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Physics Laboratory and Demonstration Experiments Organization on the Basis of International Technology

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Abstract. In this article, the educational system, laboratory and demonstration experience of developed countries were studied and analyzed. For higher, secondary specialized and general educational institutions, laboratory and demonstration experiments based on new physical technology are proposed and their examples are given.

Keywords: international, higher, specialized secondary, general education, physics, laboratory, demonstration, experiments.

1. Introduction

In the decision of the President of the Republic of Uzbekistan dated September 5, 2018 "On the program of measures for the further improvement of the public education system of the Republic of Uzbekistan in 2018-2021" No. PQ-3931, improving the quality of education and introducing innovative educational technologies defined as one of the tasks. According to the content of this decision, based on the experience of the educational system of developed countries, it is planned to develop new modern state education standards and curricula for general secondary education and adapt the content of the program to international technology students.

The main part. One of the main approaches to the modernization of modern physics education is to improve the laboratory and demonstration experiences of the physics course at school, that is, to implement the connection between its content, implementation methodology, laboratory and demonstration. The problem of improving the laboratory and demonstration experiments of teaching physics is not a new problem, but it has always required revision along with the development of science and technology. Today's digital education requires rethinking even in the age of resources.

In the second half of the last century, scientific research was conducted by the Organization for Economic Cooperation and Development (OESD) in order to find solutions to various social and economic problems that have arisen on a global scale. In particular, on the basis of this organization, measures are being taken to organize the educational process based on the criteria of international research (PISA, TIMSS) in order to develop the general secondary education system, which is one of the main links of education in the world. The reason for this OESD's focus on the general secondary education system is that it promotes the idea that the quality of school education depends on the development of competitive and creative thinking personnel for any organization in society.

In the developed countries of the world, great attention is paid to inculcating these international research criteria in general secondary education physics laboratory and demonstration experiments. For example, in Australia, Canada, Germany, France, Italy, Japan, Korea, Portugal, Turkey, Poland and other countries, the methods developed on the basis of the international research criteria of the educational process have been implemented in general secondary educational institutions. It should be said that, among developed countries, many reforms are being implemented in our republic, especially in natural science laboratory and demonstration experiments. In particular, reforms are being implemented to introduce and improve the methodology of performing laboratory and demonstration experiments in the creation of a new generation of science curricula, study guides and textbooks, as well as in the teaching of exact and natural sciences.

It is known that the general competences related to basic and science are specified in the current DTS, and one of the main competencies is "Mathematical literacy, awareness and use of science and technology innovations". This competence allows students to make personal, family, professional and economic plans based on accurate calculations, to be able to read various diagrams, drawings and models in daily activities, to use science and technology innovations that ease human labor, increase labor productivity, and lead to favorable conditions. refers to the formation of receiving abilities [5,6].

In order to select talented young people in all regions of our republic, schools under the Presidential Agency were opened and they were specialized in teaching based on international assessment requirements. STEAM teaching technology is considered one of the technologies of organization based on the requirements of international evaluation in general education schools, and this technology is a modern approach to education that connects with real life. Initially, natural sciences, technology, engineering and mathematics were integrated in the teaching of international assessment technology, but due to the needs of the times, Art (art) was added to it and it was called STEAM technology. The Massachusetts Institute of Technology (MIT) is considered a leader in the organization of the educational process based on the STEAM approach to education, and the main motto of its university in education is "Mind and hand". Scientists of the Massachusetts Institute of Technology have established STEAM educational centers for implementation of STEAM technology activities. The main idea of the STEAM technology approach to education is the existence of such an important principle as the theoretical unity of practice. That is, during the study of science, attention is paid not only to intellectual thinking, but also to the formation of practical application skills. The approach to education based on STEAM technology not only provides students with theoretical knowledge, but also directs them to practical and social spheres.

Educational practice shows that when they start learning physics at the elementary stage, they actively participate in the first topics taught in the lesson and students actively participate in the physics lesson. However, as students get older, the number of students interested in physics decreases. Due to lack of updating of teaching methods by teachers, interest in studying science is lost among students.

It is known that TIMSS (Trends in International Mathematics and Science Study) is an international research criteria for evaluating students' theoretical and cognitive (remembering, identifying, sorting, calculating and reasoning) knowledge in mathematics and natural sciences. In this international evaluation system, criteria are developed by subject:

Below is an international evaluation in general education schools based on STEAM technology integrated option of teaching in natural sciences[4,5].

1. Instead of the science of the world around us (1 hour per week, total 33 hours) (1 hour per week, total 33 hours).
2. Instead of the science of the world around us (1 hour per week, 34 hours in total) (2 hours per week, 68 hours in total).
3. Science (1 hour per week, total 34 hours) instead of science (2 hours per week, total 68 hours).
4. Science (1 hour per week, total 34 hours) instead of science (2 hours per week, total 68 hours).
5. Instead of geography and biology (2 hours per week, 68 hours in total) (2 hours per week, 68 hours in total).
6. Instead of geography, biology, physics (6 hours per week, 204 hours in total) (3 hours per week, 102 hours in total).

Including a total of 28 laboratories and more than 150 demonstration experiments in physics must be completed as a minimum requirement.

Below are some of the new demonstration experiments for the physics education system in the modernization of physics education.

Organization of laboratory work based on superconductors (high-temperature superconductors).

Purpose of work: to have an idea about high-temperature conductive samples and experimentally observe one of their magnetic properties.

The main purpose of writing these laboratory and demonstration experiments is to give general school students a little information about this area and introduce them to new discoveries.

Below are examples of demonstration experiments [8,10].

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Determination of what state (superconducting or normal) the materials are in.

These include the following:

a) If the sample is prepared in the form of a rectangle, it is done as follows.

Experiment 1

1. Place several magnets with their poles as shown in Figure 1.

2. Liquid nitrogen is poured into the penoplast container and the sample is lowered.

3. Place the permanent magnets as shown in Figure 1.

4. Place the liquid nitrogen container with the sample at a certain distance from the magnets.

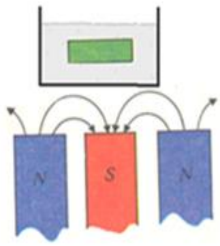

Fig № 1

5. After a certain time, the sample is raised to a certain distance from the bottom of the container, and if it hangs on the magnets, it will be in the superconducting state.

6. If the magnets are rotated around their axis, the sample should also rotate.

b). If the sample is prepared in the form of a bubble, experiment 2 is determined by performing the following procedure.

Experiment 2

1. Tightly tie a high-temperature superconductor (in the form of a ceramic bubble) to a thin thread 40-50 cm long and hang it on a tripod.

2. Bring a permanent magnet close to a superconducting sample suspended by a string.

3. There is no interaction between the sample and the field created by the permanent magnet T>Tc (Fig. 2a).

4. Move the magnet away from the sample.

5. Immerse the sample in liquid nitrogen and bring the magnet closer.

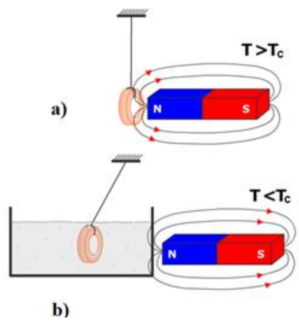

Fig № 2

6. You observe that the sample deviates from its previous position by a certain angle T<Tc (Fig. 2b).

7. Remove the liquid nitrogen container from the sample and move it to a certain distance.

8. After a few seconds, you will see that the sample approaches the magnet T>Tc (Fig. 2a).

9. Repeat the experiment several times and explain the physical nature of this phenomenon.

Experiment 3

Solar energy conversion technology [7].

The principle of operation of a solar power plant consisting of semiconductor solar cells can be divided into the following stages:

1. The light energy falling on the solar cell (panel) turns into constant electrical energy.

2. Produced constant electricity charge tracking device

(controller) is transmitted to the battery. The function of the controller is to control the charging and discharging of the battery.

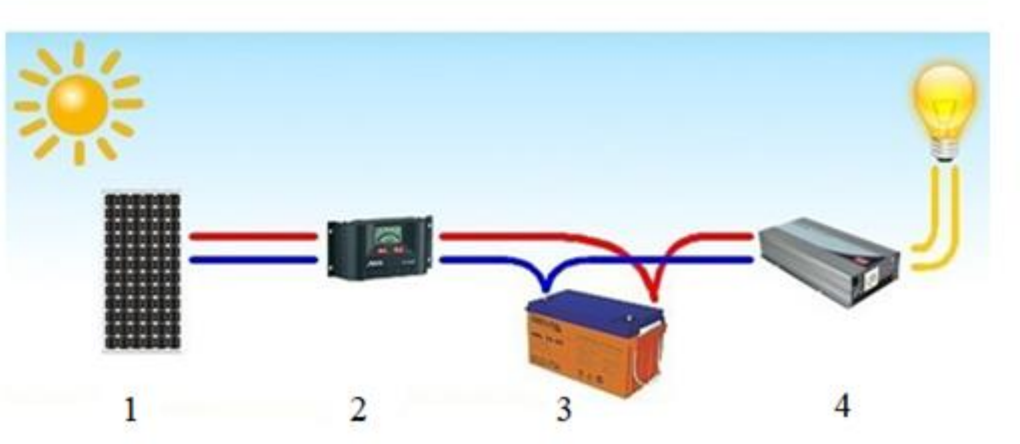

Fig № 3

3. A rechargeable battery is needed to store electricity.

4. An inverter is a device that converts direct current into alternating current (alternating current into direct current) by changing the voltage value in a certain range (12-220 V). Our customers need an alternating current source to turn on light bulbs, TVs and refrigerators, and for that we use a device called an inverter.

Teachers can use the above schemes to learn the fundamental and practical basics of solar energy and electricity generation.

Experiment 4.

Determination of amperage [9].

1. Place the tripods on the table as shown in the picture.

2. Place the horseshoe magnet on the table.

3. Connect the leads to the source as shown in the picture.

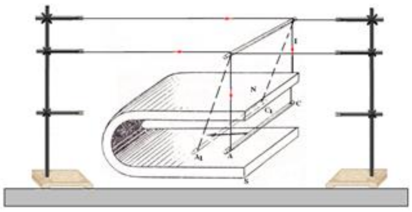

Fig № 4

4. Turn on the source.

6. Watch the conductor As move into the magnet.

7. Delete the source.

8. Reverse the direction of the current and observe that the direction of movement of the AS conductor changes.

9. Make sure that the magnetic field exerts an Amperes force on the current conductor.

10. Experimentally determine that the amperage is proportional to the length of the part of the conductor in the magnetic field, the current passing through it, and the sine of the angle between the directions of the current and the magnetic field induction vector.

11. Repeat the experiment several times.

The conclusion. Improvement of the methodology of conducting laboratory and demonstration experiments in physics, enrichment with modern techniques and technologies revealed promising opportunities for training students, laboratory and demonstration competence is improved. Improving the quality of education ensures efficiency by creating effective opportunities to improve the organization and conduct of laboratory and demonstration experiments in educational institutions.

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