meters (Figure 2).

1. "Electricity" laboratory kit.





2. A set of current and voltage meters

Conducting laboratory work of a partially research nature helps students to determine the relationship between physical quantities, to develop the ability and skills to work with laboratory equipment. The level of independence and activity in the classroom is determined by the content of the work and the set goal. At the initial stage of the formation of skills and qualifications, students receive detailed instructions for performing the work correctly. In this case, in the process of performing the work, students should form an understanding of the relationship between physical quantities, therefore, L-microlaboratory equipment plays an important role. Working with digital sensors makes it easier for students to process

accurate measurement results and experimental results. The time required to complete the experiment is also reduced and allows them to focus on the essence of the work.

Educational physics experiments in the form of a demonstration experiment and laboratory work are an integral and important part of the physics course. The successful combination of theoretical material and experimental activity helps to improve pedagogical results, develops active cognitive activity of students and a creative approach to the subject being studied. In order for a person to form an idea of something or a phenomenon, the student needs his sensory perception and sensory experience. Therefore, the process of forming students' scientific understanding of a physical phenomenon should begin with a demonstration of the objects and phenomena under consideration, that is, with an experiment. Physics experiments at school are one of the most important methods of teaching physics to schoolchildren; It has several unique types and is not yet fully formed, but is constantly developing and expanding, replenished with new equipment, methods and means of implementation. Therefore, great attention is paid to its study. *Summarizing all of the above, we note that the successful solution of all problems that arise in the process of studying physics by students equips them with a system of knowledge on the foundations of physics and contributes to the development of scientific thinking (research and theoretical). In the process and as a result of mastering physical knowledge, the foundations of a scientific worldview are created - a powerful tool for human creative activity. This includes the development of a deep understanding of natural phenomena and social life, the ability to consciously explain these phenomena and determine the attitude to them, consciously build one's own life, set goals and plan to achieve them. Conscious mastery of the system of physical knowledge contributes to the development of abstract and logical thinking, memory, attention, imagination, intellectual abilities, and the development of inclinations and talents. Successful study of physics is usually accompanied by the successful study of other natural, humanitarian and social sciences. It is no coincidence that many physicists have made a significant contribution to the development of philosophy, chemistry, ecology, synergetics, pedagogy, and other sciences.*

The classification of laboratory work may vary depending on the characteristics that form its basis. From a methodological point of view, it is of great interest to classify work in accordance with the tasks and goals that the teacher sets for himself when organizing laboratory classes.

According to these characteristics, the following types of work can be identified, for example:

1. Observation and study of physical phenomena.
2. Familiarity with the structure and operation of various physical devices, installation and handling techniques.
3. Familiarity with measuring instruments and measuring physical quantities.
4. Determining or verifying quantitative quantities
5. To determine physical constants and become familiar with various methods of such determination.

A vivid example of the first type is work of the following nature: students observe the expansion of solids, liquids and gases as a result of heating in simple experiments. They are convinced that gases expand more than others, and in this way they get acquainted with methods for determining small expansions. Many other works also belong to this type, in which students are convinced that objects heat up as a result of the work performed; observation of the thermal conductivity of various metals; convection in water and air; chemical action of current; They examine crystalline and amorphous bodies, sound recordings on gramophone records, etc.

The second type includes, for example, works in which students are introduced to the structure and operation of ball and roller bearings, the structure and operation of a galvanic cell, etc. In them, students are introduced to the operation of a battery, the structure and use of an electromagnet, an electromagnetic relay, a simple electric motor, a mirror periscope, etc.

The third type of work can be illustrated by the following works: they introduce students to the structure and use of a number of common measuring instruments: balance scales, dynamometers, hydrometers, thermometers, ammeters, voltmeters , etc.

An example of the fourth type of work, in which quantitative regularities between physical quantities are determined or verified, is the work that reveals Ohm's law for the circuit part or the work formula for electric current is verified. In addition, this includes the following works: determining the efficiency. the law of conservation of momentum when lifting a body on an inclined plane , determining the equilibrium state of a lever , as well as works related to constructing graphs of the melting of naphthalene and the boiling point of water .

Conclusion

Thus, the goal of physics education is to develop students' observation and thinking skills, as well as to arouse interest in the problems of the world around them and ways to solve them. Physics should teach them to observe, classify, relate phenomena and give explanations to them. In modern education, when teaching physics, special attention should be paid not only to the formation and development of thinking, scientific knowledge and skills, but also to the upbringing of a knowledgeable and thoughtful person, able to understand scientific problems in a social and personal context.

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