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EVALUATION OF THEORETICAL AND EXPERIMENTAL INFORMATIVE VALUE OF LABORATORY WORK IN PHYSICS

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Abstract
Improving the efficiency of the experimental teaching physics at a university requires accurate knowledge of the components and informative weight of knowledge. An example of the evaluation of the theoretical and experimental informativity of the content of the laboratory problem of the general physical workshop is given. A list of parameters has been developed, on the basis of which the corresponding scientific and methodological search is conducted. The research activity of a student is an indicator of the quality of education in a higher educational institution, which proves its relevance. In the context of an in-depth study of physics, it is this direction that becomes the most priority.

Keywords: education, informativity, experiment, training, research activities, methods of developing research skills.

Introduction

The task of increasing the effectiveness of experimental teaching of physics at a university requires knowing exactly the components and informative weight of knowledge acquired by a student when performing one experimental work and a group of works that are thematically related to each other. Academic information covered by one laboratory task of a physical workshop is different depending on the specifics of the university and faculty. These differences are programmed in the process of setting tasks and methods of conducting classes. When compiling the tasks of a student's individual task for a physics workshop for one semester, one should specifically determine the nature and amount of information extracted from a separate laboratory work so that from a set of works he receives full-fledged scientific information required by the program.

Methodology

In practice, it often happens that an uncontrolled random selection of workshop papers for one student per academic semester leads to the unevenness of the academic

information received by group students, and weakens the connection between experimental learning and the lecture course.

Below is a sample of the assessment of the theoretical and experimental informativity of the content of the laboratory problem of the general physical practice. A list of parameters has been developed, on the basis of which the corresponding scientific and methodological search is conducted.

Here is the list:

1. Connection of the theory of the phenomenon under study with the theoretical course;
2. Questions of the theoretical course, developed, deepened and tested on the experiment;
3. Introduced abstraction in modeling the experiment and in the theory of the phenomenon;
4. The methods used here for processing the results of measurement and analysis of the final result of the experiment;
5. Interdisciplinary connections with the course of higher mathematics: measurements and analysis of the final result of the experiment;
6. Interdisciplinary connections with the course of higher mathematics: measurements and in assessing the accuracy of the final result;
7. Establishing a connection between theoretical and experimental information, acquired in this work with similar information extracted from a set of other works of the workshop;
8. Possibilities of expanding, deepening the content of the experiment and its implementation by the student in the form of UIIR.

Usually, in the description of the workshop, a brief theory of the phenomenon is given, the features of the experimental setup and the measurement technique are characterized. Methods for processing measurement results and calculating measurement errors in a particular task are reported by the teacher and depend on the type of tasks.

As an illustration of this practical program, let's consider the analysis of the laboratory work of the general physical workshop "Determination of the coefficient of internal friction and the mean free path of air molecules." The theory of the phenomenon under study covers the following basic physical concepts related to the phenomena of transfer in the eyes, to internal friction in the air, which are closely related to the theoretical course. In particular, when analyzing the phenomenon, the concepts and regularities of molecular physics are involved: laminar flow of incompressible viscous

air through a capillary, the Hagen–Poiseuille law, internal friction forces, dynamic and kinematic viscosity coefficients, mean free path, velocity and pressure gradient, pressure difference, number Reynolds, average air flow velocity, arithmetic average velocity of a gas molecule, dependence of viscous air flow velocity on capillary radius. The student, performing this work, experimentally study and check the correctness of the Hagen–Poiseuille formula, which describes the laminar flow of viscous incompressible air through the capillary, the dynamic method for determining the mean free path, the average air flow velocity, kinematic viscosity, laminar flow. The dependence of the pressure difference on the air flow and the constancy of the pressure gradient are also checked by a graphical method. When modeling the experiment and in the theory of the phenomenon, the compressibility of air, the sliding of molecules along the walls of the capillary, and the temperature dependence of the volume of air passing through the gasometer are neglected. It is believed that $P_1-P_2<P_2$ and at a low flow velocity the pressure difference is unchanged.

When performing an experiment, the student masters the methods of direct measurement (time, length, radius, capillary). Indirect method measure: pressure difference using a water pressure gauge; the volume of air flowing through the capillary, using a gasometer, determine the dynamic and kinematic viscosity of the air, the mean free path. Performing this laboratory work, students acquire the skills and abilities to work with millimeter rulers, a measuring microscope, stopwatches, and a micrometric manometer. The optimal conditions for the experiment are also selected, the limits for varying the rate of water outflow from the gasometer and the rate of air outflow through the capillary are set at a constant pressure difference between the inlet and outlet of the capillary.

Results and its discussion

In this work, the student can apply the differential method to process the experimental data. The results of the experiment are analyzed by comparing the data obtained by various methods (analytical calculation, graphical method); when studying the phenomenon of transfer, when deriving the Hagen–Poiseuille formula, the student uses knowledge of a differential equation, a definite integral, a gradient of a physical quantity, a Cartesian coordinate system, equations of 1 and 2 orders. When calculating the errors of the final result, students get acquainted with the differentiation of a complex function with many variables, with the concepts of probability of a distributed random variable, confidence interval, with the Student's coefficient, with graphical interpolation. The acquired experimental information in this work (the coefficient of internal friction, the gas-liquid outflow velocity, the mean

free path, the Reynolds number, kinematic viscosity give the student the opportunity to link them with similar information extracted from a set of other works of the workshop. These are such laboratory works as " Determination of the coefficient of internal friction of a liquid by the Stokes method", "Determination of the coefficient of internal friction of a liquid by a rotational viscometer by M.P. Volarovich". to establish the connection of the studied method with other methods for determining the coefficient of internal friction of liquids and gases, to generalize the concept of the outflow of gases and liquids through capillaries, to check the condition of laminar flow of liquids and gases in this group of experiments.

Conclusion

The study of the work of the workshop on the basis of such a program will allow you to more effectively manage the volume and content of academic information contained in the complex of laboratory tasks that are defined for the academic semester or academic year.

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