

STAGES OF DEVELOPING A COMPETENCY-BASED APPROACH IN PHYSICS LABORATORY SESSIONS

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Annotation: This article analyzes methodological approaches aimed at developing students' competencies through laboratory sessions in physics education. It highlights the stages of organizing a competency-based learning process, the roles of teachers and students, and aspects of collaboration in practical activities. The article contributes to the development of methodological foundations that meet modern educational requirements.

Keywords: competency-based approach, physics laboratory sessions, methodological design, teacher and student roles, experimental skills, practical training.

Introduction. In today's educational process, the competency-based approach plays a crucial role. This approach is aimed not only at ensuring that learners acquire theoretical knowledge but also at developing their ability to apply it in practice. The competency-based approach is particularly significant in physics laboratory sessions. This article examines the stages of developing a competency-based approach in physics laboratory sessions and its impact on the learning process.

1. Methodological Design Based on Components and Learning Objectives. To effectively organize physics laboratory sessions, the following methodological design stages play a key role:

Defining Goals and Outcomes. For each laboratory session, specific learning objectives are established. These objectives determine the theoretical knowledge (e.g., Newton's Second Law), practical skills (e.g., measuring force using a dynamometer), and competencies (e.g., analyzing observations and drawing conclusions) that students will develop. For example, in the laboratory experiment "**Determining the Acceleration of Free-Falling Objects**," students gain competency in experimentally verifying physical laws and representing results in graphical form.

Selecting the Content of Experiments. Experiments are chosen from topics that help students scientifically explain phenomena encountered in everyday life. For example, the experiment "**Testing Ohm's Law**" allows students to apply theoretical knowledge about electric current by testing it in a real electrical circuit. This enables them to understand and apply the topic in practice.

Determining Methodological Tools. In conducting laboratory work, it is advisable to use a combination of modern technologies and classical tools. For example, in the experiment "**Determining the Speed of a Moving Object**," students can utilize both traditional distance-measuring instruments and computer simulations. This helps develop their competency in performing experiments under various conditions.

Developing Analysis and Assessment Methods

In each session, students' activities and results must be evaluated. Assessment methods include observation tables, problem-based questions, final reports, and self-assessment sheets. For example, in the experiment "**Measuring the Amount of Heat**," students must analyze the obtained results, compare the experimental outcome with the theoretical value, and explain the reasons for any discrepancies.

The following table outlines these stages:

Stage Name	Content
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Defining Goals and Outcomes	The knowledge, skills, and competencies that students will develop are determined in advance.
Selecting the Content of Experiments	The content of the experiment is determined based on real-life scientific problems.
Determining Methodological Tools	Virtual laboratories, simulations, and traditional equipment are selected.
Developing Analysis and Assessment Methods"	Assessment criteria and methods for determining knowledge and skills are established.

2. Defining Didactic Objectives and Developing Competencies in Laboratory Work. The effectiveness of laboratory sessions primarily depends on the didactic approach, i.e., the correct methodological strategy for each stage of the session and a strategy aimed at developing student competencies. The first stage of this process begins with theoretical preparation. At this stage, students receive the fundamental theoretical knowledge necessary to understand the content of the experiment. For example, before conducting the "**Ohm's Law**" laboratory experiment, students must first acquire a theoretical understanding of current, voltage, and resistance. This stage serves as the foundation for their subsequent practical activities.

The next stage is **experiment design and planning**. The student independently plans how to conduct the experiment, determines the necessary equipment, reviews safety rules, and predicts the expected observational results in advance. This stage is particularly based on problem-based learning methods and helps develop students' **analytical thinking competencies**.

At the **practical execution stage**, the student directly conducts the experiment. They learn to use equipment, take accurate measurements, and record results properly. For example, in the "**Measuring Heat Energy**" laboratory experiment, the student uses a thermometer, calorimeter, and other tools. At this stage, **experimental discipline** is developed, fostering precision and consistency in work.

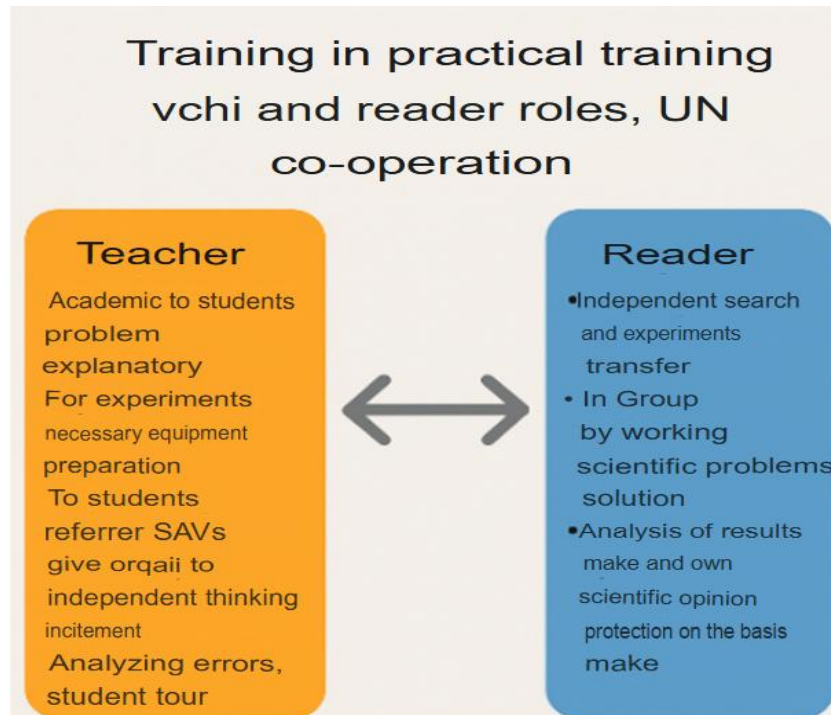
The **final stage** is **analyzing results and drawing conclusions**. The student analyzes the collected data, summarizes findings using graphs and tables, identifies differences between theoretical and experimental results, and formulates scientifically grounded conclusions. At this stage, students develop **logical thinking, data analysis skills, and the ability to defend their conclusions with reasoned arguments**.

3. Roles of Teacher and Student in Practical Exercises and Their Cooperation. For successful implementation of **physics laboratory exercises**, the **interaction between the teacher and the student** plays a crucial role. The **teacher** defines the **objective** of the laboratory session, explains the **scientific problem**, and outlines the **experiment's content**. Additionally, to **increase student engagement**, the teacher uses **guiding questions** to encourage **independent thinking**. The teacher also prepares the **necessary equipment**, familiarizes students with **safety rules**, and **analyzes errors** that arise during the experiment, offering ways to correct them. Thus, the teacher acts as a **mentor**, **providing guidance** while allowing students to **develop independence**.

Students actively participate in **laboratory work**, striving to complete the given tasks **independently**. They **design** the experiment, **plan** the practical work, and **execute** it. Through **group work**, they **advise** each other, **exchange ideas**, **analyze results**, and **draw collective conclusions**. This process helps them develop essential **competencies**, such as **collaborative teamwork**, **scientific reasoning**, and **defending their findings**.

During practical lessons, the interaction between the teacher and the student creates an interactive environment. The teacher takes on the role of an observer and guide. The student acts as an active participant and experimenter. As a result, laboratory sessions go beyond simple knowledge acquisition, transforming into a creative, analytical, and communication-based activity.

Conclusion and Results. A competency-based approach in physics laboratory classes helps



students develop independent thinking, problem-solving, analytical, and experimental competencies. Through this approach, students not only acquire fundamental knowledge of the subject but also gain the ability to apply it in various practical situations. Organizing laboratory work not just as an experiment but as an active tool for student reasoning enhances the effectiveness of education. This, in turn, fosters not only scientific thinking but also creativity, communication, and teamwork skills—essential competencies in the modern world. To successfully implement this approach, comprehensive methodological planning is required on one hand, while clear didactic goals and effective teacher-student collaboration play a crucial role on the other. Laboratory sessions based on a competency-based approach not only ensure a deep understanding of physics but also prepare students for future engagement in scientific activities, technological advancements, and innovative processes.

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