ISSN 2056-5852

THE DEVELOPMENT OF LABORATORY PRACTICE-TRAININGS IN THE IDENTIFICATION OF COMPARATIVE SPECIFIC HEAT CAPACITY IN LIQUIDS AND SOLIDS

Makhmanov Ergash Binokulovich
Senior Lecturer, Department of Physics, Karshi Institute of Engineering Economics, **UZBEKISTAN**
E-mail: emaxmanov.1976@mail.ru

ABSTRACT

This article highlights techniques concerning the organization of the educational process using modern laboratory equipments in teaching physics; the improvement of students' logical thinking abilities and their intellectual capabilities. Furthermore, the issues on the practical proof of the result obtained with theoretical values are provided, regarding the amount of comparative specific heat capacity of various chemical elements, including liquids and solids, depends on the type of substance.

Keywords: Temperature, duar pot, comparative specific heat capacity, thermometer, amount of heat, heat balance equation, specimens, calorimeter.

INTRODUCTION

In the present state of the educational process, the high interest and great attention to the use of interactive methods, innovative technologies, pedagogical and information technologies are increasing day by day. One of the basic grounds for this issue is observed in the following copmarison.While students used to acquire only ready-made knowledge in the traditional education, they begin to search for their own knowledge, study and analyze it independently, and draw conclusions in the usage of modern technologies.

In educational activities, the application of innovations leads to the highest results in the implementation of educational goals. It is substanciated on a principle that allows management and control.

As present in all areas, in education "innovation" is based on certain conceptual approaches to activity, the result of which serves to develop, improve or change a particular system.

In teaching physics, the application of multifunctional teaching aids in laboratory classes will be a problem-solving research of an innovative nature that will contribute to the effective organization of independent research work. This further develops students' creative and independent abilities.

In the laboratory practice-trainings, the necessery characteristics are observation, abstraction of important aspects of the event, hypothesis making, analysis and comparison of the obtained data, generalization and systematization of experimental factors.

The content, method, and tools of teaching physics can be a learning experiment in teaching physics. The knowledge of students expand and develop in the course of laboratory practice-trainings. Students develop logical thinking, practical and experimental skills in the process of performing and analyzing laboratory work. Demonstrating the fact that the application of physical phenomena in engineering, manufacturing, and processes in nature, convinces them of the application of the laws of physics. Indeed, it is important to use the component of a learning experiment in physics to shape cognitive interest. Impressions from laboratory work will be remembered for a long time, the feeling of skepticism about a law will disappear, the desire to know the real cause of the observations and try to repeat it will encourage students to experiment. However, opportunities to develop students' thinking, especially logical thinking, should be indicated. Solving a logic problem involves a complex thought process. This allows the execution of a certain sequence of logical actions, working with concepts, using different logical constructions, and building a clear and accurate thinking chain with intermediate and final conclusions.

Materials and methods

In the process of laboratory classes, the basic directions of the formation of logical thinking, as an integral part of cognitive competence of students include:

- the organization of research activities aimed at enabling students to see their theoretical knowledge of physics in the laboratory;
- the research of physical laws, optimal methods of scientific analysis of objective evidence and support of science-based criteria;
- the improvement of students' ability to work with different sources: literature, modern equipment, tools, devices;
- having the ability to express and defend their point of view based on the results of small experiments conducted by themselves;
- enlarging the use of information technology in the performance of laboratory work and the announcement of the results, the creation of new presentation materials.

Physics, mathematics, computer science, chemistry and biology, which are the main subjects studied in the first year of higher education, play an important role in the development of scientific and logical thinking as an integral part of students' cognitive competence. The formation of students' scientific thinking skills in physics has its own characteristics, which should be carried out in the following areas: in the process of learning, students understand that they must not only solve a problem or do laboratory work on a specific topic, but also know that it is aimed at a specific goal; that is, to develop students' scientific outlook and interest in science on the basis of proof of a physical phenomenon or law; it will be necessary to form in students' knowledge of the principles and features of scientific thinking.

In the following part, below we present the connections between physical quantities based on an innovative approach with modern equipment using laboratory work **"Determination of specific heat capacity of liquids and solids"**. The modern device for laboratory work is the equipment imported from Germany and slightly different from the ones used in the education system so far.

Sample: **Exercise 1. Determination of the temperature of the liquid mixture.**

Initially, students will get acquainted with the description of the work of this laboratory. The teacher explains the theoretical part of the work, the necessary equipment, the sequence of work, the necessary physical formulas on the board. The results obtained are recorded in the table.

The aim of the work is to determine the temperature of the mixture using the heat balance equation and compare it with the theoretically determined value.

Necessary tools and equipment: Calorimeter, water, graduated cylinder, utensils, thermometer (see Fig. 1), mixer, scales and its stones, heater.

Sequence of work:

1. Let water of mass m_1 and temperature t_1 be poured into the first container.
2. Heat the water in the first vessel to a temperature of 100^0 C.
3. Mix 100^0C water with water in the second container.
4. Wait a certain time $(t_1 > t_м > t_2)$ until the mixed water reaches equilibrium $(t_м)$.

Using the heat balance equation,

$$Q_{given} = Q_{taken} \quad (1)$$

$$c_1 m_1(t_1 - t_м) = c_2 m_2(t_м - t_2) + C(t_м - t_2) \quad (2)$$

From this C=cm is the specific heat of the calorimeter, the value of which is taken as 125 $\frac{J}{degree}$. $c_1 = 4{,}2\ 10^3\ \frac{J}{kg\ degree}$- is the comparative specific heat capacity of water.

The temperature of the mixture is found using the following formula:

$$t_м = \frac{c_1(m_1 t_1 + m_2 t_2) + C\,t_2}{c_1(m_1 + m_2) + C}. \quad (3)$$

The following table is filled up for each liquid.

Table 1

Experiment	m_1, kg	m_2, kg	t_1, ^{0}C	t_2, ^{0}C	$c_1, \frac{J}{kg\ degree}$	t_m	
						Practical	Theoretical
1	0,103	0,0815	100	41,5	4,2 10^3	70,4	69,4

Students perform this laboratory work under the guidance and direct supervision of the teacher.

Exercise 2. The aim of the work: To study the first law of thermodynamics, methods for determining the heat capacity of solids and liquids.

Necessary tools and equipment

- ✓ Dewar lid (1)
- ✓ Dewar bowl (2)
- ✓ Mobil-CASSY® universal tool (3)
- ✓ Thermometer (4)
- ✓ Heater (5)
- ✓ Lead, copper, glass specimens (6)
- ✓ Steam generator (7)
- ✓ Glass 400 ml (8)
- ✓ Steam container lid, 7 mm Ø (9)
- ✓ School and laboratory scales (10)
- ✓ Heat protection gloves.

The amount of heat ΔQ absorbed or released during the heating or cooling of a body is directly proportional to the change in temperature Δt and the mass m:

$$\Delta Q = cm\Delta t. \quad (4)$$

Here, the coefficient of proportionality- c is called the specific heat capacity of the body, and its value depends on the type of material. In this experiment, the specific heat capacity of different materials in the particular form is determined.

For each case, the specimens are weighed and heated to t_1 temperature, then the mass is weighed and poured with water of temperaturet_2. After good mixing, the water with specimens reaches the total temperature in exchange for heat exchange $t_м$. In this case, the amount of heat released from the specimens is ΔQ_1.

$$\Delta Q_1 = c_1 m_1(t_1 - t_м). \quad (5)$$

(Here, m_1-the weight of the specimens c_1- is comparative specific heat capacity of the specimens) the amount of heat absorbed by the water and the calorimeter $\Delta Q_2 + \Delta Q_3$ is equal to the following:

$$\Delta Q_2 = c_2 m_2 (t_M - t_2). \quad (6)$$

$$\Delta Q_3 = c_3 m_3 (t_M - t_2). \quad (7)$$

$$\Delta Q_1 = \Delta Q_3 + \Delta Q_2 \quad (8)$$

$$c_1 m_1 (t_M - t_1) = c_3 m_3 (t_2 - t_M) + c_2 m_2 (t_M - t_1). \quad (9)$$

Here, m_2-the weight of the specimens c_2- is comparative specific heat capacity of the specimens. m_3- the weight of calorimeter. c_3- comparative specific heat capacity of the calorimeter.

The specific heat capacity of the specimen $c_1 -$ is calculated using the following formula for the values $t_{M,}$ t_1 , $t_{2,}$ m_1 and m_3 measured experimentally:

$$c_1 = \frac{(t_M - t_1)(c_3 m_3 + C)}{m_1 (t_1 - t_M)} \quad (10)$$

RESULT AND DISCUSSION

1. Figure 2 shows the experimental device.
2. Set the heater on the tripod.
3. Fill the steam generator with water and connect it to the hose connection above (steam inlet) of the heater using the steam tank pipe.
4. Connect the steam tank pipe to the hose connection (steam outlet) at the bottom of the heater and insert the other end of the pipe into the beaker. Make sure that the pipes are securely fastened in all connections.
5. Fill the sample chamber of the heater with lead specimen and close it as tightly as possible with a stopper.
6. Connect the steam generator to the mains and then heat the pits in the heater for 20-25 minutes by passing steam through them.
7. During this time, determine the mass of the empty duar vessel, then pour about 180 g of water into it.
8. Place the Dewar dish in the holster and place the thermometer or temperature sensor accordingly. Measure the water temperature t_2.
9. Open the lid of the Dewar container and push it aside to insert the net intended for the samples into the Dewar container.
10. Place the specimens with a temperature of 100^0 C in a sample tray, close the lid and mix them thoroughly with water vapor.
11. Determine the temperature of the mixture when the water temperature does not rise.
12. In addition, determine the mass m_1 of the specimens. Repeat the experiment with copper and glass specimens.
13. Record the results of the experiment in Table 2.

Table 2

Substance	m_1, g	m_3, g	t_1, ^{0} C	t_2, ^{0} C	t_M , ^{0} C
Steel	131,5	180	100	100	34.6
Copper	76	180	100	100	31

14. Record the values of the specific heat capacity determined in the experiment and the corresponding results obtained from the literature in the second table.

15. In Table 2, enter the specific heat capacity values of the substances calculated according to formula (10).

Table 3

Substance	Experiment c, $\frac{kJ}{kg\ degree}$	Literature results c, $\frac{kJ}{kg\ degree}$
Steel	0,502	0.500
Copper	0.3864	0.385

Table 3 shows the specific heat capacity of the substances calculated on the basis of formula (10) and the values given in the literature.

CONCLUSION

The results of the experiment show that as a result of an innovative approach to laboratory training in physics:

- Students will be able to determine the temperature of the mixture using the heat balance equation and compare it with the theoretically found value in the study of the topic "**Determination of specific heat capacity of liquids and solids"** ; the ability to work with modern equipment is formed, they perform independently, find the necessary formulas and come up with a solution by putting the results;
- They learn to assemble a laboratory device in the study of the first law of thermodynamics, methods for determining the heat capacity of solids and liquids; they get acquainted with the structure and working principle of each device, observe the process, make sure in practice that the value of the specific heat capacity of different chemical elements depends on the type of material;
- At the same time, students learn the material clearly, consciously and deeply, develop logical thinking skills;
- The need to find and explore new ideas appears in the process of research, it is achieved that the student is not indifferent during the lesson, his logical thinking, creativity, a constant increase in interest in knowledge in the learning process;

It should be noted that step-by-step laboratory work requires creative thinking, intellectual potential and innovation from the student. This will lead to a relentless search in the students' subsequent activities.

REFERENCES

1. Ishmuradova G.I., Makhmanov E.B. Formation of students' skills in solving logical problems in physics. // Modern Education, 2020,3 (88) -11-17-p.
2. Ishmurodova G.I., Maxmanov E.B. Conducting laboratory classes in physics on the basis of an innovative approach.// Modern education, 2019,8 (81) -16-22-p.
3. Douglas C. Giancoli, Physics: Principles with Applications, Prentice Hall; 6th edition January 17, 2004 USA.
4. Raymond A. Serway, John W. Jewett. Physics for Scientists and Engineers with Modern Physics, Cengage Learning; 9 edition (January 17, 2013), Brooks/cole 20 Channel Center Street Boston, MA 02210 USA.
5. Sultanov N. Physics course. Textbook. – T., Science and Technology, 2007.
6. Trofimova T.I. Physics course. – M., Academy, 2007
7. Q.SH.Tursunov, CH.H.Tashhulatov.Laboratory lessons in physics.-T.Tafakkur wing, 2017.

8. Kahor Tursunov, Ergash Makhmanov. Methodology Forming The Concepts Of Astronomy And Cosmonautics In Initial Classes: International Journal of Advanced Science and Technology Vol. 29 No. 9s (2020): Vol. 29 No. 9s (2020) Special Issue
9. Turaev S.J. Methodology of formation of professional competences of students on the basis of programming languages. European Journal of Research and Reflection in Educational Sciences Vol. 8 No. 8, 2020 Part III ISSN 2056-5852. – P.21-26.