

VIRTUAL LABORATORIES AND MOBILE LABORATORY STANDS AS EDUCATIONAL TECHNOLOGIES IN PHYSICS TEACHING

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Abstract: The article analyzes the use of educational technologies in teaching physics using virtual laboratories and mobile laboratory stands.

Keywords: physics, virtual laboratories, mobile laboratory stands.

The constant development of science and technology leads to the emergence of new innovative technologies, as well as the development and improvement of existing ones.

Since physics is the basis of scientific and technological progress, the importance of physical knowledge and the role of physics are constantly increasing. Practical methods and means of cognition are in demand in almost all spheres of human activity. The use of practical knowledge and skills is necessary for every person to solve problems that arise in everyday life [1].

A virtual laboratory, used as an innovative technology, is a software and hardware complex that allows experiments to be carried out without direct contact with real devices or in its complete absence.

Compared to traditional laboratory work, virtual laboratory work has several advantages. Firstly, there is no need to purchase expensive equipment and materials hazardous to health. Secondly, it will be possible to simulate processes that cannot occur in laboratory conditions. Third, virtual laboratory work provides a more visual representation of chemical or physical processes than traditional laboratory work. However, working in a virtual laboratory also has its disadvantages. The main thing is not to come into direct contact with the object of study, instruments, or equipment. Therefore, in the educational process, the most reasonable solution is to combine traditional and virtual laboratory work, taking into account their advantages and disadvantages[2].

Electronic circuit simulators are used to study real electronic devices or circuits. Examples of this include:

Free online simulations such as EasyEDA, DcAcLab, EveryCircuit, DoCircuits, PartSim, 123Dcircuits, TinaCloud, Spicy schematics, Gecko simulations, Circuit Sims and [Gnucap](#), [KTechLab](#), [Logisim-evolution](#), [LTspice](#), [Micro-Cap](#), [Ngspice](#), [PSPICE](#),

FOR-TI, Qucs, Qucs-S, SAPwin, SPICE, TINA-TI, Xyce, Qucs, Multisim - computer design simulators of various types of electrical circuits.

As another innovative technology, we can mention mobile educational laboratory stands. Experiments serve as a method of teaching and research in physics. Therefore, the creation of educational laboratory stands for the study of physics, especially mobile educational laboratory stands, is a hot topic. Such stands allow students to conduct experiments and practically observe phenomena associated with electric current[3].

A mobile educational laboratory stand is a set of equipment and software that allows you to conduct a variety of experiments and research. These stands are portable or foldable, allowing them to be used in any classroom or laboratory.

The use of mobile stands for physics laboratories in an educational environment has a number of advantages.

First, they provide a variety of experiences that are difficult or even impossible to achieve through traditional teaching methods. They are equipped with necessary instruments and devices such as ammeter, voltmeter, generator, oscilloscope, etc., which enable various measurements and studies to be carried out, resulting in more accurate results and data analysis.

Secondly, mobile laboratories allow students to independently conduct experiments and research, which develops their practical skills and helps them better understand the material. Students can take measurements, analyze the data obtained, draw conclusions and independently test theoretical assumptions.

Thirdly, mobile physics laboratory stands are very flexible and adapt to various tasks and needs of the educational process. They can be used both at the school curriculum level and for more complex and in-depth research in higher education institutions. In addition, these stands can be combined with computers and interactive whiteboards, creating opportunities for interactive learning and teamwork[4].

Finally, mobile stands for physics laboratories help reduce the cost of purchasing individual elements and instruments for conducting experiments. The stand includes all the necessary equipment, which makes it cost-effective for a school or university.

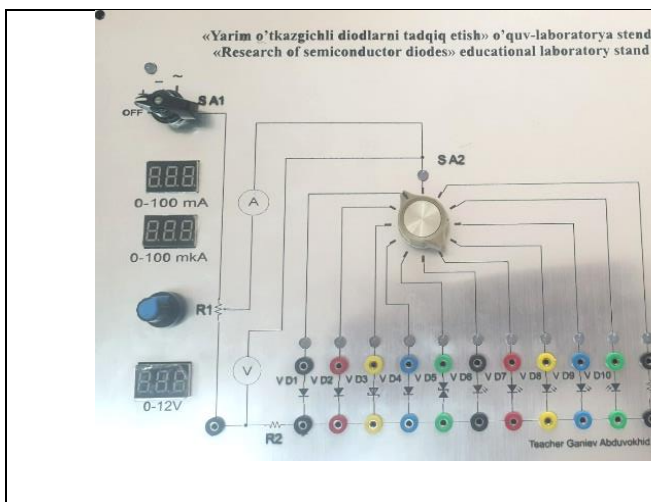


Fig. 1. Training laboratory stand for research of semiconductor diodes

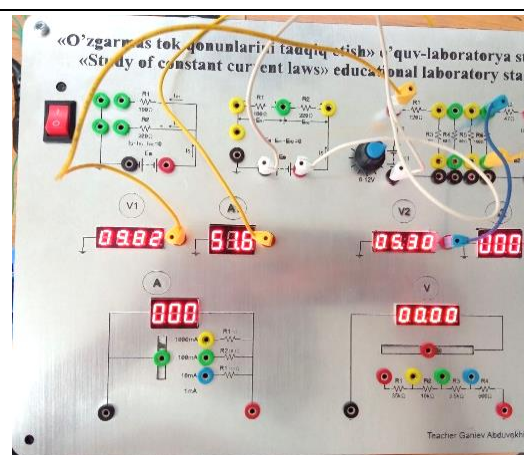


Fig. 2. Educational laboratory stand for studying the laws of direct current

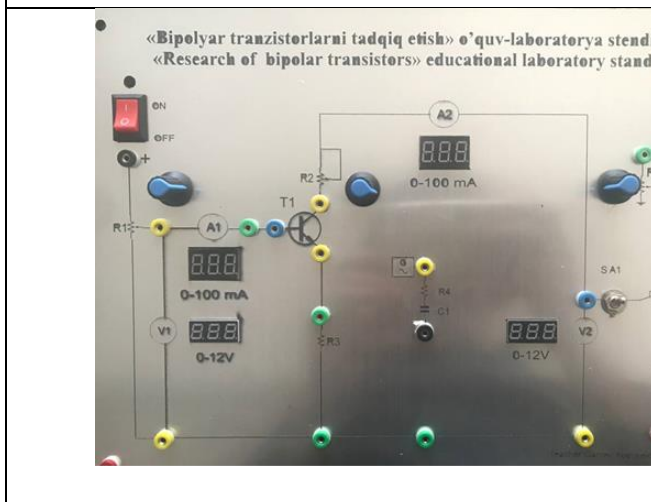


Fig. 3. Training laboratory stand for research of bipolar transistors

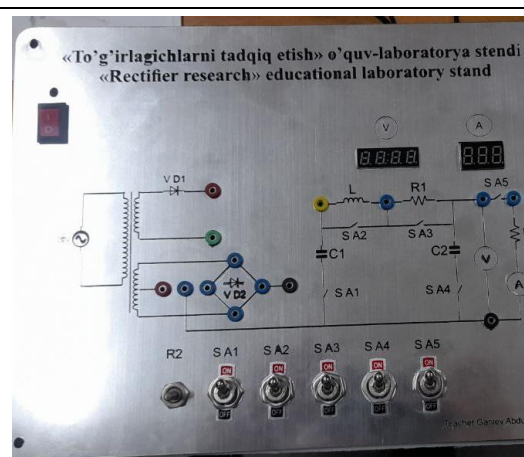


Fig. 4. Training laboratory stand for research of rectifiers

Thus, using mobile physics laboratories for electrical current research in an educational environment offers many benefits, such as increased experimentation opportunities, development of practical skills, flexibility, and cost-effectiveness. This makes them an excellent tool for teaching physics effectively and interactively.

Such stands are a combination of theory and practice, which helps to more fully and deeply understand the topic of electricity. Students can independently determine the current strength, voltage, resistance and other quantities of the circuit, as well as study Ohm's and Kirchhoff's laws (Fig. 1-4).

Thanks to the use of mobile laboratory stands, students and schoolchildren will have the opportunity to test in practice the correct observance of the laws of physics,

work with instruments and develop skills in conducting experiments. This will help to develop a complete understanding of the theory and the ability to apply it in life.

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