ORGANIZATION OF VIRTUAL LABORATORY WORK IN PHYSICS IN DISTANCE LEARNING WITH USING THE FRAME MODEL

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Abstract. *The article discusses methodological approaches to conducting virtual laboratory work in physics classes for distance education students, the importance of students being able to apply the necessary experiences in practice in relation to their future specializations and where they can apply them. their role in production. It is possible to perform virtual laboratory work in physics using the Phet open-source pedagogical software tool. Examples of laboratory works of different levels of complexity are given and their effectiveness is discussed.*

Keywords: *distance education, virtual laboratory work, Phet, pedagogical software tool, Frame model, educational process, quality of education.*

Introduction. The global task of distance education is the formation of independent highly qualified specialists in the fields of training. For this, it is necessary for the student to transfer the logical and scientific thinking skills acquired during the work of the virtual laboratory to the types of production activities. If the student gets intellectual pleasure from the scientific approach to the work of the virtual laboratory, he realizes the need for the studied material in the educational process at the higher educational institution, in his future professional activity, and strives to apply the acquired knowledge and skills. One of the most effective ways to achieve this goal is conducting virtual laboratory work through Phet pedagogical software in distance education [1-2]. In distance education, virtual laboratory work is one of the forms of organizing the educational process. Laboratory work is a necessary component of educational programs in all areas. The organization of virtual laboratory work online and offline, the ability to distinguish and use the right choice of virtual laboratory equipment in the virtual environment can lead to an increase in the effectiveness of online classes[3].

In the 2022-2023 academic year, the Tashkent University of Information Technologies named after Muhammad al-Khorazmi introduced the form of distance education along with full-time and part-time education. Students were admitted to distance learning courses available at the university (Computer engineering ("Computer engineering", "IT service", "Multimedia technologies"), Software engineering). In this regard, a separate distance education faculty was established at the university, and educational programs (syllabus, video lectures, practical, virtual laboratories, e-textbooks, e-library, etc.) were developed by professors and teachers of each subject. 2]. All educational content has been created and placed in the learning management system for students enrolled in distance education.

A multi-topic virtual laboratory through Phet pedagogical software to conduct virtual laboratory work on the section (Electromagnetic Vibrations and Waves) developed and effectively used by the professors of the Department of Physics for distance education students we can see their work. The purpose and function of conducting virtual laboratory training is that it can be used

not only in the course of physics, but also in the study of other subjects, including special subjects [4].

The methodology of our analytical work consists in the deductive generalization of personal experience in the use of scientific literature data in understanding the process of implementation of virtual laboratory work through the Phet pedagogical software tool, and the use of the Frame model in the training of distance education students. The analysis of scientific literature showed that the improvement of teaching physics, which is the basis of technical science, is one of the urgent problems of modern engineering education. From the development stage of engineering education, physics virtual laboratory classes have been important in the training of engineers and technicians. The physics course and other general education subjects at the undergraduate level are aimed at solving the problems of students' formation of skills necessary for the formation of independent highly qualified specialists. Skills necessary for specialization are coherent and logical thinking, planning and organization of work, working with devices and techniques in a virtual environment, and the process of applying skills to future work activities. Psychological studies have shown that the role of motivation is very important [5].

Professional skills in physics are performed in a virtual laboratory, in a virtual environment, and the analysis of the obtained results is studied. Therefore, the work of the virtual laboratory allows the student to understand the essence of the studied phenomenon in a virtual environment, to understand it more deeply and to remember it. A student who has conducted the necessary research in the process of performing virtual laboratory work in a virtual environment, has the skills to conduct experiments in accordance with the goals and tasks of the virtual laboratory work set by the professor, to work with virtual equipment and to use them in professional activities and production. .

Creating skills and competencies in the virtual environment, in the process of performing virtual laboratory work, and knowing that they are necessary for mastering specialized subjects at the next stages of the form of distance education is a complex process that requires additional effort from the professor-teacher. . In order to implement this process, we use special subjects (such as Circuits and Electronics, Systems and Signal Processing, Antennas and Radio Broadcasting, Multimedia and Communication Networks, Artificial Intelligence) and physics. About rni, we give examples through logical reasoning. We need to provide students with the knowledge and skills necessary for future professional activities while doing virtual laboratory work or other educational work, and that they can take advantage of the opportunities to do this work with independent interest in the virtual environment [6- 8].

If the distance education students are inspired by a scientific idea or are interested in the philosophical questions that arise in learning, they deeply feel the need for science, and it is very important for them to be able to use the experimental method of virtual laboratory work in a virtual environment and to be able to do it with interest. A student studying in the form of distance education develops the ability to independently perform theoretical knowledge and virtual laboratory exercises in a virtual environment.

By performing virtual laboratory work in a virtual environment using the Phet pedagogical software tool, on the example of the Department of Electromagnetic Oscillations and Waves, the student can understand the meaning of physical quantities (oscillation period, frequency, cyclic frequency, logarithmic decrement, attenuation coefficient, wavelength, etc.) to know To know and be able to apply the equation of motion of harmonic oscillation, the equation of standing wave;

should be able to use examples of free and forced oscillations and waves (as an example of free oscillations, mathematical, piston, physical pendulums, and as an example of forced oscillations, as electromagnetic oscillations in an inductive coil in an electric circuit) [9]. At the same time, students will get acquainted with the following in a virtual environment:

• Physical quantities (such as period, frequency, cyclic frequency, charge, current, voltage) using devices that can be examples of free and forced oscillations (mathematical, physical, piston pendulums and electric circuit) in a virtual environment through the Phet pedagogical software tool with the classic method of extinguishing;

• Performing electromagnetic vibrations and waves through physical processes in a virtual environment and comparing the results;

• Perform theoretical calculations, compare and draw appropriate conclusions based on the measurement results of the formulas for calculating electromagnetic vibrations and waves (period, frequency, cyclic frequency, wavelength, charge, current and voltage).

While doing this virtual lab work in a virtual environment, most professors and teachers can assign assignments to students through the Phet pedagogical software tool to do individual work, but we suggest doing this work in a different way. The professor-teacher sets a task for students of the distance education form on a scientific problem related to the topic. He talks about electromagnetic oscillations and waves and their generation, Harmonic oscillations, free and forced oscillations rules and offers a virtual laboratory work to learn about its properties using physical equipment in a virtual environment. Using the frame model, we can create a data frame based on the following table.

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Table 1: Tasks set by professors and teachers will allocate virtual laboratory works for distance education students through the Phet simulations open site.

Table 2: Students of the future field independently in the virtual environment in the fields of their choice, perform the work of the virtual laboratory according to the order of execution, fill out a report, draw a conclusion.

Table 1

№	Subject name	Grouping	Types	Sorting	Connection	Grouping	Condition	Sorting	Events
1	Harmonic Oscillations	Mechanical Oscillations	Free Oscillations	Mathematical Pendulum, Purijine Pendulum, Physical Pendulum	Waves	Mechanical waves	Coherent waves	A tidal wave,	Diffraction (maximum and minimum) conditions
2		Electromagnet oscillations	Forced oscillations	An electromagnetic oscillation in an inductive coil in a		Electromagnet waves		Chopar wave	Interference (maximum and minimum) conditions

				closed loop					

Table 2

№	Mutual cooperation	Directions	Fields	Connection
1	Professors and teachers of the Department of Physics	Physics II (theoretical and practical)	Vibrations and waves. Optics. Atomic and nuclear physics.	Electromagnetic vibrations and waves (as an example of the section)
2	Distance education students	60610500–Computer engineering ("Computer engineering", "IT service", "Multimedia technologies")	"Circuits and electronics", "Systems and signal processing", "Antennas and radio broadcasting", "Multimedia and communication networks", artificial intelligence..	
		60610600–Software engineering		

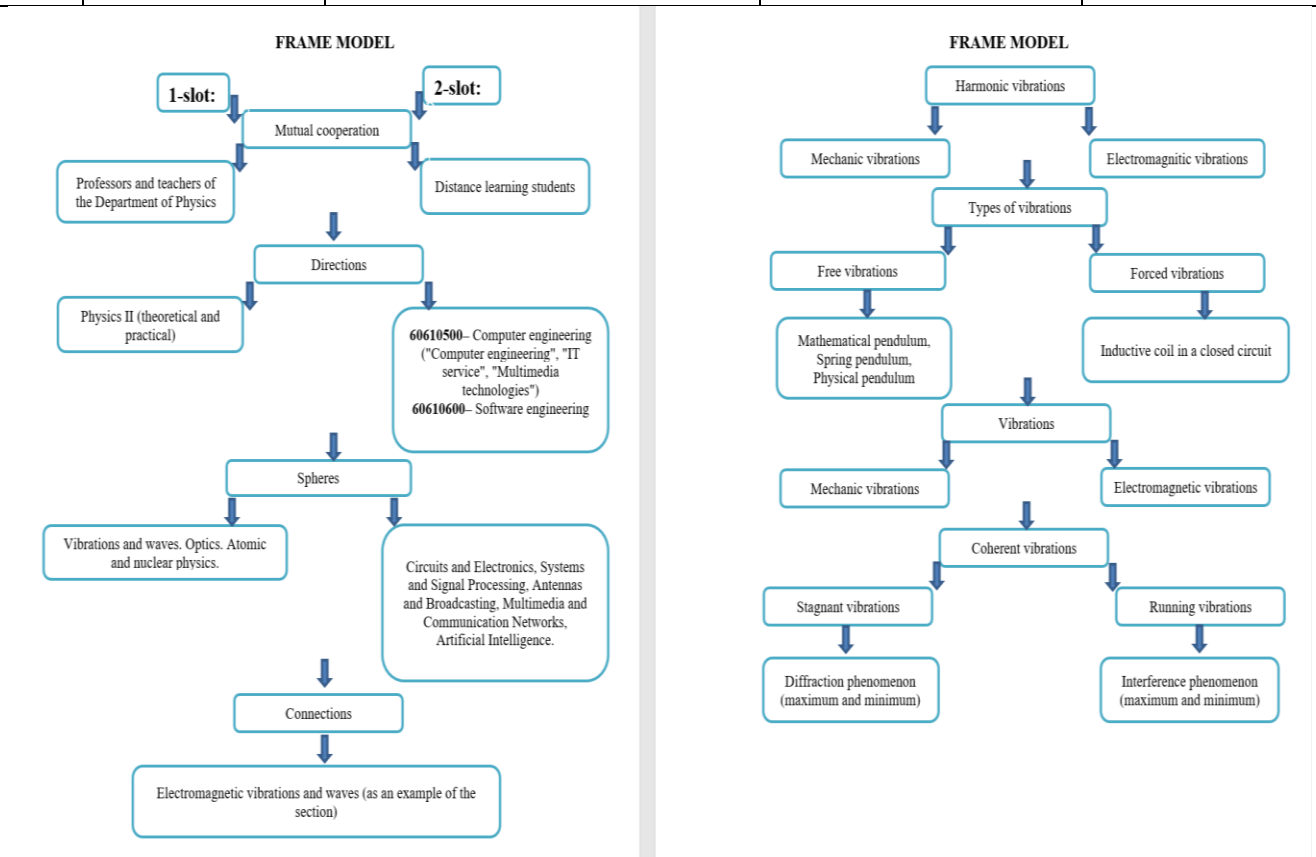

Figure 1. Instructions for using the frame model

Second: Distance learning students (such as periodic frequency, cyclic frequency, logarithmic decrement, stretch coefficient wavelength, amperage, voltage and electromagnetic oscillation in an inductive coil in a circuit) identify electromagnetic oscillations and waves while

doing virtual laboratory work. will have to take. At the same time, students will get acquainted with:

• With virtual laboratory work in Phet pedagogic software.

• Finding the value according to the experimental results on the example of the section of electromagnetic vibrations and waves.

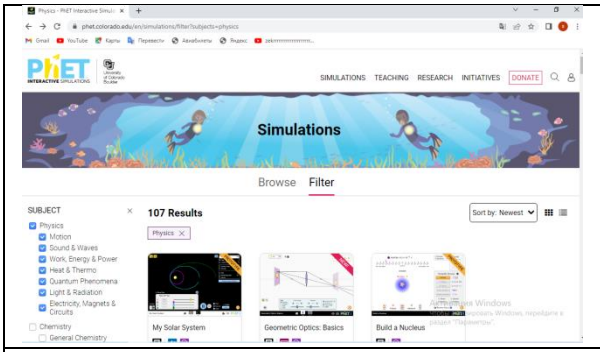

Figure 1. Overview of the Phet open source software package

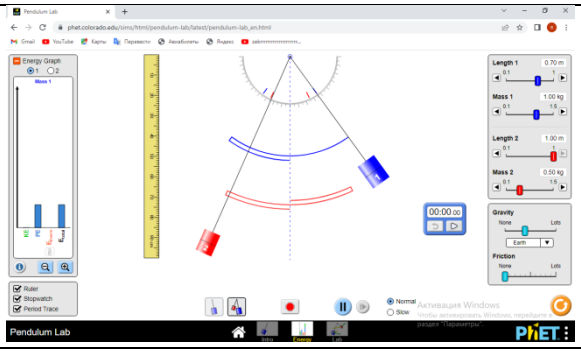

Figure 2. Mathematical pendulum

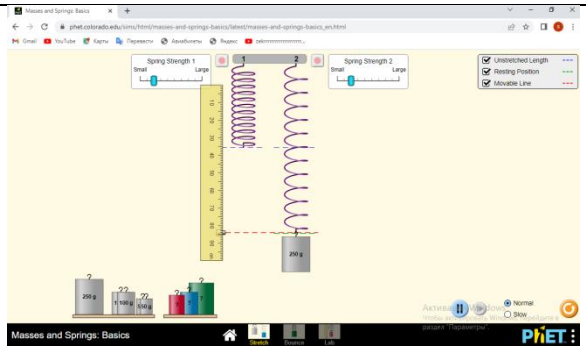

Figure 3. Spring pendulum

Figure 4. Sinusoidal graph

Through the open-source Phet pedagogical software tool using the frame model, they can gain an understanding of (learning harmonic oscillations and the equation of electromagnetic oscillations, oscillating according to the sine or cosine law). In the example of the physics section of Electromagnetic Vibrations and Waves, students will have to observe, learn, think independently, and finally make a final conclusion and express their thoughts in writing. How electromagnetic vibrations and waves are generated, how they can be observed, how they can be used in the field, and how they can be analyzed.

In distance education, conducting virtual laboratory work using the Frame model is more beneficial than traditional laboratory work. The benefits are as follows (they should learn to determine the purpose of virtual laboratory work, make reports, work with physical equipment in a virtual environment, perform experiments correctly, make accurate measurements and identify their errors, draw conclusions, etc. Such tasks are necessary for comprehensively solving global problems, such as the formation of knowledge and skills discussed earlier using the Frame model in this article, successfully completing the course and mastering special subjects at the university.

In distance education, we meet students with different levels of general knowledge of physics. Often we try to equate the learning of low-achieving students with average-achieving students. However, high-achieving students complete the program faster than average-achieving students and become academically equivalent to average-achieving students, who should be given differentiated support to acquire more knowledge and skills. will be[9]. A differentiated approach

to practical and virtual laboratory training in physics can be implemented using the following methods:

1) distance education students independently think and analyze beyond the given task and draw a final conclusion;

2) creation of virtual laboratory work of different difficulty;

3) development of methods of processing measurement results of different complexity;

4) implementation of independent performance of work.

Consideration. In order to improve the mastery of distance education students, using the Frame model, the "Physics" course for students studying in the fields of engineering is divided into two semesters (Physics I and Physics II) and each student independently for the semester they will have to perform virtual laboratory work on the sequence of topics. 1) "Mechanics"; 2) "Molecular physics and thermodynamics"; 3) "Electromagnetism" 4) Oscillations and Waves. 5) Optics 6) Atomic and nuclear physics (special methodological manuals for the organization and conduct of each virtual laboratory were developed by the teachers of the department).

All distance education students perform the virtual laboratory work extracted through Phet pedagogical software, but based on the Frame model, after students have calculated the results of the experiment, they must write their independent opinions in detail (experiment implementation, cause, consequences analysis). will be needed. In this way, they are positively evaluated based on their independent thinking.

Using the frame model, the student develops his independent thinking skills in virtual laboratory classes in physics. Students learn about their results by calculating, identifying errors, and analyzing the cause. Based on the obtained results, they will be able to draw a graph in the coordinate system and connect physical quantities.

Summary. Phet pedagogical software for distance education students offers a large number of virtual laboratory works and selection and discussion of laboratory works related to the topic. Which of the existing virtual laboratory work should the student perform, the results of the completed work will be obtained in the production, organization taking into account students with different levels of knowledge, virtual laboratory work will be carried out using the Frame model, measurement results performed through processing methods is a more efficient work than in a typical laboratory. The advantage of this model is that all physical processes, from the execution of any virtual laboratory work to obtaining the results, are explained, discussed and concluded. If the student can fully answer such questions, he will be evaluated positively, otherwise, he will be evaluated based on his written essays. At the end of this work, the stability of students' knowledge will be tested once again, and a significant level of efficiency in teaching will be achieved.

REFERENCES

1. Э.З. Имамов, Х.Н.Каримов, С.С.Халилов, А.Э.Имамов // Будущее за обучением с активным процессом самообразования студентов // “Science and innovation” international scientific journal. (ISSN: 2181-3337) 2022. № 5.-С. 479-482. URL://cyberleninka.ru/article/n/buduschee-za-obucheniem-s-aktivnym-protsessom-samoobrazovaniya-studentov/viewer
2. Khalilov S.S., Suyarov K.T. "Strengthening students' knowledge of physics in distance education using the Freim model" SCIENCE AND INNOVATION INTERNATIONAL

SCIENTIFIC JOURNAL VOLUME 1 ISSUE 7 UIF-2022: 8.2 | ISSN: 2181-3337 Tashkent -2022. No. 7. -B. 1570-1573

3. K.P. Abdurakhmanov, Sh.Kh. Ismailov, B. Ibragimov, S.S. Khalilov, use of Oberbek's pendulum as a physical pendulum in the study of oscillating motion. "Physics, Mathematics and Informatics" magazine. 2020 year. Number 1. -B. 99-103
4. Халилов С.С, Суяров К.Т, Аширбаева А.К. «Возможности самостоятельного развития студентами дистанционного обучения в вузе через систему elms» XI Международная научно-практическая конференция “Наука и образовование в современном мире: вызовы XXI века”. Астана-2022. октябрь –С. 12-14
5. J.E.O‘sarov, K.T.Suyarov. //Developing Pupils’ Learning and Research Skills on the Basis of Physical Experiments// “International Journal of Psychosocial Rehabilitation” Volume 24 Issue 2. 2020. –P. 1337-1346. URL: https://www.psychosocial.com/article/PR200433/10133
6. Kh.N. Karimov //Using virtual laboratory work in physics teaching// Engineering problems and innovations. 2023. -P. 102-104 (https://scholar.google.com/citations?view_op=view_citation&hl=ru&user=i5SoNTcAAAAJ&citation_for_view=i5SoNTcAAAAJ:qxL8FJ1GzNcC)
7. E.Z. Imamov Kh.N. Karimov, A.E. Imamov // Problems related to the introduction of renewable energy sources in New Uzbekistan // "Science and innovation" international scientific journal. (ISSN: 2181-3337) 2022. No. 3. -S. 367-372. URL:https://cyberleninka.ru/article/n/yangi-zbekistonda-ayta-tiklakhti-energiya-manbalarini-zhoriy-etish-bilan-bo-li-muammolar/viewer
8. Kh.N. Karimov, M.M. Asfandiyorov, M.A. Akhmadov. //Development of physics teaching based on modern approaches// Engineering problems and innovations. 2023. -P. 113-115 (https://scholar.google.com/citations?view_op=view_citation&hl=ru&user=i5SoNTcAAAAJ&citation_for_view=i5SoNTcAAAAJ:M3ejUd6NZC8C)
9. Kh.N. Karimov, A.E. Imamov, E.Z. Imamov, //Development of creative thinking in higher education// Science and innovation» international scientific journal. (ISSN: 2181-3337) 2023. No. 3. -S. 359-361