

METHODOLOGY FOR COMBINING REAL AND VIRTUAL LABORATORY WORK IN THE EDUCATIONAL PROCESS OF STUDENTS

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In higher educational institutions, when receiving higher education, laboratory work becomes a mandatory part of the educational process of engineering and technical specialties, and students in practice study the operation of this or that equipment, the reactions of reagents and chemicals, as well as other equally fascinating processes.

The essence of the laboratory work is already described in its title; it is not for nothing that the first line in the design has the corresponding title “Topic”. But the purpose of such a lesson is to study and understand certain physical processes and laws, chemical reactions and patterns. The work is carried out and reliable results are obtained experimentally in a special room - a laboratory, that is, visually, so to speak [1-3].

Deep understanding is very important during the learning process, otherwise the work cannot be judged successfully. That is why, on the eve of the exam, the teacher informs about the upcoming work and asks students to prepare additionally for it.

Laboratory work involves:

1. Study of a certain physical process in practice, using methods previously studied in lectures.
2. Selection of the most optimal method for performing measurements and research, which provides the most accurate result.
3. Determination of the actual result and its comparison with the theoretical data described in the textbook according to the chosen topic.

4. Detecting the reasons for the resulting discrepancy and correctly presenting them in the laboratory report.

5. Competent drawing up of conclusions in accordance with the requirements of the manual.

Protection of the work done is carried out on an individual basis, even when the task was completed collectively. Each student must have his own completed report and a minimum amount of knowledge on the topic, which in the near future will have to be shared with the teacher [4-6]. Global education is increasingly enriched with innovative technologies that significantly facilitate the learning process and at the same time increase its efficiency. One of such innovations can be considered virtual laboratories. Virtual laboratories are a hardware and software complex for conducting training without direct contact with real installations [7-10]. Laboratories artificially simulate work situations during the training process. Such laboratories significantly reduce the cost of the learning process, since it does not involve real expensive equipment. But this does not affect the effectiveness of training at all. Students gain the same experience and skills that they would gain from working on real sites.

This is a complete simulation of work processes in virtual execution. Such training allows you to quickly change the conditions under which work is carried out. This allows you to simulate various situations without much expense and in a short time.

Advantages of training in virtual laboratories:

- There is no need to buy expensive equipment;
- Possibility of modeling processes, the occurrence of which is fundamentally impossible in laboratory conditions;
- Absolute safety of experiments;
- Rapidly conduct series of experiments under different conditions.

Performing any laboratory work, real or virtual, consists of several stages:

1) preparation for work - the student writes a brief description of the work in the workbook. The job description reflects the purpose of the work, a brief theory, the

necessary equipment, the procedure for performing the work, tables for recording measured values;

- 2) admission to work - the teacher conducts a work survey;
- 3) performing the experimental part of the work;
- 4) calculation and processing of measurement results. Finding instrument errors;
- 5) protection of laboratory work. Students answer test questions given at the end of each work and submit a written report on the results of their research.

Every positive aspect of using virtual laboratories in the educational process is associated with certain negative ones. When choosing laboratory work for a virtual workshop, you should weigh these pros and cons to achieve the optimal balance [11-13].

The Crocodile Technology 609 program is a powerful simulator; it makes it possible to simulate physical processes, create and observe experiments in the areas of physics, mechanics, electrical circuits, optics and wave processes. This program can be used during classes via an interactive whiteboard, and also when doing independent work on a personal computer [14-17].

As an example in Fig. 1. shows the window of the virtual laboratory work “Diod-voltage” in the discipline “Electrical Engineering and Electronics”, performed using the Crocodile Technology 609 program.

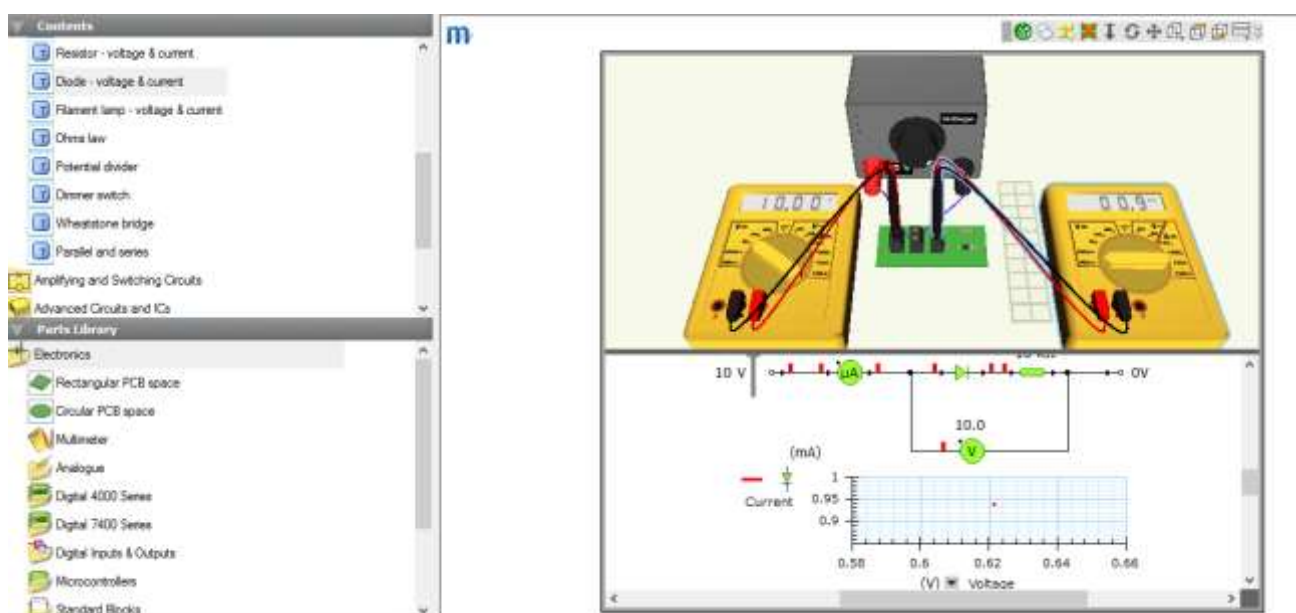


Fig.1. Window of virtual laboratory work “Diod-voltage” in the discipline”

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