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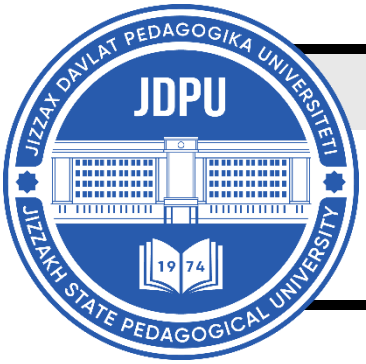

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ADVANTAGES OF USING VIRTUAL LABORATORIES IN TEACHING OF PHYSICS

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ABOUT ARTICLE

Key words: Virtual laboratory, Visual Basic, Python, model, 3d animation. physics, computer, software, intellectual capacity.

Abstract: In this article, the advantages and convenience of using computer technologies in teaching physics, virtual physical experiments learning through laboratories is covered.

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INTRODUCTION

As a result of reforms aimed at education in our country, on the development of the material and technical base of educational institutions and information exchange systems, the integration of information communication technologies (ICT) and software-pedagogical tools into the educational process, and the improvement of educational and methodological support opportunities are being created. In the action strategy for the further development of the Republic of Uzbekistan, "Further improvement of the continuing education system, increasing the possibilities of quality education services, training of highly qualified personnel in line with the modern needs of the labor market, introduction of international standards for evaluating the quality of education and training Priority tasks such as achieving" have been defined.

Resolution of the President of our Republic on March 19, 2021 No. PQ-5032 "On measures to improve the quality of education in the field of physics and develop scientific research" and the concept of the development of the higher education system of the Republic of Uzbekistan until 2030 accepted [1, 2]. In these documents, tasks such as development of integration of science, education and production in order to accelerate intellectual development, training of competitive personnel, effective organization of scientific and innovative activities and strengthening of international cooperation were taken as a basis. Today, it is important to improve the quality of physics teaching

in educational institutions, to introduce modern teaching methods into the educational process, to select talented students, to prepare competitive specialists for the labor market, to develop scientific research and innovations, and to focus on practical results. attention is being paid. The presidential decree approved a comprehensive program of measures to improve the quality of education in physical sciences and ensure the effectiveness of scientific research in the field of physics in 2021-2023. The main goals and objectives of the program are to improve the quality of physics teaching in educational institutions, improve textbooks and study guides, and introduce modern teaching methods, including information and communication technologies, into the educational process.

In the educational process, the most pressing problem is to discover a new teaching method for any subject of physics. This is directly related to the reform of the teaching process, that is, it will consist of introducing a new teaching method that corresponds to the possibilities of real knowledge of the subject studied by students based on an innovative approach to educational materials. In the teaching of physics on the basis of pedagogical software tools, scientific-methodical researches aimed at the development of students' intellectual potential are the most important current problems, and students' thinking is developed through computer technology models of physical phenomena. Currently, the technical direction of making models of physical phenomena, virtual physical experiments with the help of information communication technologies has a practical effect on the development of the intellectual potential of students of higher educational institutions. Computer models of many physical phenomena are very easy to explain the physical phenomenon and serve to develop students' cognitive abilities and imagination. Examples include material point, ideal gas, model of Rutherford's experiment, charged particles. Technical direction of physical models is also widely used in higher education institutions. Educational computer models in the form of virtual physical experiments have a high role in teaching physics.

In addition to the visual representation of standard laboratory work in physics, virtual physics experiments can also demonstrate various physical phenomena that cannot be performed in the classroom. Based on the fact that this is the basis for the development of students' mental thinking, it should become one of our main goals to establish the teaching of physics using pedagogical software tools and to conduct scientific methodical studies of the development of students' intellectual potential. Physics cannot be studied without an experimental part. Much can be said about the need to move to new standards of education, the need to introduce information technologies into the educational process. Currently, more attention is paid to virtual laboratory work on various topics. They should only be supplemented without completely changing the actual laboratory work being given. Additionally, virtual lab training should only be used in training after the student has become familiar with real devices. Laboratory work in physics is divided into the main sections of the program. There are 3D options for lab work. A virtual laboratory is a hardware and software complex

that allows you to conduct experiments without direct contact with a real installation or in its complete absence. In this case, the concepts of "virtual laboratory" and "virtual remote laboratory" should be distinguished. The basis of a virtual laboratory is a computer program or a set of related programs that perform computer modeling of certain processes. A remote virtual laboratory is a group organizational structure of several scientists belonging to different scientific centers and connected by mutually beneficial cooperation relations through the Internet. Compared to traditional laboratory work, virtual laboratory work has several advantages.

First, there is no need to buy expensive equipment and dangerous radioactive materials. For example, laboratory work in quantum or atomic or nuclear physics requires specially equipped laboratories. And virtual laboratory work allows to study such phenomena as the photoelectric effect, Rutherford's alpha particle scattering experiment, crystal lattice detection by electron scattering, gas laws, nuclear reactors, etc. Second, it is possible to simulate processes that do not exist in the laboratory. In particular, most of the classical laboratory works in molecular physics and thermodynamics are closed systems, at the output of which certain electrical quantities are measured, from which the required quantities are calculated using the equations of electrodynamics and thermodynamics. In the process of performing virtual laboratory work in these areas of physics, students can use animated models to observe dynamic pictures of the studied physico-chemical phenomena and processes that cannot be observed in real experiments, at the same time, they can observe the corresponding graphical structure of physical quantities along with the experiment. Third, virtual laboratory work can visualize physical or chemical processes more visually than traditional laboratory work.

Another advantage of virtual labs over traditional labs is security. In particular, it is appropriate to use virtual laboratory work in situations where you work with high voltage or hazardous chemicals. However, virtual labs also have their drawbacks. The main thing is the lack of direct contact with the object of study, tools, equipment. It is absolutely impossible to train a specialist who only sees a technical object on a computer screen. There may be those who wish to refer to a surgeon who previously only trained on the computer. Therefore, the most reasonable solution is to combine the introduction of traditional and virtual laboratory work into the educational process, taking into account their advantages and disadvantages. The use of virtual laboratory work in the study of physics is important.

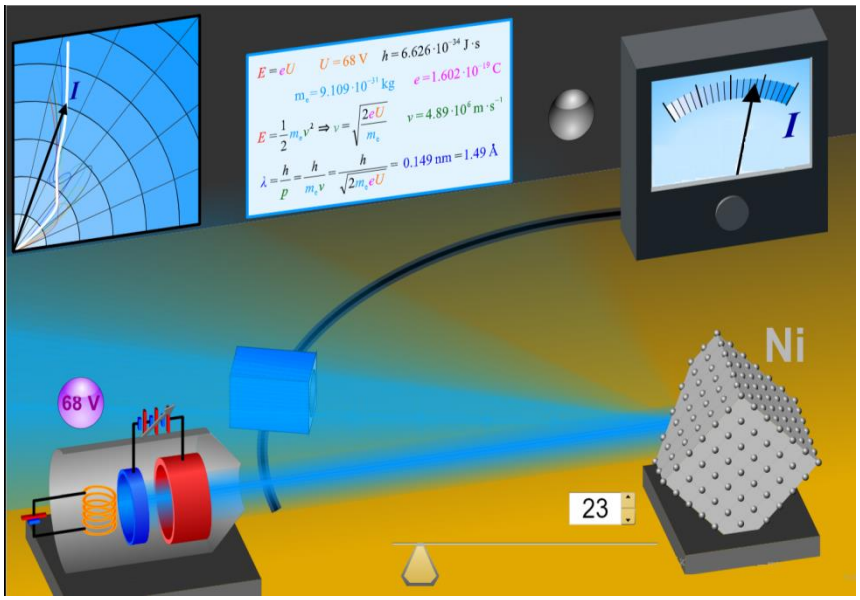
To date, reforms in the field of education serve to further improve the quality of education. We can see this from the achievements of our youth in science and technology in the world. Also, for our country to become one of the developed countries, not only the economy, but also the field of education plays an important role. We can see this in the case of developed countries. For example, Japan,

Switzerland, Germany and similar small countries can be examples. When we will be among the developed countries, when we can fully use the opportunities given to us.

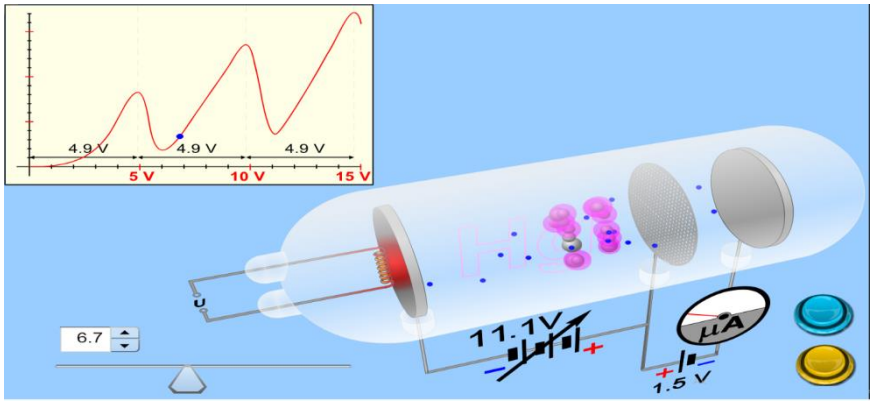
Using the opportunities given to us, we developed our own project to contribute to the development of our country. The project was mainly developed for the educational sector, and we believe that its results will contribute to the development of all sectors in the future. We face a number of difficulties in studying physics, which is distinguished by its complexity among sciences.

a result of our many observations, we have come to understand that some pupils - students easily solve examples in mathematics. But he finds it difficult to study physics. What is the reason for this?

In our opinion, it is difficult to imagine physical processes and to inculcate the idea that "physics is difficult". We have been using several programming languages to overcome this problem. We choose programming languages depending on the type of physical process. For example: I use Visual Basic programming language to develop 2D animations. We use the Python programming language to create 3D animations. As an example of 2D animation, we can cite the project " Virtual Laboratory of Davison and Germer Experiment " shown in Figure 1.



We can cite the project "Virtual Laboratory of Frank Hertz Experiment" shown in Figure 2.



This project was written in the Visual Basic programming language, and below is its short code:

```
dt = 0.1
For i = 0 To 4
v1(i) = v1(i) + ax1(i) * dt
e(i).Left = e(i).Left + v1(i) * 5
vy1(i) = vy1(i) + ay1(i) * dt
e(i).Top = e(i).Top + vy1(i) * dt * 3000
Print v1(i)
Next i
For i = 0 To 4
ay1(i)=0
If U < 5 And U >= 0 Then
ax1(i) = U * el * 10 / (mel * 10)
ElseIf U >= 5 And U < 10 Then
ax1(i) = U * el * 10 / (mel * 10)
ElseIf U >= 10 And U <= 15 Then
ax1(i) = U * el * 10 / (mel * 10)
End If
```

As an example of 3-dimensional animations, we can say the following Python program "Magnetic field of a toroid". Its appearance in 3 different states is shown in Fig. 3.

Figure 3. 3D view of the magnetic field of the toroid Short code for the "Magnetic Field of a Toroid" animation made in Python:

```
while True:
rate(100)
if drag:
newobs = scene.mouse.pos
if newobs != obs:
obs = newobs
```

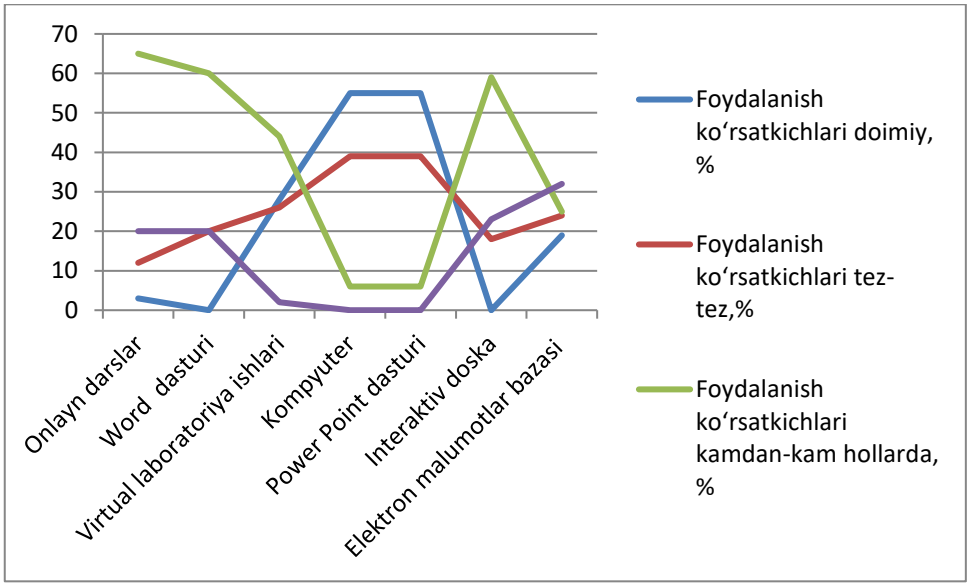
```
Bvector. axis = Bscale*BField(obs)
Bvector.pos = obs
if scene.mouse.events:
m = scene.mouse.getevent()
if m.button == 'left':
if m.press:
obs = scene.mouse.pos
Bvector.axis = Bscale*BField( obs)
Bvector.pos = obs
elif m.drag:
drag = True
obs = None
elif m.release or m.drop:
drag = False
arrow(pos=obs, axis=Bscale*BField(obs), shaftwidth=vwidth, col or=(0,1,1))
```

A deep understanding of physics comes in handy in virtual labs to learn theory and solve various computational, qualitative and experimental problems. If the student gets acquainted with theoretical questions in lectures, then the theory is applied in laboratory exercises, and in addition, practical skills are formed in conducting physical measurements, processing and presenting results. Pedagogical software environment used in different departments of physics, informational learning environment, intellectual teaching systems, multimedia lessons, case laboratories, students' scientific research work in the field of creating a computer model of a physical phenomenon and creating software. It is of great practical importance.

Integrating information and communication technologies into physics, which is a modern direction of teaching in the development of students' knowledge, skills and abilities in physics, developing teaching models, forming students' competence in information and communication technologies, electronic software-methodical education we analyzed the improvement of the methodological system for expanding the supply on a scientific basis. In our research, we conducted questions and answers in order to determine the level of use of virtual laboratory systems (information and communication technologies) by students in physics. The students of Chemistry, Physics and Astronomy of Jizzakh State Pedagogical University named after Abdulla Qadiri participated in the question-and-answer process. The identification phase was carried out through a questionnaire. In the questionnaire, students were asked about the types of information and communication technologies, the level of their use (constant, frequent, rare).

Table 1. Indicators of the use of information and communication technologies by students.

ICT name	Usage indicators			
	constant, %	often, %	rarely, %	familiar
Online classes	3	12	65	20
Word program	0	20	60	20
Virtual laboratory works	28	26	44	2
Computer	55	39	6	0
Power Point program	55	39	6	0
Interactive whiteboard	0	18	59	23
Electronic database	19	24	25	32



As can be seen from the table, when asked about the use of the Internet, all students answered that they use the Internet all the time. In online classes and conferences, all students wrote that they use it to learn English. Only 3% of them regularly, 12% used it often, 65% less and 20% of students said they were not familiar with online classes and conferences.

Regarding the use of the computer in the process of preparing lessons, 55% wrote that they use it regularly, 39% often, and 6% rarely. According to the results of the experiment, those who regularly use the interactive whiteboard showed 0%, more - 18%, less - 59%, and those who do not use it at all - 23%. The answers of the students who rarely use it are different: I use the interactive whiteboard only in university and institute classes, while preparing slides while doing group work, some answered that it is because of the malfunction of the interactive whiteboard. 75% of the students who

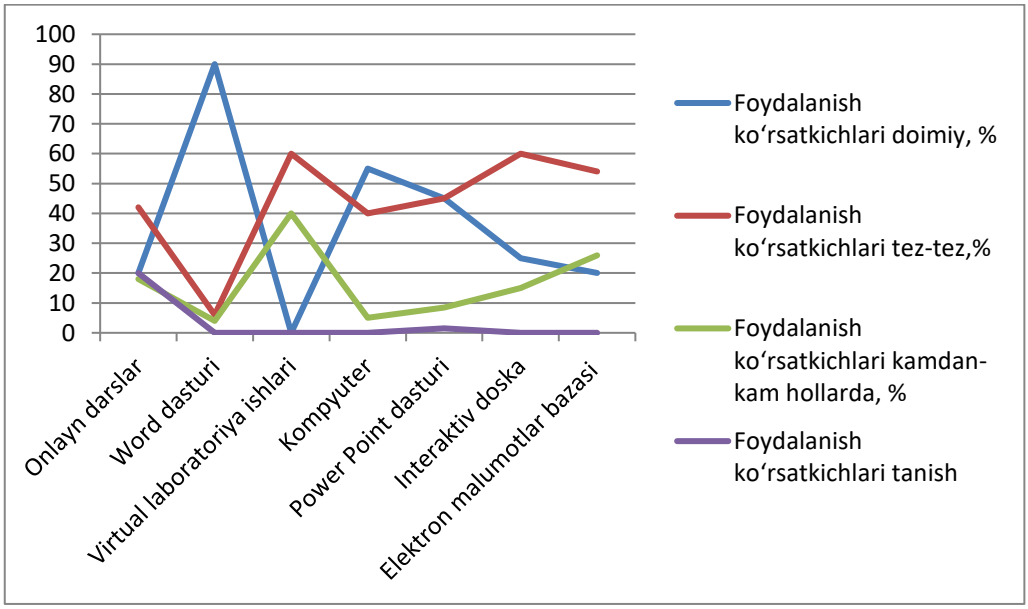
participated in the survey said that they use an electronic textbook for classes; of them always - 9%, often - 18% and rarely - 48%. It was found that 68% of students are familiar with online databases and use them to get the necessary information. It was found that 55% of students consistently reported that they were able to work with Power Point and create slides. Nowadays, slides are used in all educational institutions.

Therefore, the results of the research show that the level of knowledge and application of information and communication technologies necessary for students in the pedagogical direction to master the knowledge and activities of future teachers is not satisfactory. came out Therefore, in order to increase students' knowledge and use of information and communication technologies, it is necessary to use electronic textbooks and manuals and virtual laboratories in the course of the lesson. We managed to increase the competence of students in information and communication technologies by using modern electronic resources in the course of lectures and laboratory sessions on electromagnetism. During the lecture, we used an electronic study guide created on the subject of electromagnetism. This electronic study guide provides an opportunity to present information related to the subject in electronic form, covering all the topics covered in the syllabus of electromagnetism. The use of multimedia capabilities of the lessons creates a number of conveniences for the students. Because, on the one hand, the audio programs, pictorial developments, animated recordings (presentations), animations on this subject are new for the teacher, on the other hand, they are interesting and attract the attention of the students. And it motivates the subject to be mastered well.

Similarly, we used virtual laboratory work for students in laboratory classes to improve their competence in information and communication technologies. In this case, the perception of objective existence with the help of natural senses is replaced by artificially created computer information with the help of a special interface, computer graphics and sound. Today, virtual existence is used in various fields of human cultural activity. The virtual entity is primarily used in the field in which it was created, in science, including physics, in modeling the dynamics of liquids and gases. In education, the digital literacy of teachers, who can freely use a personal computer, communicate with communities and students, plays an important role; in education, they update their resources using electronic technologies, in which a system of tasks performed by students in electronic form is implemented. At the end of the course, we re-administered the questionnaire to check the competence of students in information and communication technologies, the results of the study are given in Table 2.

Table 2. Indicators of use of information and communication technologies by students at the end of the electromagnetism course.

ICT name	Usage indicators			
	constant, %	often, %	rarely, %	familiar
Online classes	20	42	18	20
Word program	90	6	4	0
Virtual laboratory works	0	60	40	0
Computer	55	40	5	0
Power Point program	45	45	8.5	1.5
Interactive whiteboard	25	60	15	0
Electronic database	20	54	26	0



From the table, we can see that the use of electronic whiteboards, electronic textbooks during lectures, and virtual laboratories during laboratory work created an opportunity to increase the competence of students in information and communication technologies (Table 2). From Table 2, we can see that students' use of Online Database and Power Point software increased. The reason is that during the course, students used the electronic database for independent work and the Power Point program for preparing presentations. The results of the research show that according to the survey taken at the beginning of the course, we can see that the students' use of ICT increased by 10-15% by the end of the course.

CONCLUSIONS

From the above scientific analysis, it can be concluded that the use of virtual laboratory programs in the course of the lesson, electronic textbooks, electronic whiteboards, and laboratory work plays a key role in improving the informational communication competence of students. Modern information technologies accelerate all stages of educational processes. Based on the use of

information technology, we can observe the increase in the quality and efficiency of the educational process, and the activation of students' cognitive activity.

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