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METHODOLOGY FOR CONDUCTING LABORATORY CLASSES IN OPTICS BY USING DIGITAL TECHNOLOGIES

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Abstract
The article deals with the use of various digital laboratories in laboratory classes in Optics.

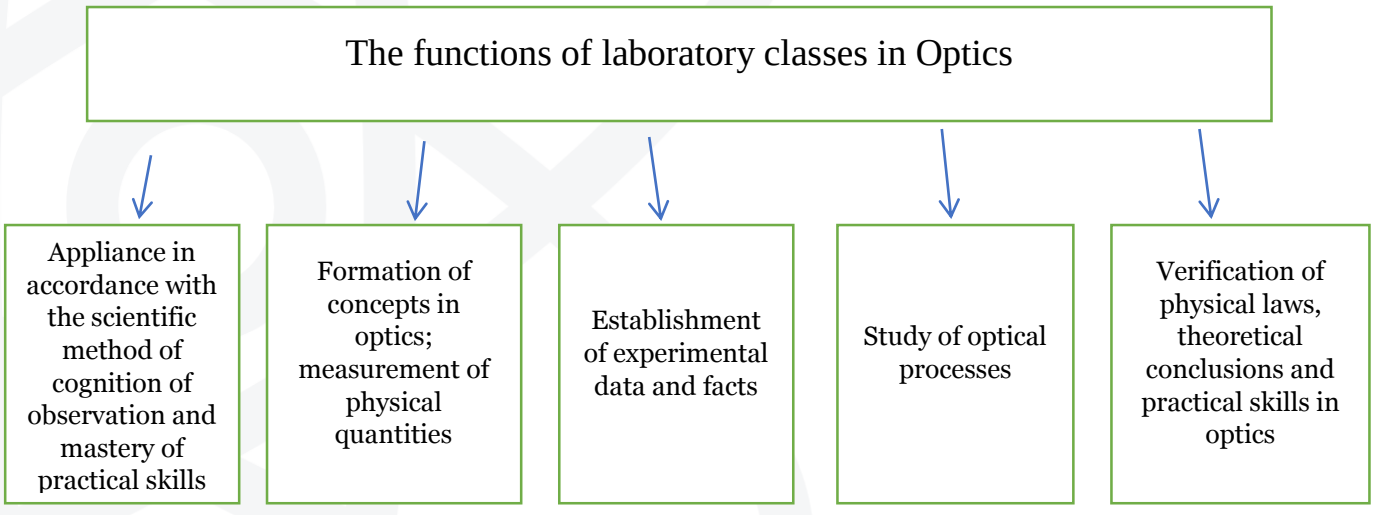
Keywords: digital laboratories, optics, laboratory work, students, pedagogical universities.

Introduction

Information technology is the most widespread in the modern world. The students' environment is connected with information technology, and the search for the necessary scientific information cannot be carried out without the use of computers, tablets, smartphones, laptops, etc. Therefore, the involvement of digital technologies in all training sessions in physics (in the Optics section) is of a particular relevance: lectures, practical and laboratory. These technologies make it possible to involve students of pedagogical universities in the activities of the reality around them [2].

Litrerature Review. Material and Methods

Laboratory classes in Optics are important in the formation of students' practical skills. Their functions are shown in Fig.1



Laboratory classes in Optics form students' understanding of physical phenomena and processes, obtained earlier in lectures, expand their horizons and practical skills. Students learn the laws of physical phenomena, get acquainted with the teaching and learning methods, learn how to work with physical instruments, installations, determine the errors of instruments and calculations, students, independently conducting laboratory work under the supervision of a teacher acquire knowledge in Optics

The development of modern technology and the practice of all-natural scientific research in the world shows that in the measurement of physical quantities, the principles of digitizing analog signals, the introduction of sensors of physical quantities in Optics, and computer processing of information obtained from these sensors are widely used [3].

The modern standard of higher education in physics requires the active development of modern methods of obtaining, processing and providing information [4].

It is important to attract new information technology such as digital educational resources which should significantly improve the quality of teaching physics due to the following factors:

- Expanding the possibility of prompt access to a variety of supporting information (reference, laboratory work, etc.);
- Increasing the efficiency and effectiveness of a control over students' activity and ensuring the flexibility of managing the educational process;
- Fixing the intermediate results of the work of each student in electronic form, the accumulation of materials for their subsequent inclusion in term papers and final qualification papers;
- Involvement of students in active participation in the educational process [7].

Virtual laboratories have a number of advantages: they allow obtaining high-precision data, recording the values of several physical quantities simultaneously, digitally processing the results of laboratory work, reflecting it in the form of a table, and the ability to build graphs of physical dependencies. The use of a computer or a laptop during laboratory work makes it possible to continuously monitor the entire process, analyze it in dynamics, and record small measurements [5].

To diversify laboratory classes with students, it is possible to use not only traditional optics equipment in the classroom, but also equipment based on the use of digital measurement methods [2]. In solving the tasks set today an important role is given to the implementation of the possibility of using a digital laboratory in the educational process of pedagogical universities, in laboratory classes in Optics. The use of a digital

laboratory forms an idea of the role and place of laboratory experiments as a scientific method of cognition.

Digital laboratory “Scientific Entertainment” is an equipment for conducting various types of research, including laboratory work using real equipment associated with digital sensors. The signal from the sensors enters the computer and is automatically processed. The received data on the computer are displayed in the form of a table. Based on these data the student can independently perform calculations using formulas, build a graph, compare the resulting curve graph with the finished theoretical one. The main difference between this complex and classical equipment is that it is convenient and wins in the visibility of laboratory work. Conventional available equipment cannot always perform important laboratory tests and students cannot test optical phenomena such as diffraction or interference by experiment.

The digital laboratory “Scientific Entertainment” is intended for individual use in laboratory classes in Optics. Plugging sensors directly into a computer simplifies digital lab work. The software, which is part of the laboratory, can be installed in students' personal computers, contains the procedure for conducting laboratory work. To check how the student completed the lab, you can check the report and the filling table in the main computer of the teacher, where the student will send his data on a particular lab. Also, the teacher can adjust the list of laboratory work in optics, depending on the changes made to the curriculum in Optics. All sensors can be used in one computer or take readings from 2 installations at once [1].

The digital complex allows students to complete about 30 laboratory works. Observation of laboratory work by students improves the quality of assimilation of educational material in Optics. When studying the Optics section, digital technologies allow you to explore the laws of photometry, including conducting laboratory work on this topic. Also, such laboratory works as: “Determination of the refractive index”, “Fresnel's law of reflection”, “Newton's rings on refracted and reflected white light”, “Determination of the wavelength of light by using a diffraction grating” etc. The complex is equipped with digital meters, the use of which can be carried out by using a computer, information for processing can be received simultaneously from 2 sensors.

The digital laboratory kit includes 4 digital sensors, a computer or a laptop with a built-in webcam, a set of necessary laboratory equipment.

Before you start working in a digital laboratory you need to start by doing some work:

1) Familiarization with the program interface;

2) Acquaintance with the video processing program;

3) It is necessary to familiarize yourself with the methodological manual of the program.

A set of laboratory works in Optics is designed for the successive performance of four laboratory works in Geometric and Wave Optics. Data registration (path of rays, interference or diffraction pattern) is carried out by using a webcam connected with USB to a personal computer or laptop.

The program for processing photographs taken by a webcam allows us to determine the distance between interference and diffraction maxima, determine the angle of rotation of the beam when passing through the boundary of 2 media, build graphs of the dependence of the angle of refraction on the angle of incidence and the sine of the angle of incidence, which makes it possible to determine refractive index through the tangent of the slope of the graph.

Opportunities of the digital laboratory in Optics:

1) Study of light refraction at the air-plexiglass interface;
2) Study of the emission spectra of the laser and LED;
3) Study of the spectrum of red and infrared LEDs;
4) Study of the interference of laser radiation on two slits [6].

Fig.2. Optics kit

The digital laboratory in the section of physics 'Optics' allows us to implement the requirements of the standard of higher education of the Republic of Uzbekistan for

mastering the methods of scientific knowledge, for conducting laboratory classes and using ICT tools for cognitive purposes.

Basic level of digital optics laboratory includes:

1. 4 digital sensors connected to the USB port.
2. The program "Digital Laboratory" is constantly updated in the public domain. The program contains templates of tables, graphs, individual for each work, formulas for the selection of graphs, functions that correspond to the results of the experiment.
3. Allows the student to generate an electronic report during the laboratory work with the initial data, a photo of the laboratory setup, the primary curve from the sensor, intermediate tables, the final graph and text comments;
5. Providing methodological materials containing instructions for a beginner user, three scenarios for mastering the program interface.
6. It has a video instruction for its operation.

A Digital Lab for the STEM Student

This digital lab contains methodological guide that provides step-by-step instructions for completing 34 labs. The optics section contains five laboratory works. The digital laboratory for optics includes:

1. Digital position sensor (4 channels).
2. Equipment for conducting experiments.
3. Container for storing sensors and equipment with a lodgment.
4. Software with guidelines for laboratory work.

All sensors included in the digital laboratory must have USB connectors (BF) for connecting to a computer (laptop) via a connecting cable. You can also use the Point Digital Physics Laboratory [8].

Achievement by students of personal, objective results of mastering the main program, included in the Higher Educational Standards, is impossible without the use in the educational process of all existing teaching aids, traditional and teaching aids based on digital technologies.

Conclusion

In conclusion, we can conclude that the adequate use of educational technologies, the use of digital technologies in laboratory classes for students of pedagogical universities, allow:

- Save time for laboratory classes;
- Increase students' interest and motivation;

- Show the possibilities of using digital technologies for further project, course and qualification paper of students;
- Improve the results of passing intermediate and final tests of pedagogical university students in Optics.

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