**Creating Problems Based on Results of Secondary School Physics Laboratory Work**

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**Abstract.** This article analyzes the issue of designing problems based on the results of laboratory work in solid-state physics within high school physics courses. Solid-state physics enables students to understand and apply essential physical laws encountered in real life. However, an analysis of existing textbooks and manuals reveals a lack of high-quality problems in this area. In addition to mastering the theoretical foundations of solid-state physics, developing students’ problem-solving skills based on laboratory experiment results is highlighted as a critical educational challenge today. By integrating laboratory results into problem-solving exercises, students can enhance their comprehension, critical thinking, and analytical skills.

**INTRODUCTION**

In the process of solving problems, the fundamental laws of cognitive activity are manifested. When introducing new concepts related to solid-state physics in the physics curriculum, defining tasks helps generate the need for knowledge and mastering the methods of acquiring it. The level of understanding of concepts in solid-state physics can be assessed by analyzing specific physical phenomena related to this field during problem-solving and by evaluating students' ability to consciously apply them.

Solving problems on topics related to solid-state physics allows students to better understand and retain the fundamental laws of physics while developing their ability to apply general theoretical principles to specific cases. In this context, problem-solving in solid-state physics serves as one of the teaching methods that not only involves studying laws, formulas, graphical relationships, and calculations but also actively applying them and analyzing specific physical situations.

There are various approaches to conducting problem-solving lessons: independent problem-solving by all students, solving problems on the board by individual students, the teacher solving problems on the board with the participation of students, and all students solving problems in stages while providing explanations.

Problem-solving in physics is an integral part of the learning process, helping to reinforce theoretical knowledge and link it to practice. Particularly, after conducting laboratory experiments in solid-state physics, creating and solving problems plays a crucial role in deepening students' understanding and developing their creative thinking skills.

During the problem-solving process, students develop skills in analyzing physical phenomena, applying mathematical methods, and connecting experimental results with theoretical knowledge. This research aims to evaluate the effectiveness of creating and solving problems in solid-state physics and to enhance students' knowledge and skills through various methods.

The study examines the connection between practice and theory, the significance of creative, experimental, and graphical problems, as well as the role of integrated problems based on real-life situations in the learning process. Based on this, the impact of problem-solving on students' deep understanding of physical phenomena, their ability to solve problems, and their independent thinking skills is analyzed.

R.A. Ackoff examines the contradictions between the knowledge taught to students in the education system and its application in real life. According to him, problems presented in lessons are often solved under ideal conditions, which reduces students' creative activity. He emphasizes the necessity of teaching students how to solve complex situations encountered in real-life problem-solving. This idea highlights the possibility of using real conditions as models when designing problems based on laboratory experiment results.

S.E. Kamenetsky and V.P. Orekhov recommend problem formulation as an effective pedagogical method. According to them, when students independently create problems, it enhances their creative thinking and logical analysis skills. This approach can be applied to designing problems based on laboratory experiment results. By formulating problems derived from experiments, students learn to apply the studied physical laws in practice.

Methods of Organizing Physics Laboratory Work

Physics laboratory work provides students with the opportunity to test and deepen their theoretical knowledge through practical applications. In particular, experiments related to solid-state physics introduce students to scientific research methods. Therefore, developing problems based on laboratory results enhances the effectiveness of lessons and improves students' analytical and problem-solving.

Research on Practical Lessons in General Secondary Schools

Studies emphasize the importance of efficiently utilizing time allocated for practical lessons and applying modern pedagogical methods. Connecting problem-solving tasks with laboratory work enhances students' comprehension of the subject and facilitates its practical application. This approach ensures that topics are studied in an engaging and relevant manner, making lessons more effective and meaningful for students.

Literature on the First Law of Thermodynamics and Heat Balance Equations

The First Law of Thermodynamics serves as the foundation for formulating problems related to the heat capacity of solids and heat balance equations. This law enables the analysis of physical phenomena by linking heat transfer and work. Applying this theoretical knowledge in laboratory experiments helps reinforce concepts and aids in the development of problem-solving tasks.

Practical Guides on Measurable Physical Quantities

Manuals on measuring the specific heat capacity, density, volume, and other physical quantities of solids provide detailed explanations of experiments and calculations. Utilizing these resources facilitates the creation of problem-solving tasks based on laboratory work, making the process more structured and effective.

Methods of Solving Physics Problems

The methodology of solving physics problems includes qualitative, experimental, graphical, and creative approaches. Experimental problems, in particular, are closely linked to laboratory work, fostering students' scientific inquiry skills. From this perspective, problems derived from laboratory experiments play a crucial role in enhancing creative thinking and analytical abilities.

Physics Textbooks in General Secondary Education in Uzbekistan

It has been noted that physics textbooks in Uzbekistan's general secondary education do not provide sufficient laboratory experiments and problem sets. Therefore, enriching the content by designing new problems and linking them to laboratory work is essential to enhance students' engagement and understanding of the subject.

R.A. Akoff [1] studied the contradictions between what students are taught in the education system and what they encounter in real-life activities. He emphasizes the following: "In real life, tasks of this kind are rarely given; instead, one usually has to navigate complex situations, and students are not trained for this." In lessons, students are placed in ideal conditions, as they are typically given assignments that are models of real situations. In such conditions, students' creative activity and independence are minimized.

Tasks also serve as a means of implementing interdisciplinary connections and developing the ability to establish these connections independently.

Problems do not always have to be presented in a ready-made form. "Assignments can be given to create and solve problems using literature—scientific, historical, as well as documentary and reference sources. In the methodology guide for problem-solving, S.E.Kamenetskiy and V.P.Orekhov emphasize that problem creation is a useful pedagogical method" [2]. According to them, such problems must be reviewed, and the most interesting ones should be analyzed. Based on the teacher's assignment, students can create problems after studying topics, using experiments and observations conducted at home, in laboratories, in nature, or in literature.

Present experimental studies in materials science, polymer physics, rheology, and electrical properties that provide a strong methodological basis for creating problem-based tasks from secondary school physics laboratory results. Despite their advanced scientific focus, these works are unified by the use of laboratory measurements, graphical analysis, and quantitative interpretation of physical relationships, which are directly transferable to school physics education [3, 4, 5, 6].

The reported experimental results can be adapted to develop calculation and analysis problems related to energy effects on materials, fluid viscosity, elasticity, thermal influence, and electrical resistance. Using real laboratory data to formulate physics problems helps students interpret experimental outcomes, analyze dependencies between physical quantities, and strengthen the link between theory and practice. This approach supports inquiry-based learning and meets the academic standards expected in Scopus-indexed educational research [7, 8, 9].

"In general secondary education schools, not much time is allocated to practical lessons, such as problem-solving and laboratory classes. Therefore, it is advisable to make the most of the allocated time and conduct lessons using modern pedagogical methods." [10, 11, 12, 13, 14, 15]

In physics, problems are classified into qualitative, experimental, graphical, and creative types based on their solution methods. However, this classification is not rigid, as solving experimental problems often involves verbal reasoning, graphical representation, and calculations.

The analysis of recent scientific and pedagogical literature shows that modern research increasingly emphasizes the integration of experimental activity with analytical problem solving in physics education. Studies in materials science, polymer physics, rheology, and electrical properties demonstrate the effectiveness of laboratory-based investigations that rely on precise measurements, data interpretation, and graphical analysis. Although these works are primarily focused on advanced physical systems, their methodological approaches are highly relevant to secondary school physics laboratories [16, 17, 18, 19].

The reviewed literature highlights that transforming experimental results into structured problem-based tasks enhances students’ conceptual understanding and analytical skills. Researchers underline the importance of using real experimental data to develop calculation, comparison, and interpretation problems, which help learners establish clear relationships between physical quantities. Moreover, the literature supports inquiry-based and problem-oriented learning as effective strategies for strengthening the connection between theory and practice in physics education. [20, 21, 22, 23, 24]

Overall, the analyzed studies confirm that laboratory results can serve not only as verification of theoretical concepts but also as a foundation for creating meaningful physics problems, thereby improving the quality and effectiveness of secondary school physics instruction.

"As an example of a physics laboratory experiment, we present 'Determining the Specific Heat Capacity of Solid Bodies'." [25, 26, 27, 28, 29]

**Objective:** To learn how to determine the specific heat capacity of a solid body.

**Required Equipment:** Calorimeter with a stirrer, balance, thermometer, three solid bodies of different masses made from the same material, and hot water.

Questions and Assignments:

What is a solid body?

What is the specific heat capacity of a solid body? What is its unit of measurement?

How does the heat capacity of objects depend on temperature?

What is the method of mixing solid and liquid bodies?

What are the main principles of the classical theory of heat capacity of solids? In which temperature range is the classical theory of heat capacity of solids valid?

The specific heat capacity of steel is 460 . Explain the physical meaning of this value.

Typically, the specific heat capacity of a substance in its solid state is almost twice as high as in its gaseous state. For example, for mercury, these values are 125  and 63 , respectively. How can this difference be explained?

In industrial applications, heated metal objects are often cooled in water, mineral oil, or air. In which medium does cooling occur the fastest, and why?

Explain the concept of specific heat capacity.

Using the heat balance equation, derive the formula for the specific heat capacity of the object mentioned in question 8 and explain it.

Analyze the results from the table and draw a conclusion.

According to its content, this law is based on the law of conservation of energy: the amount of heat supplied to a system is used to increase its internal energy and to perform work against external forces.

Δ*U* = *Q* + *A*  (1)

this law states that the internal energy ΔU of a body (or a thermodynamic system) can change due to the amount of heat Q supplied to it and the work A done on or by the system. Internal energy is a state function, meaning its change depends only on the initial and final states of the system.

The amount of heat and work depends on the type of process and is not considered a state function. Therefore, the heat capacity of a substance—the amount of heat required to change its temperature by one degree—also depends on the type of process.

In solid bodies, heat capacity depends very little on the type of process. This is because when heated, the volume of solid bodies changes very little, meaning the expansion work *A* = *p*Δ*V* is also small. Therefore, almost all of the heat supplied to a solid is used to increase its internal energy.

Heat capacity is divided into two types: molar and specific heat capacities.

Molar heat capacity refers to the heat capacity of one mole of a substance.

Specific heat capacity is a physical quantity that represents the amount of heat required to raise the temperature of a unit mass of a substance by 1°C.

In practice, a substance is heated from a certain temperature *t*1 to *t*2, and a specific amount of heat Q is supplied during this process. In such cases, the concept of the average specific heat capacity of the substance over this temperature range is introduced.

 (2)

One of the oldest methods for determining the heat capacity of solid bodies is the method of mixing solid and liquid substances. The essence of this method lies in the fact that when bodies heated to different temperatures come into contact with each other, the amount of heat lost by the hot body is equal to the amount of heat gained by the cold body. This holds true only if no heat is lost to the surroundings.

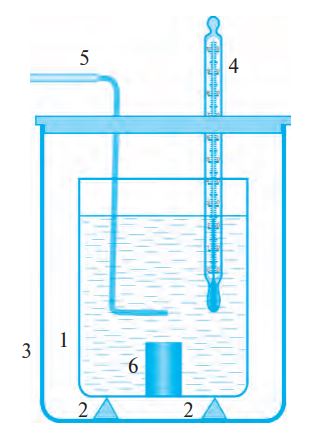
 (2)

**Procedure for Performing the Work**

1. The calorimeter used for the experiment is shown in Figure 1. *W* eigh the calorimeter and the stirrer together using a balance to determine their mass (*mk*). Since the calorimeter is made of aluminum, assume its specific heat capacity as .

2. Measure the volume of water (*Vw*) using a graduated cylinder and pour it into the calorimeter.

3. Calculate the mass of the water in the calorimeter using the formula *mw = ρwVw*, where *ρw* is the density of water.

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**FIGURE 1.** Appearance of the experimental device

4. Insert a thermometer into the calorimeter. Wait for some time until thermal equilibrium is established, then record the temperature of the water (*tw*).

5. Weigh the solid object whose specific heat capacity is to be determined and record its mass (*ms*).

6. Tie the solid object with a string and immerse it in boiling water. Wait for 2-3 minutes to allow thermal equilibrium between the object and the boiling water. Measure and record the temperature of the boiling water (*ts*) using a thermometer.

7. Quickly transfer the heated object into the calorimeter containing cool water. Stir the water in the calorimeter and record the final equilibrium temperature (*tf*) shown by the thermometer.

8. Determine the specific heat capacity of the solid object using the following formula:

 (4)

9. Repeat the procedure for two additional objects of different masses but made of the same material.

10. Calculate the average specific heat capacity <*cs*> for the three objects.

11. Record all obtained results in the following table 1.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **№** | ***mk*, *kg*** | ***mw*,** ***kg*** | ***ms*, *kg*** | ***ck*,** | ***tw*, ºC** | ***ts*, ºC** | ***tf*, ºC** | ***cs*,** | **<*cs*>,** |
| **1** |  |  |  |  |  |  |  |  |  |
| **2** |  |  |  |  |  |  |  |  |  |
| **3** |  |  |  |  |  |  |  |  |  |

**TABLE 1.** Table for recording all results obtained in the experiment

**METHOD**

The methodology of this study is aimed at developing problems based on laboratory work in solid-state physics and exploring effective ways to implement them in the educational process. The study employs the following methods:

1. Theoretical Analysis Method

This method involves analyzing existing educational materials, laboratory experiments, textbooks, and scientific-methodological literature on solid-state physics. The focus is on:

The content and practical significance of laboratory experiments;

Types of problems aimed at applying theoretical knowledge in practice;

The existing problem bank and the proportion of problems related to laboratory work.

2. Experimental-Testing Method

The practical part of the research involves conducting laboratory experiments in solid-state physics. These experiments follow several stages:

Developing an experimental plan – Identifying the necessary instruments and measuring tools, selecting the research object;

Conducting measurements – Determining physical quantities such as the specific heat capacity, density, and volume of solid materials;

Recording and analyzing results – Creating tables and graphs based on the experimental data and analyzing the obtained results.

3. Problem-Formulation Method

The formulation of problems based on laboratory experiment results is carried out in the following steps:

Selecting data – Choosing physical quantities and relevant measurements from the experimental results;

Constructing problem conditions – Writing problem statements based on selected data;

Determining the solution method – Identifying the physical laws and formulas necessary to solve the problem;

Review and refinement – Verifying and refining the developed problems in collaboration with other educators.

4. Pedagogical Experiment Method

A pedagogical experiment is conducted to implement the developed problems in the educational process. This experiment consists of two stages:

Trial lessons – Testing the problems in lessons and assessing their impact on students’ engagement and learning process;

Control assessments – Conducting control tests in experimental classes to analyze the effect of the problems on students’ knowledge acquisition.

**MODERN PEDAGOGICAL APPROACHES IN PHYSICS EDUCATION**

Modern physics education is increasingly oriented toward student-centered and inquiry-based learning approaches that emphasize active engagement, critical thinking, and the integration of experimental practice with theoretical knowledge. One of the key pedagogical trends is the use of laboratory-based learning, where students not only perform experiments but also analyze results and formulate problem-solving tasks based on empirical data. This approach transforms laboratory work from a purely demonstrative activity into a meaningful source of conceptual understanding and analytical skill development.

Another important approach is problem-based learning (PBL), which encourages students to solve real-world and experimentally grounded problems. By creating problems derived from laboratory results, students develop the ability to interpret measurements, identify physical relationships, and apply mathematical models to explain observed phenomena. This method enhances logical reasoning and supports the development of scientific thinking skills that are essential for further education in physics and engineering.

In addition, the integration of digital technologies and data analysis tools has become a significant component of modern physics education. The use of simulations, graphical analysis software, and digital measurement systems allows students to visualize complex processes and work with real experimental data more effectively. These technologies also support differentiated instruction, enabling learners with different levels of preparation to engage productively with experimental tasks.

Overall, modern pedagogical approaches in physics education focus on linking theory with practice, fostering analytical and research-oriented thinking, and creating learning environments where students actively construct knowledge through experimentation and problem solving.

**RESULTS**

According to the research results, applying problems derived from laboratory work in solid-state physics in the educational process has provided the following benefits:

Increase in Students’ Knowledge Level

Solving problems based on laboratory results has strengthened students' theoretical knowledge. Specifically:

Acquisition of Practical Knowledge – Students gained a deeper understanding by measuring physical quantities and observing their interrelations in practice.

Development of Logical and Analytical Thinking – The problem-solving process enhanced students' ability to reason logically and conduct analytical analysis.

Increase in Interest and Motivation

Problems based on laboratory work results sparked significant interest among students:

Connection with Practical Applications – Problems helped students comprehend physical phenomena in everyday life.

Creative Thinking – Non-standard problems encouraged students to explore innovative approaches.

Formation of a Problem Bank

During the research, a problem bank was created based on laboratory work in solid-state physics:

Types of Problems – Problems ranged from simple calculations to complex analytical and research-oriented questions.

Didactic Materials – Explanations, solution algorithms, and control questions were developed alongside the problems.

Positive Evaluation by Teachers

Teachers found the application of problems derived from laboratory results to be effective:

Enrichment of Teaching Methods – Using problems made it easier to explain complex topics.

Increased Classroom Engagement – Students participated more actively in lessons and showed interest in applying their knowledge in practice.

Development of Pedagogical Recommendations

Based on the findings, methodological recommendations were developed for teachers:

Selection and Formulation of Problems – It is recommended to solve problems based on laboratory work results immediately after conducting the experiments.

Collaborative Discussion and Group Work – A method was proposed where students are divided into groups to discuss and solve problems together.

**DISCUSSION**

This study analyzed the effectiveness of applying problem-solving based on laboratory work results in solid-state physics within the educational process. As the research findings were thoroughly examined, the following aspects were discussed:

1. Connecting Theoretical Knowledge with Practice

Solving problems based on laboratory work results enhanced students' ability to apply theoretical knowledge in practice. Specifically:

Deepening knowledge – Students developed a deeper understanding of topics by analyzing physical quantities and laws based on precise data.

Activating thinking processes – Logical and analytical thinking processes were observed to be more active during problem-solving.

Discussion: These findings confirm Dewey and Kolb’s experiential learning theories, demonstrating that students retain knowledge more effectively through hands-on experience.

2. Increasing Interest and Motivation

Problems derived from laboratory work results fostered high motivation and interest among students:

Practical relevance – Since the problems were linked to real-life phenomena encountered by students, the topics felt more relatable.

Encouraging creative approaches – Solving unconventional and complex problems pushed students toward creative thinking.

These results support the constructivist theory, which emphasizes that knowledge is best acquired not merely through memorization but through solving practical problems.

In general secondary schools, physics problems have been designed based on the results of laboratory work related to solid-state physics or conceptually similar topics.

Based on the results of laboratory work on topics related to solid-state physics in general education schools, or in terms of content, closely related problems are compiled:

1. How much dry wood must be burned to obtain the heat released when burning 20 kg of coal?

2. What is the specific heat of combustion of fuel?

3. How is the amount of heat released during the combustion of m of fuel determined?

4. What does the expression specific heat of combustion of fuel is equal to  mean?

5. What mass of alcohol releases 5.8 MJ of heat when burned? The specific heat of combustion of alcohol is equal to 2.9·107 .

6. How much dry wood needs to be burned to obtain the same amount of heat released when 25 kg of coal is completely burned?

7. If a Nexia car consumes an average of 10 liters of gasoline per hundred kilometers, how much heat is released per kilometer? The density of gasoline is 700 .

8. 12 kg of dry firewood was burned in a stove to cook food. One-fourth of the heat released during the burning of the firewood was absorbed by the food, while the remaining portion went towards heating the stove, pot, and air. How much heat did the food absorb before it was fully cooked?

9. 4.65 kg of water, taken at a temperature of 286 K, is heated to 308 K by immersing a piece of iron with a temperature of 773 K in water. Heat exchange with surrounding bodies and evaporation is neglected.

10. After a body heated to 100°C is immersed in water with a temperature of 10°C, a temperature of 40°C is established after some time. What will the temperature of the water be if, without removing the first body, another body of the same kind is immersed in it at a temperature of 100°C?

11. 24 kg of cement at a temperature of 5°C and 30 kg of water at a temperature of 35°C were mixed. Determine the solution temperature if the specific heat capacity of cement is 830 .

**12.** To increase the hardness and strength of steel products, quenching is used (heating to a certain temperature followed by rapid cooling). How much heat is required to heat a steel hammer with a mass of **500 g** from **17°C** to **817°C**? Calculate the amount of heat released by the hammer when it is cooled in liquid oxygen, which has a temperature of **-183°C**. The specific heat capacity of steel is **460** .

**13.** To determine the temperature of a furnace, a heated steel ball with a mass of **0.3 kg** was dropped into a copper vessel with a mass of **0.2 kg**, containing **1.27 kg** of water at **15°C**. Calculate the temperature of the furnace if the water's temperature increased to **32°C**.

**14.** A steel drill bit with a mass of **100 g**, heated to **84°C**, is quenched by immersing it in a container with machine oil at **20°C**. How much oil should be used to ensure that the final temperature of the drill bit does not exceed **70°C**? The specific heat capacity of oil is **2000** .

**15.** An aluminum calorimeter with a mass of **500 g** was filled with **250 g** of water at **19°C**. A metal cylinder with a mass of **180 g**, composed of two parts—aluminum and copper—was then placed into it. As a result, the water's temperature rose to **27°C**. Determine the masses of the copper and aluminum parts of the cylinder if its initial temperature was **127°C**.

**16.** An aluminum calorimeter with a mass of **29.5 g** containing kerosene at **20°C** was used. A tin cylinder with a mass of **0.6 kg**, preheated to **100°C**, was immersed in the kerosene. How much kerosene was in the calorimeter if the final temperature of both the kerosene and the tin was **29.5°C**, and **15%** of the heat was lost to the surroundings?

**17.** To what temperature was a steel cutting tool with a mass of **0.15 kg** heated during quenching, if after being placed in an aluminum vessel with a mass of **0.1 kg**, containing **0.6 kg** of machine oil at **15°C**, the oil heated up to **48°C**? Assume that **25%** of the heat was lost to the surroundings.

**18.** Using the law of Dulong and Petit, determine how many times the specific heat capacity of iron is greater than the specific heat capacity of gold.

**19.** To heat a metal ball with a mass of **10 g** from **20°C** to **50°C**, an amount of heat equal to **62.8 J** was used. Using the law of Dulong and Petit, determine the material of the ball.

**20.** Determine the mass of a weight if the mass of the calorimeter and the material from which it is made are known. Create a plan for performing the operations. **Equipment:** calorimeter, graduated cylinder, cold water, heater, vessel with water, thermometer, reference book.

**21.** To determine the specific heat capacity of copper, the following experiment was conducted. A copper object with a mass of **0.5 kg** was heated to **100°C**. It was then placed in an aluminum calorimeter with a mass of **0.05 kg**, containing **0.4 kg** of water at **15°C**. The final temperature stabilized at **23.4°C**. What value of the specific heat capacity of copper was obtained?

**22.** A **200 g** metal object, initially heated in boiling water to **100°C**, was placed in **400 g** of water at **22°C**. After some time, the temperature of both the water and the object became **25°C**. What is the specific heat capacity of the metal? Disregard heat loss to surrounding objects.

**23.** Using the calorimetric method, determine the material of a weight. Create a plan for performing the operations. **Equipment:** calorimeter with cold water, heater, vessel with water, weight on a string, graduated cylinder, balance with counterweights, dynamometer.

**24.** Suggest a method for comparing the specific heat capacities of two different metals without using a table of specific heat values.

**25.** Determine the specific heat capacity of soil. **Equipment:** dry soil, container, calorimeters, thermometer, water, heater.

**26.** Determine the specific heat capacity of kerosene. **Equipment:** balance without counterweights, sand, calorimeter with a known specific heat capacity, thermometer, electric stove, water, kerosene, two glasses (sand is used as a counterweight).

**27.** Determine the temperature of a metal object well-heated in the flame of a spirit lamp or candle.

These tasks can be solved at different stages of execution: during preparation for a laboratory experiment, during the experiment itself, or during its defense. However, a number of objective reasons do not allow for a significant increase in the number of such tasks to a level sufficient for acquiring the necessary skills and competencies.

The primary requirement for a well-constructed problem is the existence of at least one solution. In addition, the task should describe physical processes and contribute to understanding the physical essence of the studied phenomena. It is advisable for each problem to be presented as a complete, logically connected text. The nature and number of tasks depend on many factors, including the type of lesson, the topic being studied, and the assimilation of concepts related to solid-state physics, among others.

"When topics related to solid-state physics are taught using didactic principles and innovative methods, students develop a better understanding of solid-state physics concepts. Now, in reinforcing these topics, along with solving problems, students can also be assigned the task of creating problems both during lessons and as homework". [13, 14, 15, 16, 17, 18, 19, 20, 22] This teaching approach actively engages students and helps them develop the skills to apply their knowledge of solid-state physics in practice. Creating and solving problems is particularly effective during the reinforcement and revision of previously covered material. At the same time, it serves as an important factor in improving the quality of education. Additionally, it facilitates the calculation of results obtained from laboratory experiments in solid-state physics and connects theoretical knowledge with practical application.

**CONCLUSIONS**

In this study, the method of solving problems based on laboratory results in teaching solid-state physics was examined. The findings showed that:

Linking theoretical knowledge with practice: Solving problems based on data obtained from laboratory experiments helps students gain a deeper understanding of theoretical concepts and relate them to real-life situations.

Increasing student interest: Problems derived from practical experiments enhanced students’ interest in the subject, encouraging active participation in the learning process.

Developing logical and critical thinking: While solving complex problems, students improved their analytical thinking, logical analysis, and creative problem-solving skills.

Teachers' perspectives: Teachers expressed positive feedback, stating that using problems based on experimental data made it easier to explain complex topics and made lessons more engaging.

Practical application: The study results indicated that this method could be widely applied in teaching solid-state physics. It is also recommended to develop similar approaches for other branches of physics.

The methodology of solving problems based on laboratory results in solid-state physics enables students to study topics more deeply, develop logical thinking, and engage more actively in the learning process. Therefore, it is recommended to integrate this method into educational curricula.

**SUGGESTIONS**

Creating the necessary conditions for students to conduct experiments related to the lesson topic (laboratory equipment, demonstration materials).

Directing students' attention to the topic by asking questions based on real-life experiences related to the studied material.

Providing students with the opportunity to demonstrate their acquired knowledge.

Organizing the lesson using modern pedagogical methods.

Reviewing the existing curriculum and textbooks for physics education and making necessary modifications to ensure effective teaching and higher learning outcomes.

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