DEVELOPING A METHODOLOGY FOR ORGANIZING STUDENTS' SELF-DIRECTED LEARNING DURING LABORATORY CLASSES IN "ELECTRICITY AND MAGNETISM"

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Abstract. *The article examines the features of developing students' self-education skills during laboratory classes in the section "Electricity and Magnetism." A methodology for organizing independent work is presented, including active and interactive teaching methods aimed at improving the quality of theoretical knowledge acquisition and developing practical skills. A review of modern approaches to self-education and the specifics of their application in the educational process of physics students is also provided.*

Keywords: *higher education, self-education, student, laboratory class, purposeful, systematic activity, electricity and magnetism, professional competence.*

Introdaction

The modern higher education system places high demands on the level of students' independence in the learning process. Of particular importance is the development of students' self-education skills—purposeful and systematic activities aimed at the independent acquisition and deepening of knowledge. This is especially important in the study of complex sections of physics, such as "Electricity and Magnetism," where the practical consolidation of theory through laboratory classes plays a key role. However, the effectiveness of laboratory classes largely depends on the degree of student involvement and their ability to organize the learning process independently. In this regard, there is a need to develop a methodology that promotes the development of self-education skills specifically within the framework of laboratory work in electricity and magnetism.

According to I.L. Shishkina, pedagogical literature emphasizes the importance of self-education as a factor in improving the quality of specialist training [1]. Studies by A.B. Bakasheva and L.Sh. Gamidova have shown that the use of distance technologies and active learning methods contributes to the development of students' readiness for independent learning activities [2]. Research by S.Y. Temurov demonstrates that the integration of independent work with practical classes significantly improves both the assimilation of educational material and the development of professional competencies [3]. L.I. Gubareva, E.V. Petrukhina, and T.A. Senkina emphasize the role of laboratory classes as a platform for the formation of experimental thinking and practical skills [4].

Materials and method

The application of these approaches is particularly relevant in the field of "Electricity and Magnetism," where theoretical knowledge requires confirmation through practical experience [5]. The organization of self-education based on laboratory work is aimed at forming in students a stable system of basic knowledge, concepts, and practical skills necessary for the application of

scientific methods of research and measurement of the parameters of physical quantities. Special attention is given to mastering various methods of analytical evaluation of characteristics based on the obtained experimental data. The educational objective of laboratory classes is to develop in students the ability to consciously apply scientific tools, including:

measurement and analysis of physical quantities;

interpretation of experimental results;

application of methods of physical and mathematical analysis.

In addition, an important component is the development of general professional competencies, such as:

the use of the laws of natural sciences in the professional field;

the application of methods of mathematical and computer modeling;

the conduct of theoretical and experimental research;

the ability to identify the physical and mathematical nature of professional tasks.

Another objective of laboratory work is to develop in students the personal qualities that are significant for professional activity, such as responsibility, accuracy, independence, and the ability to communicate in a scientific and technical environment. These qualities contribute to successful integration into the professional community and to the effective solution of research and applied problems within the chosen field of specialization.

The ultimate objectives of the laboratory practicum include:

familiarization with modern technologies used in laboratory research;

the development of skills in conducting laboratory experiments and properly preparing technical documentation;

the development of the ability to apply theoretical knowledge in practice;

the formation of sustainable skills in working with educational and scientific literature.

Increasing the level of students' independence in solving practice-oriented tasks. In the context of the academic course in the section "Electricity and Magnetism," the main objective of the study is to develop an effective methodology for organizing students' self-education within laboratory classes. Such a methodology should contribute not only to better assimilation of educational material, but also to the development of autonomy in the learning process.

The objectives addressed within the framework of this study are as follows:

to analyze the theoretical foundations of self-education in the higher education system;

to identify the specific features of laboratory work in the section "Electricity and Magnetism";

to develop methodological techniques and tools that promote students' independent learning activities;

to evaluate the effectiveness of the proposed methodology, provided that experimental data or practical implementation results are available.

Laboratory classes may be conducted either using physical equipment or within a software environment. Each laboratory assignment is aimed at studying a specific physical phenomenon and has its own unique structure: it differs in the experimental methodology, the characteristics of the instruments used, and the approaches to processing the obtained data. For this reason, when organizing self-education during laboratory classes, separate methodological guidelines are developed for each topic.

As a rule, methodological materials include:

a statement of the objective of the work;

a list of equipment and supplementary materials;
brief theoretical information;
a description of the laboratory setup;
a step-by-step experimental procedure;
algorithms for processing the results;
requirements for writing the conclusion;
control questions;
a list of recommended sources.

The objective of laboratory work reflects the expected outcome that the student should strive to achieve. It helps students focus on the key concepts and results at both the theoretical and experimental levels. At the same time, an element of self-education is introduced already at the initial stage: the student independently analyzes what type of task the work belongs to and which knowledge needs to be activated.

The list of equipment and materials used is usually placed at the beginning of the guidelines; however, a detailed description of their structure and operating principle is provided in the section devoted to the experimental setup. This allows students to become visually familiar with the instruments in advance, assess their condition, and, if necessary, inform the instructor about any malfunctions. Such actions also develop observation skills and responsibility, which are important elements of self-learning in engineering and scientific practice. The theoretical part provides a concise overview of the key concepts, as well as the necessary formulas with explanations of the symbols used. This allows the student, even within the framework of independent preparation, not to spend time searching for information in textbooks, but to proceed directly to solving specific tasks. Such an approach contributes to the development of skills in purposeful information search and selection, which is an important component of self-education.

The methodological guidelines for conducting laboratory work and processing the results contain a detailed sequence of actions: from setting up the instruments to entering data into tables, performing calculations, estimating errors, and recording the final results. These sections not only teach the technical aspects of the work, but also develop independent thinking, since working with real measurements requires students to interpret deviations and understand the causes of possible discrepancies. The section devoted to the conclusion helps the student summarize the results and formulate a well-reasoned outcome of the work performed. The ability to draw logical conclusions based on an experiment is a key component of both scientific activity and the process of self-development.

The final sections include control questions, which help assess the depth of understanding of the topic, and a list of references used. Answering such questions, especially when preparing without the assistance of an instructor, contributes to strengthening independence in learning and to a deeper mastery of the material. The methodology is based on the principles of actively involving students in the learning process, stimulating their critical thinking and reflection, as well as integrating independent work with practical laboratory experiments.

The specific features of laboratory classes in electricity and magnetism within this topic require not only a theoretical understanding of physical processes, but also the ability to apply knowledge to the analysis and conduct of experiments. Independent preparation for classes contributes to a deeper assimilation of the material and to the development of professional competencies. Specific methods and techniques:

preliminary independent study of theoretical material using textbooks, lecture materials, and electronic resources;

completion of individual and group projects related to laboratory work;

use of digital educational platforms and simulators for preparation and skills development;

discussion and analysis of laboratory results in groups with an emphasis on self-assessment and peer learning.

The developed methodology for organizing self-education in laboratory classes within the section “Electricity and Magnetism” is aimed at improving the quality of students’ assimilation of educational material and developing their independent learning skills. The implementation of the proposed methods contributes to the development of critical thinking, responsibility, and professional competence, which is an important aspect of training modern specialists.

Laboratory work is an integral element of the educational process, requiring students to possess thorough theoretical preparation, mastery of experimental procedures, confident use of measuring instruments, as well as skills in analyzing and interpreting the obtained data. It is not merely a practical task; rather, it is “experimental thinking in action,” where theory proves its validity through practice.

Conclusion

The effectiveness of laboratory classes is shaped at the intersection of several factors: the scientific and pedagogical competence of the instructor, the quality of lesson preparation, the level of laboratory equipment, methodological support, and, undoubtedly, the cognitive engagement of students. The key to successful mastery of the material lies not only in the transmission of knowledge, but also in creating conditions for its independent acquisition. Students’ independent work is an intellectual laboratory in which skills of analysis, critical thinking, and a research-based approach are formed. Its effectiveness is ensured by the availability of an integrated methodological framework: lecture materials, teaching aids, laboratory instructions, individual assignments, topics for essays and projects, as well as a system of knowledge assessment. Instructor supervision serves not so much as a means of control, but rather as feedback aimed at correcting and supporting the student’s learning trajectory. Thus, students’ independent work is not an isolated element, but an integral part of the educational process, contributing to the continuous improvement of both the learner and the instructor.

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