

Advantages of Teaching Laboratory Classes in the Department of Optics in Higher Educational Institutions Based on Computer-Modeled Developments

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Abstract:

In this article, in the modern teaching methodology of the department of optics in higher educational institutions, a physical experiment is a component of an integral educational process that combines theoretical and experimental methods of studying and researching physical phenomena. The advantages of teaching theoretical and experimental laboratory training based on computer modeling of developments, problems and disadvantages are proposed.

Keywords: physical experiment, physical phenomena, optics, laboratory, visual physical experiments, modeling, development, personal computer.

Introduction: In the physics course, there were always many very complex and difficult to understand concepts. The rapid development of science leads to an increase in such concepts, facts, ideas, and patterns. For the continuous integration of new concepts into students' scientific knowledge, their creative use and development in their subsequent practical activities, continuous improvement of the physics course teaching methodology and implementation of significant efforts are required.

In modern methods of teaching physics, the physical experiment is an integral part of the holistic educational process, in which the theoretical and experimental methods of studying and researching physical phenomena are combined.

Literature analysis and methods: According to Professor N.Ya. Molotkov, "visual physical experiment plays a decisive methodological role in connecting students' conceptual foundations

with the empirical foundations of physical sciences and technology, helping to understand the essence of the phenomena and processes being studied" [1]. This connection is carried out in three directions. Firstly, the experiment "serves as a source of subjectively new empirical facts for students, serving as a starting element in their interpretation based on conceptual content, which ultimately helps develop and establish students' theoretical knowledge." Secondly, experimentation "is a necessary factor in the formation of students' conceptual apparatus and idealized objects of theoretical knowledge, on the basis of which the creation and reproduction of subjectively new knowledge is carried out." Thirdly, the experiment "allows for a clear depiction of theoretical constructions and conclusions, ensures the connection between abstract conceptual rules and objective truth, ensures the entry of students' "theoretical world" into the sphere of practical activity, and applies the theory in practice"[2].

In this regard, the role of laboratory practical work in the training of future specialists is extremely important, and the creation of modern laboratory work and the development of new methods for its implementation is very relevant.

In the laboratory laboratory on general physics, edited by E.M. Gershenzon and N.N. Malov, a description of the work for pedagogical institutes is given, from which it follows that it directly takes into account the specifics of training future physics teachers. This manifested itself, first of all, in the desire to study the most general, fundamental problems. In addition, some tasks have a certain illustrative character; they emphasize the importance of maximum illustrativeness of the experiment; some tasks have the characteristic of qualitative tasks.

This is also expressed in the creation of descriptions that encourage students to work independently with books.

The Optics Laboratory includes 24 laboratory works, which cover a wide range of issues:

1. Study of electromagnetic waves.
2. Interference and diffraction of electromagnetic waves.
3. Newton's rings.
4. Study of the temporal coherence of radiation.
5. Young's experiment.
6. Determination of the wavelength of light.
7. Fraunhofer and Fresnel diffraction.
8. Diffraction of laser radiation.
9. Diffraction of light.
10. Diffraction grating.
11. Telescope, microscope, eye as an optical system.
12. Determining the focal length of thin lenses.
13. Linearly and elliptically polarized light.
14. Propagation of light.
15. Light at the interface between two media.

To perform the above work, similar to previous practical work, equipment is sometimes required that is not available in universities for a number of reasons - a mercury lamp, a microscope with opaque lighting, a gas outlet tube, a collimator, a laser, a goniometer, etc. However, it should be noted that this seminar includes laboratory work on the study of electromagnetic waves in a two-

wire line and the study of interference and diffraction in the decimeter and centimeter ranges of electromagnetic waves - and, for example, the second work, a centimeter wave generator and a metal screen are sufficient, an indicator and a microammeter are very convenient equipment for any university.

For many years, a comprehensive general physical laboratory seminar on wave optics in two wavelengths has been developed: optical and radiophysical.

Results and discussions. The works of many methodological physicists show that the use of centimeter electromagnetic waves in physical experiments on wave optics allows for a significant expansion of the range of phenomena studied experimentally.

With the help of simpler and more convenient means, it became possible to visually study a number of subtle optical wave phenomena:

- superposition of two coherent waves with all possible polarization patterns;
- diffraction pattern control;
- study of the properties of two-phase refracting plates;
- modeling of X-ray diffraction;
- studying the optical analog of the tunnel effect, etc.

Thus, the analysis of current practices in optics showed that they are aimed at developing students' experimental competence, including the skills of creating experimental devices and the ability to perform a set of studies on ready-made experimental devices.

Currently, interest in models and modeling has become universal, and now, perhaps, there is no science or field of knowledge that does not try to talk about models and engage in modeling. Naturally, modeling and computer experimentation did not neglect the educational process.

Today, the personal computer is a necessary and integral element of the student training process. The personal computer has found serious and long-term use as a tool in the process of teaching students, especially in conducting educational experiments. However, computer-based learning should and can be interconnected with classical teaching methods.

The justification of the necessity and expediency of introducing computer and microprocessor technologies into educational practice includes two main, closely related components.

Firstly, the enormous technical and operational capabilities of the computer include didactic material incomparable to the technical means of teaching previously used in the educational process.

Secondly, the true effectiveness of scientific and technological progress (and the widespread use of computers is one of its most striking manifestations) is decisively dependent on training personnel at the level of modern requirements. The study and use of computer technologies in the educational process is an important component of preparing students for future work life. It is impossible not to take into account that the future profession of most graduates of higher educational institutions will be in one way or another connected with computers.

It is important to pay attention to the following. Physical theory remains one of the most difficult elements in the content of the wave optics course, as it contains a large amount of abstract material. The study of theoretical models without the use of computer practice, applied in practice in the traditional teaching of physics, is associated with a number of difficulties associated with the abstractness of models. Not every student can see a physical phenomenon using a mathematical apparatus that describes a physical model. Although students have mastered the mathematical apparatus well, difficulties often arise in transferring research results to physical (even idealized)

objects. The software of the model (computer model), along with its visualization, allows one to imagine how the real object would behave if it truly obeyed the laws described in theory. The computer model allows you to reproduce and better understand the behavior of the model at the level of idealization and abstraction inherent in physical theory.

However, issues of modernizing students' teaching methodology. At the present stage, wave optics in the microwave -band with the help of a computer support program has not yet been correctly reflected in pedagogical science and practice and requires further research.

Based on the analysis of scientific, methodological literature and research, as well as the results of the defining stage of the experiment, contradictions were identified between the following:

- the need for a comprehensive study of wave processes and the lack of training time for conducting a complex experiment;

lack of computer support tools.

If we develop and implement a computer program to support laboratory sessions on wave optics in the microwave range of electromagnetic waves, complementing the natural experiment, this will not only lead to an increase in the learning process. Increasing students' interest in using computer support tools in their future professional activities, as well as increasing their level of knowledge.

Computer presentations offer several advantages over traditional presentations, allowing for the visualization of an event or object in an idealized form without distorting design features or technical manipulation. With the skillful use of computer technologies, it is possible to activate students' thinking, develop their creative abilities, and increase their interest in complex theoretical issues. The computer model allows the model's behavior to be replicated with the degree of idealization and abstraction characteristic of physical theory, allowing for a better understanding [5].

At the same time, methodologically developed interactive computer programs adapted to physical demonstrations and even more modern educational conditions are expanding very slowly. As a result, the physical side of many phenomena is presented in the form of "chalk".

This made it possible to highlight the following aspects of improving the experimental training of future specialists in the context of university education:

1. Educational activity at the university should be considered not as reproductive, reproductive, but as effective, creative, in which the student himself creates and masters new professional knowledge and methods of its acquisition.
2. The need for continuous improvement of the content of physics lessons and methods of conducting lessons (seminar concept; selection of topics and content of laboratory work; development of teaching aids and equipment; justification of the methodology for conducting laboratory work and organizing experimental work).
3. Laboratory seminars involve the combined use of theoretical and practical aspects of the knowledge acquisition process.
4. Conducting experiments in the educational process contributes to the formation of a number of skills and abilities not only of a purely practical, but also of an intellectual nature.
5. Helps develop creative abilities in mental activity.
6. There are serious shortcomings in the formation of skills and abilities in the independent performance of laboratory work among students.

Conclusion and recommendations:

In conclusion, modern laboratory classes of the Optics Department in higher educational institutions must meet the following requirements:

1. A modern laboratory laboratory is, first and foremost, a laboratory where modern equipment based on the latest achievements of science and technology is used in conducting physical experiments.
2. A modern laboratory laboratory must correspond to a high scientific and methodological level.
3. The result of each laboratory work of the physics laboratory should be an understanding of the place of the studied phenomenon in the unified physical picture of the world, and taking into account the trends in the development of educational physical experiments, the dissertation concludes that it is necessary to supplement the existing full-scale laboratory of microwave optics with the help of a computer. Program that allows for a more multifaceted, in-depth, and systematic study of wave processes, combining natural and computer experiments.

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