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ADVANTAGES AND DISADVANTAGES OF TRADITIONAL AND SIMULATION LABORATORY WORKS IN HIGHER EDUCATION

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Abstract

In this article, when organizing traditional and virtual laboratory work in conducting educational activities in accordance with modern requirements in the higher education system, the teaching methods in both cases were analyzed, the necessary resulting ideas were summarized, and the specifics of each method, namely its advantages and disadvantages, were addressed. In particular, as a result of considering the pros and cons of using simulation virtual laboratory work in teaching technical disciplines, it has been proven that it is the most effective tool today.

Keywords: Higher education, simulation, technical direction, traditional education, virtual laboratory, illustration, demonstration

Introduction

Nowadays, the preparation of electronic information and educational resources using practical software tools and their effective use in the teaching process is an important task for every teacher.



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Preparing educational materials taught in the higher education system using modern software tools and organizing instruction using them expands the opportunities for students [1].

The use of virtual laboratory work in the educational process of technical higher education institutions is of great importance. Deep understanding of knowledge virtual laboratories are useful for studying theory and solving various computational, qualitative, and experimental problems. If a student is familiar with theoretical questions in lectures, then the theory is applied in laboratory sessions, and in addition, practical skills are formed in conducting physical measurements, processing, and presenting results.

Traditional teaching methods have one common goal: to provide the student with new knowledge and convey relevant information on any subject. The perfection of such methods is based on the informative and illustrative nature of the teacher's activity, as well as the reproductive nature of the student's activity.

The student becomes acquainted with previously unknown information about the subject they are studying and uses new methods of action and thinking in the process of understanding. Then, having solved the relevant problems, he applies the acquired knowledge in practice. Associative memory is primarily involved in this process, which is associated with the presentation of knowledge in a ready-made form.

In this article, we do not aim to criticize or reject traditional teaching methods in their favor, as this question is very broad and controversial in many respects; however, we will only consider these methods and demonstrate their features, as their effectiveness has already been tested by time.

Traditional teaching methods typically include lectures, stories, explanations, conversations, educational discussions, work with books, demonstrations, exercises, self-study, laboratory work, practice, and independent work. Let us consider in detail the demonstration and laboratory work of these traditional teaching methods.

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The demonstration method is also called the demonstration method. It is designed to create a visual model of the object, process, or phenomenon being studied by students directly during the lesson or during the lesson itself. Depending on the content of the topic under study and the students' methods of action, various presentation options are used:

- Individual demonstration of the process or technique being studied;
- Demonstrative presentation with the help of students with special skills;
- Show real objects: tools, materials, equipment, etc.;
- Demonstration of visual aids;
- Presentation of video materials.

In the process of applying various demonstration options, the following didactic principle must always be taken into account: visual aids must be used in optimal quantities, and the means of demonstration must be presented in a specific sequence. The effectiveness of the demonstration process also depends on the correct selection of objects and the teacher's ability to focus students' attention on the main points of what is being shown.

Conditions for effective presentation:

- Students must be able to clearly see what is being shown to them;
- Students should, if possible, perceive what is shown not only with their eyes, but also with the help of other senses;
- The most important features of the specified object or phenomenon should leave a maximum impression on students and attract their attention;
- During the demonstration process, students should have the opportunity to independently study and evaluate the exhibition;

The demonstration method is closely related to the illustration method, although it is traditionally considered independent of conventional didactics.

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Illustration is the demonstration of phenomena, processes, and objects, as well as their perception in a symbolic form. This is done through drawings, reproductions, diagrams, graphs, drawings, photographs, maps, posters, etc.

These two methods are used in conjunction with each other, thereby not only complementing each other but also enhancing each other's actions. If the subject of the demonstration must be perceived by the students in a holistic picture, then it is common to use a real demonstration.

It should also be noted that as a result of the introduction into pedagogical activity of more and more new sources of visual representation of information, such as computers, projectors, etc., it has become possible to distinguish one relatively independently. This teaching method is called the video method. It is intended both for the presentation of information and for its control, systematization, generalization, reproduction, and consolidation.

The video method allows for the effective resolution of many problems of the educational process, including:

- Provide new knowledge about processes and phenomena that cannot be seen with the naked eye, such as the passage of electric current through the work of conductors or magnetic induction lines;
- Whether calculation graphs can be obtained in the process itself. That is, to study the electrical load graphs of industrial enterprises by viewing them on a monitor;
- Presentation of video documents in the classroom for any subject or subjects;
- Organization of testing;
- Performing educational work and exercises, performing simulations and measurements, etc.;
- Creation of databases necessary for conducting research and educational activities;
- Implementation of a simulation approach in organizing the pedagogical process;

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- Rationalization of the educational process by improving the quality of pedagogical methods, increasing productivity, and ensuring the optimal amount and assimilation of incoming information.

The effectiveness of the video method is influenced by the quality of the video materials and the equipment used during the implementation of the method. Furthermore, the video method is much more demanding in organizing pedagogical activity compared to other methods - it must be more purposeful, thoughtful, and precise.

The question of what is the difference between laboratory work performed in a laboratory room and virtual laboratory work has been discussed several times among educators. During the analysis, it was examined to what extent the diversity of lessons affects a student's academic performance.

The basis of the laboratory work method is based on students conducting independent research and experiments. This method is primarily used in the process of studying natural and technical sciences. Laboratory work can be individual or group-based.

Through the laboratory method, students gain the opportunity to acquire skills and competencies in working with instruments. This method also guarantees an optimal environment in which important practical skills are formed, such as selecting learning methods, verifying and processing results, calculating, measuring, etc.

The main disadvantage of traditional teaching methods is that the student acquires knowledge templates; firstly, they are easily forgotten, and secondly, they cannot be applied to other types of problems and tasks.

The correct application of the laboratory method in the traditional educational process requires special equipment, the training of teachers and students, and sufficient time and energy resources.

As the American philosopher and educational reformer John Dewey emphasized, "If we teach our children the way we taught yesterday, we will have stolen their



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future," the reputation of a teacher and the effectiveness of their activities depend not only on the level of knowledge in the course content and their pedagogical abilities, but also on the teacher's level of application of modern information and communication technologies in collecting, processing, and teaching specific educational material. In other words, education in the digital age must be reconsidered and the educational paradigm changed, as students no longer want to learn in the traditional way, and teachers should not continue to teach in such a conventional way [2].

Recently, computer simulation of various physical and technical experiments has become an integral part of the virtual learning environment. The natural and technical sciences have provided all their extensive and fundamental material for processing using computer technologies and for testing these technologies. Virtual demonstration of technical processes and phenomena, as well as computer simulation of laboratory work, are widespread in the software market.

Demonstrations of phenomena on laboratory equipment in higher education institutions are used less frequently for a number of reasons (obsolete and not modernized due to a lack of material resources, insufficient development of the experimental abilities of modern teachers, etc.). Its various aspects are quite actively discussed by educators, psychologists, and information technology specialists in our country and abroad [3].

The purpose of this research is to analyze the advantages and problematic aspects of using simulation virtual laboratory work in the educational process of training future engineers, as well as to approve experiments in this field. It seems appropriate to consider various aspects of using simulation virtual experiments in the educational process and to divide them into two opposing groups. This analytical breakdown is presented in the table below.

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Comparing the opposing aspects of using simulation virtual experiments in the educational process

№	Positive side	Negative side
1	The low cost of simulations compared to the actual device	To some extent, freeing from the need to focus on the modern equipment market
2	Provides greater flexibility when upgrading virtual equipment compared to actual equipment.	Rapid changes in computer technology, software obsolescence
3	The availability of a simulation virtual laboratory frees up from infrastructure expansion.	Weakening perceptions of actual device maintenance and related infrastructure requirements
4	Safe from harmful physical factors. It is not necessary to provide protection against their influence.	There is a general impact of negative physiological and psychological factors resulting from computer use, but it is not significant.
5	Regulating the time of an experiment, significantly reducing it by decision of the experimenter	Leaving the real-time mode, weakening ideas about it
6	Significant reduction in the complexity of routine procedures for processing measurement results and increasing the speed of calculations	Weakening of the ability to evaluate a numerical result without using modern computing tools, as well as the ability to adequately perceive the obtained numerical values.
7	Unlimited opportunities for remote work in any mode (online and offline)	Weakening of perception of real laboratory research environment
8	Developing students' skills in using computer technologies and working with various electronic resources	Limiting opportunities to develop skills in conducting real research experiments
9	Increasing interest in labor and increasing the level of motivation for mastering science and its experimental methods	The absence of the attributes of research activity, which requires constant labor, contributes to the development of an appropriate attitude toward it. Risk of increasing computer addiction

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As seen from the table, each positive aspect of using simulation virtual laboratories in the educational process is associated with a specific negative aspect. Significantly reducing the complexity of routine procedures for processing measurement results and increasing the speed of calculations increases the speed of student report preparation [4].

The limitless possibilities of remote work in any mode allow for the assignment of laboratory work for independent work[5].

Thus, virtual laboratories are understood as two types of software and hardware systems:

- Installation of a laboratory with remote access - we call such complexes remote laboratories;
- software that allows for the simulation of laboratory experiments - virtual laboratories.

When selecting laboratories for simulation virtual experimental work, it is necessary to weigh these pros and cons to achieve the best balance. In the virtual case, the real experiment is very simple, convenient, and visual, does not require modern expensive equipment, and is carried out in a short time. For this reason, the virtual preparation of relevant laboratory work is provided for in the training courses of all universities, which led to the spread of computer simulations at the next stage. The use of simulation virtual laboratories is fully justified not only for full-time education but also for distance education.

When using educational simulators in higher education, the student acquires knowledge in their field not only at the place of study but also at production enterprises and reinforces it in practice (Fig. 1).

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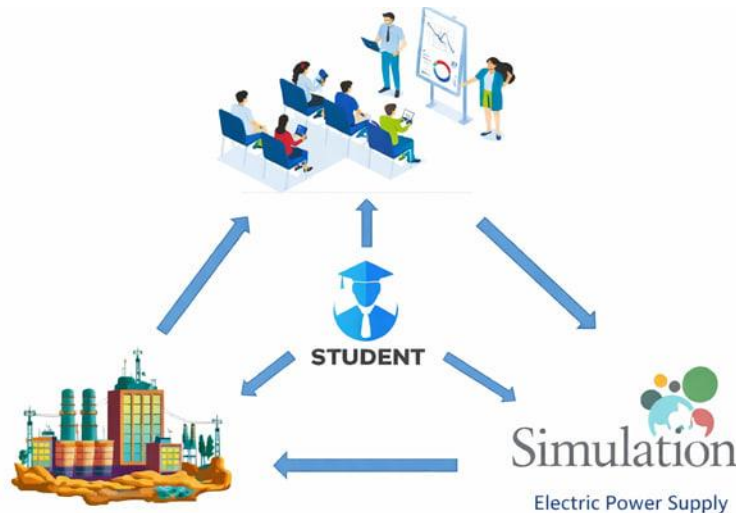


Figure 1. Scheme of the training simulator's relationship with the educational and practical process

Simulated virtual learning creates a foundation for increasing the effectiveness of feedback when working with students, especially when working remotely. Currently, the relationship between the teacher and the student in organizing and implementing the educational process often indicates the existence of a number of problems both on the part of the student and the teacher [6]. Regarding the conduct of laboratory sessions, this dependency is carried out by students in the form of presenting and defending their reports on laboratory work during the corresponding lesson, where the student determines their level of knowledge and skills in laboratory work during a direct interview.

CONCLUSION

The use of a complex of simulated virtual laboratory work has many positive aspects, while being recognized as a complete alternative to any real laboratory equipment; however, only real experimental work fully activates all areas of students' interaction with objects of study in the natural and technical sciences.

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Visual implementation of laboratory work creates a safe learning environment. Most virtual simulators, consisting of computer simulators of various measuring instruments and more complex technical devices created using simulation software, meet these security requirements.

Within the framework of scientific work, it is possible to implement all the aforementioned capabilities in the application of a simulation online textbook created on the basis of a simulation approach(<https://eltaminas.herokuapp.com>). Virtual reality helps to gamify the educational process, and in the presentation of information in this style, the student will have many opportunities to reinforce the knowledge acquired, conduct practical exercises and much more. At the same time, as described in these studies, in a number of cases, the virtual model and the work based on it are a very effective tool for achieving the set educational goals. The experience of applying simulation laboratory work created on the basis of the proposed simulation approach in the educational process is effective and can be used in various educational institutions.

References

1. Suropov B.M. Improving the methodological support for teaching information and communication technologies in an electronic educational environment. Doctor of Philosophy dissertation in Pedagogical Sciences. 13.00.06. - Tashkent, 2019, 75 p..
2. Concept for Adapting the Higher Education System to the Digital Generation // With the Support of the European Union Erasmus+ Program Tashkent - 2019 // <https://hiedtec.ecs.uni-ruse.bg>
3. Zakirova E.I. The use of virtual laboratory workshops in the educational process of a technical university // Discussion. - 2020. – Vol. 59. - No. 7. - Б. 122-126.



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4. Franklin R., Smith Ju. Practical assessment on the run–iPads as an effective mobile and paperless tool in physical education and teaching. *Research in Learning Technology*, 2015, vol. 23: 27986
5. Holovko M.V. Virtual modeling of physical experiment for distance learning systems in the secondary and higher pedagogical schools / M.V. Holovko, S.Y. Kryzhanovskiy, V.M. Matsiuk // *Информационные технологии и средства обучения*. - 2015. - Т. 47. - № 3. - С. 36-48
6. Stozhko D.K. On the issue of the nature of the labor market in the system of modern higher education in Russia // *Bulletin of the Kosta Levanovich Khetagurov North Ossetian State University*. - 2016. - No. 3. - P. 188-192.