

THE IMPORTANCE OF PROBLEM-BASED TEACHING OF THE ELECTRODYNAMICS SECTION OF PHYSICS IN HIGHER EDUCATIONAL INSTITUTIONS

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Abstract

This article examines the importance of problem-based teaching technologies in teaching the electrodynamics section of physics in higher educational institutions. Modern reforms in higher education require the organization of the educational process based on innovative pedagogical technologies. In technical and engineering education, the development of students' independent thinking, creativity, and practical competencies is considered one of the main priorities. Since electrodynamics includes complex theoretical concepts, mathematical models, and practical processes, the use of problem-based teaching methods significantly improves the effectiveness of learning. The article analyzes the pedagogical significance of problem-based learning, its influence on students' scientific thinking, and the role of digital technologies, virtual laboratories, and simulations in teaching electrodynamics.

Keywords: Problem-based teaching, electrodynamics, physics education, higher education, digital technologies, virtual laboratories, scientific thinking, pedagogical technologies, simulations, engineering education.

Introduction

Today, higher education institutions are implementing educational reforms aimed at improving the quality of teaching and preparing competitive specialists. In this process, physics occupies an important place, especially in technical and engineering fields. The electrodynamics section of physics contains many abstract concepts, mathematical expressions, and complex physical processes.

Therefore, teaching this section effectively requires the application of innovative pedagogical approaches.

One of the most effective approaches is problem-based teaching technology. This method encourages students to think independently, analyze problems, and search for scientific solutions. As a result, students become active participants in the educational process rather than passive recipients of ready-made knowledge. Electrodynamics forms the theoretical basis of many modern technologies, including electric power engineering, electronics, telecommunications, automation, and information technologies. Consequently, improving the methodology of teaching electrodynamics is considered an important pedagogical and scientific task.

Theoretical Foundations of Problem-Based Teaching

Problem-based teaching is a pedagogical technology based on presenting scientific, logical, or practical problems to students and directing them toward independent solutions. According to pedagogical literature, problem-based learning includes the following stages:

- creating a problematic situation;
- understanding the problem;
- proposing hypotheses;
- testing through experiment or analysis;
- drawing conclusions.

The primary purpose of problem-based teaching is to develop students' scientific worldview, logical thinking, creativity, and professional competencies. In physics education, this method is especially effective because physical laws are generally understood through observation, experimentation, and analysis. Problem-based teaching allows students not only to memorize formulas and definitions but also to understand the physical meaning of concepts deeply and consciously.

The Importance of Problem-Based Teaching in Electrodynamics

Electrodynamics studies electric and magnetic phenomena and includes such important concepts as electric fields, Coulomb's law, electric potential, electromagnetic induction, electromagnetic waves, and Maxwell's equations.

Most of these concepts are abstract and mathematically expressed, which often creates difficulties for students.

For example, questions such as “Why does the movement of a magnet generate electric current?” or “Why does electric current create a magnetic field?” create problematic situations that stimulate scientific thinking. Through such questions, students analyze physical phenomena independently and develop analytical reasoning skills.

Problem-based teaching also helps students connect theoretical knowledge with practical applications. Students understand the operating principles of transformers, generators, electric motors, and communication systems more effectively when they solve practical and conceptual problems independently. In addition, this teaching method increases students’ interest in physics, develops creative abilities, and strengthens practical competencies.

Methods of Problem-Based Teaching in Electrodynamics

Several problem-based methods can be effectively applied in teaching electrodynamics.

Problem-Based Question Method:

At the beginning of a lesson, students are given thought-provoking questions such as:

- Why are birds not electrocuted when sitting on electric wires?
- Why does lightning produce enormous energy?
- Is it possible to see a magnetic field?

These questions motivate students and increase their curiosity about the topic.

Problem-Based Experimental Method:

The teacher demonstrates experiments while students analyze the causes of observed phenomena. For instance, when a magnet approaches a coil and the galvanometer needle deflects, students are asked to explain why electric current is generated.

Project Method:

Students prepare small projects such as:

- an electromagnet model;

- a solar panel system;
- electrical safety devices.

This method develops students' practical and creative skills.

Digital Technologies in Teaching Electrodynamics

Modern digital technologies create broad opportunities for teaching electrodynamics effectively. Virtual laboratories, PhET simulations, animations, 3D models, and artificial intelligence technologies help students visualize abstract concepts and better understand physical phenomena. Through virtual experiments, students can observe electric and magnetic processes interactively. For example, electromagnetic induction demonstrated through simulations is often more effective than traditional explanations. The advantages of digital problem-based learning include:

- interactivity;
- visualization;
- independent learning opportunities;
- rapid feedback;
- individualized learning approaches.

The integration of digital technologies with problem-based teaching significantly increases the effectiveness of engineering education.

Conclusion

Problem-based teaching of the electrodynamics section of physics is one of the important directions of modern higher education. This pedagogical technology contributes to the development of students' scientific thinking, independent learning skills, creativity, and professional competencies.

Through problem-based learning, complex theoretical concepts in electrodynamics are understood more deeply and consciously. Furthermore, the connection between theory and practice becomes stronger. The integration of digital technologies, virtual laboratories, and interactive simulations into the educational process improves the quality of teaching and increases students' interest in physics.

Therefore, the widespread implementation of problem-based teaching technologies in technical higher educational institutions is considered an urgent pedagogical task for preparing future engineers and specialists.

References

1. Maxmutov M. I. Organization of Problem-Based Education at School. Tashkent: Teacher Publishing House, 1981.
2. Ishmuhamedov R. Pedagogical Technologies. Tashkent, 2019.
3. Tolipov O., Usmonboyeva M. Applied Foundations of Pedagogical Technologies. Tashkent, 2017.
4. Muslimov N. Innovative Educational Technologies. Tashkent, 2021.
5. Mavlonova X.J. Principles of Using Methods of Teaching the Mechanics Section to Higher Educational Institution Students in Innovative Educational Conditions. Academic Research in Modern Science International Scientific Online Conference, pp. 11–18. <https://doi.org/10.5281/zenodo.8004624>
6. Mavlonova X.J. Teaching Students of Higher Educational Institutions in Innovative Educational Conditions. Innovations in Technology and Science Education, 2023, pp. 652–658.
7. Mavlonova X.J. Development of Physics Teaching Methodology for Students of Higher Educational Organizations. Ilm-fan, 1(17), pp. 33–37. <https://doi.org/10.5281/zenodo.8134159>.