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Development of School Students' Experimental Training in Physics Based on a Competency-Based Approach

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Abstract: This scientific work explores the theoretical and methodological foundations for developing school students' experimental training in physics based on a competency-based approach. The research emphasizes the formation of students' practical knowledge, skills, and abilities through experimental activities, as well as the enhancement of independent thinking, problem analysis, and interest in scientific inquiry. Furthermore, the application of modern pedagogical technologies and interactive methods in organizing physics experiments is justified from the perspective of the competency-based approach. As a result, methodological recommendations for the effective organization of experimental training have been developed and their positive impact on the quality of education has been analyzed.

Keywords: competency approach, experimental preparation, physics education, methodology, laboratory work.

Introduction. One of the main objectives of the modern education system is to develop not only strong theoretical knowledge in students but also practical skills and professional competencies. In particular, in the teaching of natural sciences, especially physics, experimental activities serve as an essential tool for developing students' scientific thinking, observational abilities, analytical reasoning, and creative approaches. Therefore, preparing school students through physical experiments and forming their experimental knowledge and skills is becoming increasingly important within the framework of a competency-based approach.

The competency-based approach in education aims to foster the comprehensive development of the learner's personality, prepare them for practical activities, and form socially significant competencies such as independent thinking, problem identification, and solution strategies. In physics education, this approach helps reinforce theoretical knowledge through experimentation, develops students' independent work skills, and strengthens interdisciplinary integration.

However, in practice, several challenges hinder the effective implementation of experimental activities in physics lessons. These include limited time allocated for experiments, a shortage of modern laboratory equipment, and insufficient methodological preparedness among teachers. As a result, students often demonstrate a weak attitude toward hands-on activities and exhibit a low level of experimental readiness.

This situation highlights the need to modernize physics instruction by organizing experimental activities based on a competency-based approach and improving their scientific and methodological foundation.

Theoretical Framework. The modern educational process is not limited to the transmission of knowledge alone; it is also aimed at fostering students' independent thinking, problem-solving abilities, and the development of competencies required to perform practical tasks. From this perspective, experimental training in physics represents a pedagogically integrated process that enables students to reinforce theoretical knowledge through hands-on experience, observe and analyze natural phenomena and laws, draw conclusions, and generalize findings within a unified educational system.

The content of experimental training primarily consists of laboratory work, practical exercises, experimental trials, observations, and data analysis. These components reveal the research-oriented

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nature of physics as a subject and play a crucial role in deepening students' critical thinking and enhancing their technological literacy.

To develop experimental training in physics based on a competency-based approach, the following theoretical foundations are essential:

1. **Constructivist pedagogy** – emphasizes knowledge acquisition through students' independent activity rather than passive reception of ready-made information;
2. **Active learning methods** – engage students as active participants in the learning process;
3. **Reflective approach** – encourages students to evaluate their learning, behavior, and self-assessment abilities;
4. **Innovative technologies** – provide opportunities for conducting experiments in interactive formats through simulations, virtual laboratories, and digital tools.

In addition, experimental activities structured in accordance with didactic principles such as scientific validity, systematization, practical orientation, and continuity contribute to the development of students' scientific thinking, observational skills, logical consistency, and the ability to make independent decisions.

The effective development of students' experimental training not only deepens their understanding of physical phenomena but also helps identify and encourage those who show interest in scientific research activities. In this process, the role of the teacher shifts from being merely a transmitter of knowledge to a facilitator, motivator, consultant, and collaborator in the student's learning journey.

Research Methodology. This research methodology is based on theoretical analysis, pedagogical experimentation, and observation methods. Throughout the study, the dynamics of the development of students' experimental skills were observed, and the results of the experiment were analyzed and evaluated.

Conclusion. The effectiveness of developing school students' experimental training in physics can be significantly enhanced through a competency-based approach. To achieve this, it is essential to establish appropriate pedagogical conditions, ensure adequate provision of laboratory equipment, and consistently engage students in research-oriented activities.

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