

ORGANIZATION AND CONDUCT OF LABORATORY CLASSES IN THE MECHANICS SECTION USING MODERN INFORMATION TECHNOLOGY

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Abstract

The paper deals with the problem of increasing the efficiency of training specialists in educational institutions. It is shown that the professional readiness of students as a personal quality and an essential prerequisite for the effective activity of a specialist, the successful performance of his duties, the correct use of knowledge and experience, helps to quickly adapt to working conditions, and contributes to further professional development.

Keywords: Laboratory classes, formation of educational and professional practical skills, form of training.

Introduction

It is well known that laboratory classes as types of training sessions are aimed at experimental confirmation of theoretical provisions and the formation of educational and professional practical skills, and constitute an important part of theoretical and professional practical training [1]. A laboratory lesson is a form of training in which, under the guidance of a teacher, students personally conduct full-scale or imitation experiments in order to check and confirm certain theoretical provisions of the academic discipline, acquire practical skills in working with laboratory equipment and computer technology. Laboratory classes are held in training workshops and laboratory classrooms. The duration of the lesson is at least two academic hours. Laboratory work is preceded by checking the knowledge of students - their theoretical readiness to perform the task. For each laboratory work, methodological instructions for its implementation have been compiled and approved, as well as assessment criteria that take into account the volume, correctness, rationality, accuracy, and independence of task performance [2]. Works of a reproductive nature are distinguished by the fact that during their implementation, students use detailed instructions, which indicate: the purpose of the work, explanations (theory, main characteristics), equipment, apparatus, materials and their characteristics, the order of work, tables, conclusions (without wording), control questions, educational and special literature.

When conducting laboratory work of a partial-search nature, students do not use detailed instructions, they are not given the procedure for performing the necessary actions, this requires them to independently select equipment, choose ways to perform work in instructional and reference literature, etc. [1.2]. Works of a search nature are characterized by the fact that students, relying on their theoretical knowledge, must solve a new problem for them.

Physical experiment is one of the main sources of knowledge



In physical science, a distinction is made between research and criterion experiment. Such a division is also possible in an educational physical experiment. When setting up experiments in the research plan, students will receive data that have subjective novelty. A criteria-based experiment aims at obtaining an expected result that confirms or refutes the assumptions made or the consequences deduced by the theory. Any type of experiment is characterized by the following features: interference in phenomena, processes of the external world by special devices; identification of really studied connections and elimination (muffling) of side and accidental influences; reproduction and repeated repetition of the studied phenomena in certain conditions; planned change in the conditions of the phenomenon or process; organization and direction in order to minimize the elements of randomness [3].

Structurally, a physical experiment can be divided into three components: the experimenter and his activity as a cognitive subject; the object or subject of experimental research; means of experimental investigations (tools, devices, experimental installations, etc.). In the interconnection of these three structural elements, the first of them is the subjective, and the second and third are the objective side of the experiment. From the methodological point of view, it follows that the objective side of the experiment is not limited to the subject of experimental research alone. It (the objective side) includes isolating, registering, preparing and transforming the object means of experimentation. The decisive role of the means of experimental research lies in the fact that all the above-mentioned features of the experiment can be realized only thanks to these means. The use of devices makes it possible to expand the natural limitation of the human sense organs, which reflect the external world in a relatively narrow range of phenomena and properties due to the adaptation of the organism to the environment [4].

An educational physical experiment is simultaneously a source of knowledge, a method of teaching and a type of visualization. An educational experiment is created and improved in accordance with the development of physics teaching methods. In general, in the teaching of physics, the following responsible tasks are assigned to the school experiment: ensuring the best assimilation of concepts, laws, and theories by students; formation of skills to apply knowledge in practice; acquaintance with the most important methods of nature research; systematization, processing and transfer of information; development of students' interests in the subject and their preparation for the development of new equipment and technology of material production; formation of students' skills of independent work and creative attitude to work; the formation of practical skills and skills, preparation for work in the field of material production [5].

At present, the university has an established system of educational physical experiment, based on the idea of a gradual increase in the independence of students in the process of mastering knowledge. Based on this, a physical experiment can be divided into five types according to the increasing degree of complexity for students and a decrease in the current control on the part of the teacher: a demonstration experiment conducted by the teacher [5,6]; frontal laboratory work performed by students in the process of studying the program material; works of the physics workshop performed by students at the end of the previous sections of the physics course or at



the end of the entire school physics course; experimental tasks; extracurricular physical experiments (at clubs, conferences) and home experimental work.

This classification of the experiment is not the only one, but the essence of all existing classifications is basically reduced to it. In addition to the general tasks solved by all types of school experiments, each type has its own peculiarity, its own narrower purpose. All these five types of physical experiment contribute to a deeper study of the laws of physics, as well as the acquisition of practical skills in the field of physical experiment by students.

Thus, physical experiment is one of the main sources of knowledge in the study of the world around us and one of the most important methods of teaching physics. Depending on the task, it can be carried out as a research and as a criterion and always has two sides: subjective and objective, and the latter plays a decisive role in it [6]. As a method of teaching, it can be divided into five types: demonstration experiment; frontal laboratory work; the work of a physical workshop; experimental tasks; extracurricular physical experiments, each of which, in an integral system of physical experiment, in its turn, contributes to a deeper study of the laws of physics, as well as the acquisition of practical skills by students.

Use of ICT in laboratory classes

The use of ICT in laboratory classes allows you to increase the interest of students in laboratory classes, implement interdisciplinary connections, improve the skills of using a personal computer, and form the appropriate general competencies of students. I would like to note that laboratory classes are an important stage in the formation of general and professional competencies of students, which are developed in educational and industrial practice in production conditions, at the enterprises of social partners. Students perform laboratory work in order to [7]:

the formation of practical skills in accordance with the requirements for the level of training of students established by the work program of the discipline / professional module for specific sections/topics of disciplines or interdisciplinary courses;

generalization, systematization, deepening, consolidation of the theoretical knowledge gained; improving the ability to apply the acquired knowledge in practice, the implementation of the unity of intellectual and practical activity;

development of intellectual skills in future specialists: analytical, design, constructive, etc.;

development of such professionally significant qualities as independence, responsibility, accuracy, creative initiative in solving problems.

The composition of tasks for the laboratory and practical lesson is planned by teachers so that they can be performed efficiently by the majority of students in the allotted time [8]. A laboratory lesson is understood as a lesson during which students perform one or more laboratory works under the guidance of a teacher in accordance with the studied educational material.

The performance of laboratory work (tasks) by students is aimed at:

generalization, systematization, deepening, consolidation of the theoretical knowledge gained;

formation of skills to apply the acquired knowledge in practice;

the realization of the unity of intellectual and practical activity;

development of intellectual skills: analytical, design, constructive, etc.;



the development of such professionally significant qualities as independence, responsibility, accuracy, and creative initiative in solving the assigned tasks. The disciplines in which laboratory and/or practical classes are planned, as well as their volumes, are determined educational standards of secondary vocational education, working curricula for the implemented areas of vocational education.

Lab Planning

The planning of the number and content of laboratory classes is carried out by the developer of the work program of the discipline (course), based on the requirements of the relevant federal state educational standard for the results of mastering the discipline (course), as well as the educational technologies and methods used. When planning the content of laboratory work, it should be assumed that laboratory work has different didactic goals. The main didactic goal of laboratory work is the experimental confirmation and verification of theoretical provisions (laws, dependencies). The content of laboratory work can be experimental verification of formulas, calculation methods, establishment and confirmation of regularities, familiarization with the methods of conducting experiments, establishment of the properties of substances, their qualitative and quantitative characteristics, observation of the development of phenomena, processes, etc. [7].

When choosing the content and volume of laboratory work, it is necessary to proceed from the level of complexity of the educational material, from the connection between disciplines and courses, the importance of the theoretical provisions studied for the future professional activity, from what place a particular work occupies in the totality of laboratory work and what is its role in the formation of a holistic view of the content of the academic discipline (course). When planning laboratory work, it should be taken into account that, along with the leading didactic goal (confirmation of theoretical positions), in the course of work, students develop practical skills and abilities to use various devices, installations, laboratory equipment, equipment (which can be part of professional practical training), as well as research skills to observe, compare, analyze, establish dependencies, draw conclusions and generalizations. independently conduct research, draw up the results [7,8].

The content of laboratory work should be planned in such a way that in the aggregate for the discipline (course) they cover the entire range of professional skills that this discipline (course) is focused on, and include the solution of various kinds of tasks, including professional ones (analysis of production situations, solving situational production problems, performing professional

In addition to the formation of skills and abilities in the process of laboratory work, theoretical knowledge is generalized, systematized, deepened and concretized, and the ability and readiness are developed use theoretical knowledge in practice, develop intellectual skills [9].

In general, the list of planned laboratory works should maximize the fulfillment of the requirements for the results of mastering the basic professional educational program, for knowledge, skills and practical experience, for the level of training of graduates established by the relevant federal state educational standards, as well as by the educational organization itself (when distributing the variable part). The share of training hours planned for laboratory classes



in the total volume of training hours allocated in the curriculum for the development of a discipline (course) does not have legally established restrictions and may be different for different disciplines (courses) [10]. The content of laboratory work, as well as the content of tasks for a practical lesson, should be planned on the basis of a preliminary calculation of the time required for their high-quality performance by the majority of students.

Organization and conduct of laboratory classes

Laboratory classes are conducted, as a rule, in specially equipped educational laboratories (Fig. 1). The duration is at least one academic hour. Duration of practical classes in academic disciplines of general professional, professional cycles

at least two academic hours in general education disciplines, academic disciplines of the general humanities and socio-economic, general mathematical and natural science cycles - at least one academic hour [11].



Fig.1. Specially equipped training laboratories.

Laboratory classes are preceded by testing the knowledge of students, their theoretical readiness to perform laboratory work. Automated test control can be one of the forms of monitoring the readiness of students to perform laboratory work. In order to prepare students for laboratory work, the teacher, as a rule, informs students about the topic of the work and determines homework, including the repetition of the theoretical material necessary for the work, the preparation of the form of a report on the results of work, etc. [12].

The necessary components of laboratory classes, in addition to the independent work of students, are:

- instruction conducted by the teacher before the start of the lesson;
- discussion of the results of laboratory work;



evaluation Done Lab work (tasks), the degree of mastery by students of the necessary skills, practical experience.

In order to increase the effectiveness of laboratory classes in which one or more tasks are performed, it is advisable to develop collections of exercises accompanied by methodological instructions, which take into account not only the level of preparedness of students to perform tasks of a particular level of complexity, but also the profession or specialty obtained (for general education disciplines) [11, 12].

Used Front Group and Private forms of laboratory work (tasks).

In the frontal form, all students perform one work (or one task). In the group form Individual Group Students Perform Different work (various tasks). With an individual form, each student performs individual laboratory work (individual task). When using various forms of laboratory classes, it is necessary consider A what most

Effective independent activity Student at Performing Full Volume work is provided by at Use predominantly individual form of work (task). Since laboratory classes are aimed at forming students' skills and practical experience, as well as ensuring a high level of intellectual activity, it is advisable to plan them based on the optimal

correlation of works of different types [13]:

works, in the performance of which students use detailed instructions, which indicate the purpose of the work, explanations (theory, main characteristics), equipment, apparatus, materials and their characteristics, the procedure for performing the work, the forms of tables, the structure of conclusions, control questions, educational and special literature (that is, works of a reproductive nature);

works in the performance of which students do not use detailed instructions containing the order of necessary actions, and they are required to independently select equipment, choose methods of performing work in instructive, methodological and reference literature, etc. (that is, works of a partially exploratory nature);

In order to ensure the effective use of the time allotted for laboratory classes, it is advisable to carry out a preliminary selection of additional tasks and tasks for students working at a faster pace [14].

Preparation of laboratory work

For the performance of laboratory work, teachers develop appropriate methodological materials (instructions), on their implementation, are considered and accepted by the relevant subject (cycle commissions) and approved by deputy directors for educational and methodological work, which are part of the main professional educational program. Methodical

Guidelines are developed for each laboratory work provided for by the work program of the academic discipline: in accordance with the number of hours, requirements for knowledge and skills, the topic of laboratory and practical work (tasks) established by the work program of the academic discipline for the relevant sections (topics) [14,15].

For example, guidelines for laboratory work may include:

the title (topic) and number of the laboratory work;

the purpose of the laboratory work;



basic safety requirements for laboratory work;
 Brief Theoretical information Necessary for Laboratory work;
 list Necessary for Perform Lab operation of equipment, reagents, etc.;
 the procedure for performing laboratory work;
 requirements to Registration ResultsPerform laboratory work (report);
 control questions;
 homework;
 used literature (bibliographic list).
 Methodical instructions for performing several laboratory works in a discipline (course) can be combined into a single methodical manual, including:
 title page;
 general safety instructions for laboratory (practical) work;
 general instructions for the performance of laboratory work and/or the algorithm for their implementation;
 annexes, if additional materials, including reference materials, are required for laboratory work;
 references (bibliography);
 content (if the volume of methodological instructions, for example, is more than 10 pages).
 Laboratory work. Studying the precession of the gyroscope
 Purpose of the work
 Study of the phenomenon of gyroscope precession.
 Tasks to be solved:
 determination of the dependence of the angular velocity of precession on the angular velocity of the gyroscope rotation (Fig. 2.);
 definition Constraints angularSpeed Precession Gyro on the applied torque of forces;
 experimental measurement of the moment of inertia of the gyroscope; Theoretical calculation of the moment of inertia of the gyroscope.

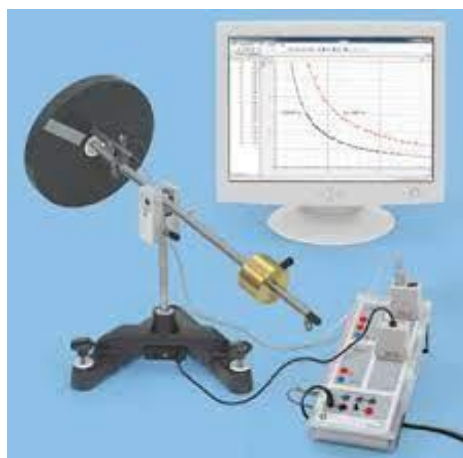


Fig.2. Determination of the dependence of the angular velocity of precession on the angular velocity of the gyroscope rotation;



Experimental Setup

Devices and accessories:

Gyroscope (disk mass = 1500 g, diameter = 230 mm); Set of cargoes; Cord for spinning the gyroscope; Computer interface-sensor CASSY; Computer.

A gyroscope is a symmetrical one that rotates rapidly around the axis of symmetry (the z-axis in Fig. 3). Since the axis of rotation coincides with the axis of symmetry of the gyroscope, its angular momentum is equal to:

$$L = I\omega, \tag{1}$$

Where is I - Moment of inertia of the gyroscope relative to the axis with , oh - Corner

From expression (1) it can be seen that the axis of rotation coincides with the direction of the angular momentum vector of the gyroscope L . The approximate theory of gyroscope motion assumes (Fig. 3) that small angular momentums of external forces cannot change the magnitude of the angular momentum L , but only change its direction.

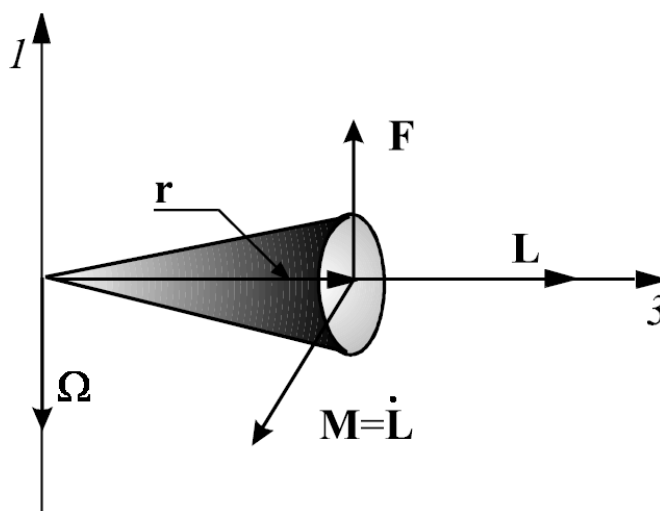


Fig.3. On the determination of the angular momentum of the gyroscope

The angular momentum of the gyroscope obeys the basic law of rotational motion:

$$\underline{dL} = M, \tag{2}$$

German

Suppose that the point of application of the force lies on the axis of symmetry (see Fig. 3), and the force is perpendicular to the axis of symmetry z . Then the moment of this force is directed perpendicular to the axis of rotation and L . Under the influence of the moment of constant force, the vector L , and consequently the axis of the gyroscope, must rotate uniformly around axis 1. This rotation is called forced precession. The angular velocity of precession can Ω be found from the following considerations. Since the vector L does not change its length,



The change in this vector $d\mathbf{L}$ over time dt is due solely to its rotation at the velocity Ω and is determined by the expression:

$$\frac{d\mathbf{L}}{dt} = [\Omega \times \mathbf{L}],$$

German (3)

From the comparison of equations (2) and (3) we have:

$$[\Omega \times \mathbf{L}] = \mathbf{M},$$

or in scalar form for this case:

$$\Omega = \frac{M}{L} = \frac{F r \sin \alpha}{L \sin \omega}.$$

(4)

Therefore, when only one point is fixed, the axis of the gyroscope can move in space in any direction depending on the direction of the moment of the external force. Such a gyroscope is called a free gyroscope.

The angular frequency of the precession of a free gyroscope is directly proportional to the angular moment of the external force and inversely proportional to the rotational speed of the gyroscope around the axis of symmetry.

Conclusion

The use of information and communication technologies in laboratory classes allows you to increase the interest of students in laboratory classes, implement interdisciplinary connections, improve the skills of using a personal computer, and form the appropriate general competencies of students. I would like to note that laboratory classes are an important stage in the formation of general and professional competencies of students, which are developed in educational and industrial practices in production conditions.

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