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FACTORS OF ORGANIZING AND PERFORMING PHYSICS LABORATORY LESSONS IN EDUCATION

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Abstract:
The article presents an analytical analysis of traditional (measuring instruments and equipment) and non-traditional (electronic pedagogical programs) methods at all stages of organizing and conducting laboratory classes in physics.

Keywords: laboratory training, traditional and non-traditional methods, measuring device, equipment, information technology tool, software, virtual, animation.

Modern information technology tools are widely used to solve various problems of education. In developing the knowledge and skills of students in physics, it is important to conduct lessons using pedagogical software that provides the opportunity to model physical processes.

Educational methods are conditionally divided into two - traditional and non-traditional types.

Traditional teaching methods of physics consist of a complex of teaching theoretical information based on various innovative pedagogical technologies, problem solving, and organizing and performing laboratory exercises.

In this method, the student studies the theoretical material, solves problems and performs laboratory work in order to develop and strengthen skills and competences from the acquired theoretical knowledge. In this case, it will certainly have its effect on students' learning of physics. But in order to increase the effectiveness of education, teaching physics using non-traditional methods, i.e., using innovative pedagogical methods, teaching physical processes using information technology tools and pedagogical software is becoming more and more powerful.

Since physics is mainly an experimental science, the laws, phenomena, and processes studied in physics are studied more deeply and more fundamentally in the process of organizing and performing laboratory exercises. That is why experience has a special place in physics education. Therefore, it is not an exaggeration to say that teaching physics is conducted on the basis of organizing and conducting laboratory exercises in physics.

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However, in recent years, the idea and methodology of organizing and conducting physics laboratory training on the basis of virtual (electronic) laboratory training on the basis of computer equipment has been promoted. Also, electronic software resources for a number of virtual laboratory exercises in physics have been developed and are being implemented in the educational process.

The reason for this is the moral and physical obsolescence or lack of experimental devices in a number of educational institutions, while on the other hand, specialists tend to simplify and intensify the training process. However, the student or students who complete the virtual laboratory training are far from the real measuring technique. Therefore, below is a critical analysis of the teaching of physics laboratory exercises using traditional and non-traditional methods.

Advantages and disadvantages of the method of organizing and conducting laboratory training:

Traditional (with tools)		**Unconventional (virtual)**	
Achievements:	**Disadvantages:**	**Achievements:**	**Disadvantages:**
- differentiation of tools and equipment by students; - direct work with tools and equipment; - direct acquaintance with the operation of tools and equipment; - long-term storage of experimental techniques in memory; - draw a conclusion by directly calculating absolute and relative errors;	- lack of tools and equipment; - failure of tools and equipment during the experiment and the problem of their repair; - Difficulty or impossibility of performing processes and experiments that cannot be seen in practice or are difficult to observe; - the impossibility of stopping all processes during the experiment and continuing from the same place (absence of direct intervention of the student); - lack of time set for the experiment; - regular (strict) monitoring, (individual) and technical and methodical control of the teacher or laboratory technician during the experiment; - high (large) probability of errors in calculating experimental results;	- student's competence to work with electronic pedagogical software tools (computer equipment) is formed; - it is possible to directly perform processes and experiments that cannot be seen in practice or are difficult to observe; - time is saved in carrying out experiments (saving time); - possibility of dynamic (animated) execution of experiments; - student's direct intervention in the experiment (temporary stopping and continuation); - achieves repeating the experiment several times within the specified time;	- students do not know how to use electronic pedagogical software tools (computer equipment); electronic pedagogical software tool (computer equipment). - lack of or improperly structured experiment method; - illogicality or incomprehensibility of the sequence of execution of the experiment; - students work more than the specified time on electronic pedagogical software tools (computer equipment); - complete lack of understanding of measurement techniques; - complete lack of understanding of the calculation method; - not being stored in memory for a long time;

1. Theoretical information (obtaining permission to perform work)

Traditional:		**Unconventional (virtual):**	
Achievements:	**Disadvantages:**	**Achievements:**	**Disadvantages:**
- the student's speech develops; - communication culture develops and speech grows; – theoretical knowledge is checked; - the ability to answer questions operatively is formed.	- lost from time; - waiting for the teacher's free time for the answer to the question and the limitation of this time; - psychological problems may arise between the teacher and the student.	- completes a test task related to the theory of experience; - time is saved; - based on the test answer, permission is obtained to perform the experiment directly through the computer.	- student's knowledge is evaluated mechanically (shallow); - the student's speech does not develop

2. The theory of the method:

Traditional:		**Unconventional (virtual):**	
Achievements:	**Disadvantages:**	**Achievements:**	**Disadvantages:**
- as a result of questions and answers with the teacher, theoretical concepts are studied more deeply and widely.	- more time is spent and psychological problems arise.	- answers the test questions operatively through the software; - time is saved.	– theoretical concepts may not be fully studied; - the method is not sufficiently comparable with other methods;

3. Acquaintance with the operation of the experimental device (device operation method)

Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages:**	**Achievments:**	**Disadvantages:**
- get acquainted with the experimental device in detail; – tests the method of operation of the device in practice.	- there will not be enough time to study the working method of the experimental device.	- the availability of an electronic device for experiments that cannot be monitored or are difficult to conduct; the device works clearly and smoothly; - get acquainted with the description of the experimental device in a short time through the test; - get acquainted with the method of operation of the device in a dynamic state (animations).	- inability to check the correct or faulty condition of the device; - the possibility of not fully understanding the principle of operation of the device; - the possibility of not being able to see the errors that occur when working with the device.

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4. The technical basis of the laboratory training device:			
Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages:**	**Achievments:**	**Disadvantages:**
- the student learns the available laboratory equipment directly; - studies the accuracy of measuring instruments, measuring limits and working techniques.	- lack of equipment; - the delicacy of the equipment, problems may arise in the measuring technique; - inability to repair or replace obsolete devices.	- complete availability of tools and equipment; - failure of tools to become unusable; - when it becomes unusable, it is possible to get another one instead; – the availability of virtual electronic instruments and equipment even for experiments that cannot be monitored or are difficult to conduct.	- the natural appearance of existing equipment and the fact that the student cannot use it with his own hands and analyze them; - failure to learn the technique of measuring instruments.

5. The process of setting up and measuring the experiment:			
Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages:**	**Achievments:**	**Disadvantages:**
- perform measurements realistically; - the student assembles a device or scheme with his own hands and directly observes its operation.	- the measuring range of the instruments should be clearly selected; - the obligation to check the correct operation of the tools; - lack of time allocated for measurements.	– measurements are performed automatically; - it is not mandatory to check the correctness of the tools; – time spent on measurements is saved; – measurements are performed quickly and with high accuracy.	- the reader does not assemble the device or scheme directly and does not see the measuring devices in real life.

6. The method of working with the obtained experimental results (calculation):			
Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages:**	**Achievments:**	**Disadvantages::**
- independent calculation of the obtained measurements by putting them into the given formula, which are theoretically correct.	- not knowing the theoretical formula; - complete lack of understanding of measurement results; - he does not know how to calculate by putting the theoretically correct formula into the given formula; - not understanding the system of units.	- the software automatically calculates the obtained measurement values in a short time with high accuracy;	- failure to consider the obtained measurements as theoretically correct by putting them into the given formula; - complete lack of understanding of computing equipment; – lack of choice of measurement units.

7. Assignment theory, experimental method and measurement error analysis (summary):			
Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages::**	**Achievments:**	**Disadvantages::**
- the theory of the task, the quality of the measurement results, the quality of the error calculation results are achieved by the teacher.	- question and answer with the teacher; - inability to analyze measurement errors; - lack of teacher's time to check for assessment and measurement errors.	– the software calculates errors in a short time with high accuracy; - the ability to repeat the measured values several times in a short time; - student performance assessment and measurement results are automatically evaluated; - that the teacher's participation in the evaluation is not necessary.	- learner's activity is evaluated without analysis of task theory, laboratory equipment operation technique, measurement results and error calculation results.

8. Theoretical and practical knowledge (analysis) acquired by the student during laboratory training			
Traditional:		**Unconventional (virtual):**	
Achievments:	**Disadvantages::**	**Achievments:**	**Disadvantages::**
- as a result of the experiment, it is analyzed whether the student's acquired theoretical knowledge is confirmed in practice or not; - theoretical and practical knowledge is relatively deeply and broadly analyzed and strengthened.	- processes often cannot be seen in a dynamic form; - the need for a lot of time to evaluate the acquired theoretical and practical knowledge.	- study of unobservable or difficult processes through electronic models and confirmation of theoretical knowledge; - the possibility of animated observation of process views and laws and their visualization.	- theoretical and practical knowledge is relatively shallow; - lack of practical application of theoretical knowledge.

As a result of the above-mentioned analysis, the following can be recognized.

Non-traditional classes differ from traditional classes in that students are given an environment of freedom and an opportunity to freely express their opinions.

According to the requirements of the non-traditional lesson, the teacher should motivate students, be a guide, supervisor, and observer. Including, the problem-based teaching method encouraging pupils and students to acquire knowledge independently, discussion, special positive tasks, and various interactive methods can take a proper place in the pedagogical process.

The use of computer technology and electronic pedagogical software as a non-traditional method in the course of laboratory training in physics creates a number of advantages for both students and teachers.

To the teacher:
- provides sufficient opportunities for full coverage of the topic chosen for the experiment, that is, the quality, number and variety of laboratory work conducted by the experiment increases several times compared to the training conducted in the traditional method;
- allows for individual control of as many students as possible during training.
- provides an opportunity to monitor students' learning of the subject along with imparting knowledge during the training.
To the reader:
- increases his interest in doing experiments in physics;
- creates an opportunity to get acquainted with various software systems and to learn them, to put them into practice together with physics experiments;
- increases students' theoretical mastery of the subject;
- gives an opportunity to test his theoretical knowledge, practical skills and abilities.
To take advantage of these benefits, students must have:
- sufficient theoretical knowledge and skills of the students;
- the technique of using information technology tools must be sufficiently developed.
It should also be noted that the preparation of virtual laboratory works requires a lot of work and expenses and makes high demands on technical equipment. The use of computer equipment in laboratory training increases the quality of training.
Summarizing the results of the above opinion and analysis, we can say that organizing and carrying out laboratory classes in an unconventional way, that is, using electronic pedagogical software, to make effective use of the student's time, to effectively acquire and strengthen theoretical and practical knowledge, to control, evaluate and analyze the knowledge of students. , allows for operational evaluation of the obtained theoretical and practical knowledge. However, in order for physics laboratory training to be effective and the theoretical and practical knowledge of pupils and students to be deep and integrated, it is desirable to organize and conduct it in parallel with traditional and non-traditional methods in the same ratio.

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