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The role of physical experiment in creating an integrated knowledge

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Abstract. This article addresses the problem of formation of the integrated knowledge in teaching future teachers of physics technology. Substantiates the efficiency of formation of physical and technical knowledge of educational physical experiments is substantiated. The concept of the educational experiment is aimed at the formation of the integrated knowledge of physics and discipline training. We offer integrative approaches and structure of the bulk physical experiment.

Keywords: *professional training, experimentation, Integration, Physics, visibility.*

Introduction. The requirements of society to a modern vocational education create conditions for solving the problem of increasing the quality of training through the integration of general subjects and vocational training. There are contradictions between the demands for quality training and personal qualities of graduates of educational institutions in today's educational environment and the level of theoretical training. The integration of science, industry, technology in all spheres of human activity defines the strategy for the development of education. Training of specialists in engineering, technology is impossible without a quality physical education. Knowledge of physics acts as the fundamental basis of modern engineering and technology. In addition, we consider physics as a unifying element between the natural sciences and engineering.

Taking into consideration that physics as an academic discipline, is the theoretical basis for the study of many technical and technological sciences, methodology and technology of physical experiment must be based on the integration with the disciplines of training.

Overview of publications. Some research are conducted related to the use of integrative approaches to learning In pedagogical theories and methods of teaching physics. However, specific studies that physical training is considered as an experiment based on the integration of the disciplines of training, were not enough.

Problems of improving the content of physics based on the ideas of differentiation and integration are revealed in studies of Y. Dick, C. Kamianetskiy, A. Peryshkin, A. Pinsky, N. Puryshev, V. Razumovsky, A. Usova, V. Fabrikant, L. Khizhnyakov etc. One of the objectives of the demonstration experiment is to provide the training clarity. The principle of visibility as a basic principle of didactics was introduced Y. Komensky. He stated that everything possible, should be presented to perception of the senses: sight, hearing, smelling, touch. If the items can be viewed simultaneously in several senses, it must immediately be covered several by senses [3].

It is proved that only visual information is absorbed by man for 25%, the audio information for 12 %, and visual perception of information raises this functional level to 65% [4].

Teaching physics has always relied on the sensory experience of the student based on the visibility and was carried out through physical training experiment. The concept of "visibility" means the availability of visual observation of the phenomenon or process under the study. Physical objects or processes become visible only when they are made up of the elements familiar to the student.

The purpose of the article is to clearly the concept of the educational physical experiments aimed at fostering an integrated knowledge in the professional training of future professionals in the field of engineering and technology.

Materials and methods. When conducting a learning physical experiment students are provided with opportunities to influence the object under the study, to create the most favorable conditions and opportunities to observe and sensually perceive it. The area of human sense perception is limited. The applications of special instruments and equipment in the physical experiment greatly expands the limits of human perception and, consequently , the scope of knowledge.

Educational experiment promotes skills of observation the objects studied from different points of view in teaching physics the students of technical and technological professions. This approach allows you to build the skills not only by highlighting certain features of the properties of physical objects, but also by highlighting functional relationships of technical objects. The integration approach to the organization of a learning experiment allows us to study the specific technical discipline, from the standpoint of physical basis of technical objects.

In the process of the integrated experimental study of physical processes, the shaped models are formed that are transformed into the models of real industrial facilities with a further study of technical disciplines. Combining the separate images, adding the new elements to them helps to create new images. The applications of the elements and technical facilities in the physical experiment, promotes a deeper assimilation as physical theories and disciplines of technical and technological training cycles. The ability to use the same knowledge in different fields of professional activity is an important part of the training of the future professional.

Thus, the ability to monitor accurately the natural phenomena becomes one of the main sources of the integrated professional knowledge. The laboratory experiment in physics forms the initial skills of a scientific and technical research a technical creativity of students. The knowledge acquired in the study of physics should be shown in other general disciplines such as chemistry, mathematics, ecology, safety of the labor and in the special disciplines: hydraulics, engineering science, electrical engineering, electronics, cutting, etc.

The amount of prior knowledge about the observed objects significantly effect on the completeness and the content of the perception learning experiment. On the other hand - the theoretical knowledge is not sufficient for the correct perception of the object. You must have cer-

tain methods of observation, which, in turn, depend on the nature of the object of study. The methods of observation are formed in stages and depend on the purpose of the demonstration and features of the process under study.

From the psychological point of view, all the tasks which need to operate the mental imagery can be divided into three main groups: tasks that require the modification of the spatial position of an object without changing its structural features, tasks that require the modification of patterns of the created image, tasks that require the conversion at the same time by its location and its structure [6].

Considering of all three types of learning tasks in the experiment makes it possible to help the student to master the technique of creating images. It is important to consider the impact of the demonstration on the mechanism of formation of the mental image of the object.

Our studies have shown that static images of studied objects are formed more easily than dynamic. The most difficult is to create the images of processes that can not be clearly observed. For these processes the physical size and relationship between them can not be determined by direct measurement. The physical experiment creates the favorable conditions for the formation of dynamic patterns and techniques of transforming activity. The level and quality of knowledge is largely determined by the methods used in the acquisition of new knowledge. The knowledge acquired by a student as a result of a self-learning experiment and constructed on the basis of previously acquired knowledge is the deepest and strongest. One should pay attention to the development and use of instruments and equipment for physical laboratory and demonstration experiments based on the integration of physical devices and facilities in the training of specialists in technology [1].

The development and application of the integrated devices in teaching physics contributes to the development of skills in the technical facility and process to observe, the physical laws and phenomena, which in turn, creates the design skills and expertise at the level of theoretical generalizations [7]. Most physical devices perform an integrating function including the elements of technical objects. Design and manufacture of physical devices with a specific professional activity of future specialists provide greater educational and developmental effects. The analysis of the principles and methodological (and theoretical) foundations of the integration approach in education makes it possible to form an integrative approach to learning physics experiment. This structure should take into account the interdisciplinary, intra-subject, interpersonal and intra-personal integration for the purpose of training future specialists in technology (Fig. 1).

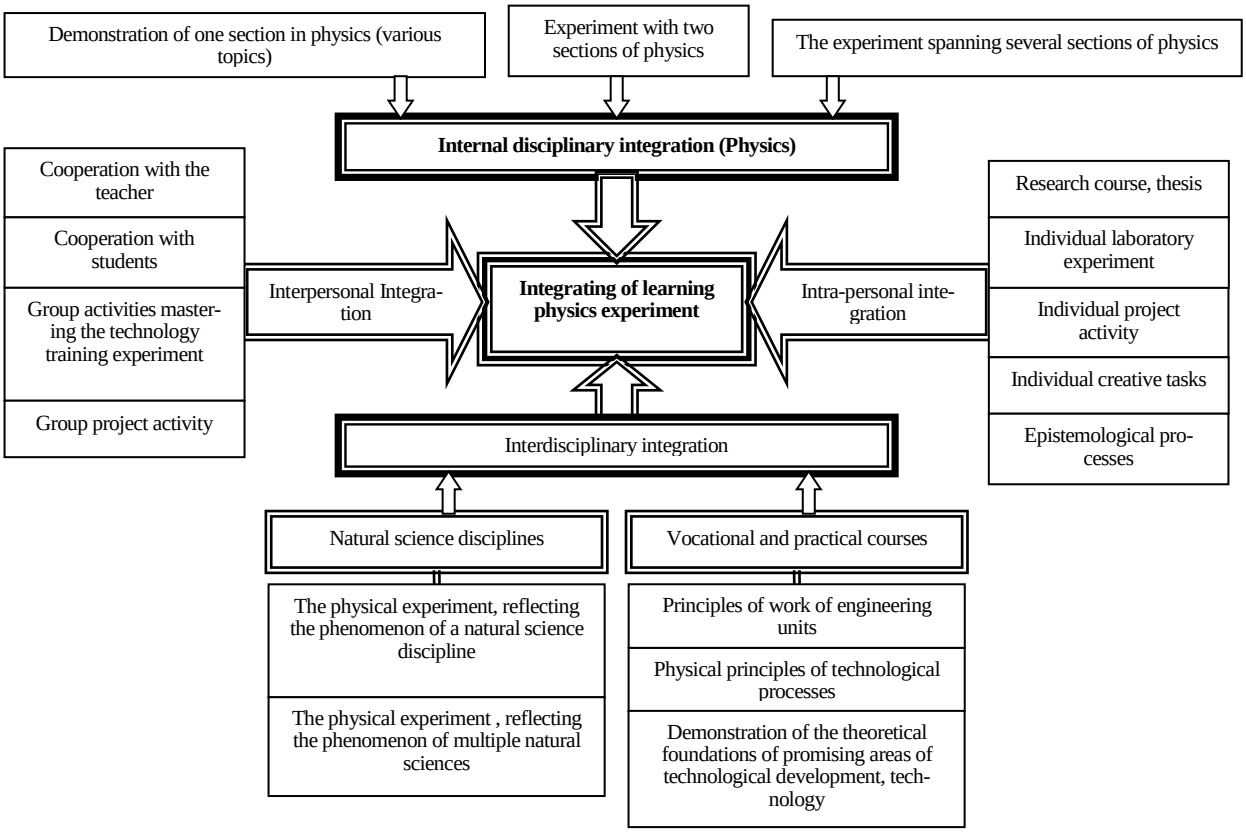

Fig. 1. Integrative approach to learning physics experiment

The unity of the surrounding material world, the relationship of natural phenomena, is the methodological basis for interdisciplinary integration. Note the fact that the clear distinction between fields of knowledge, and hence between academic disciplines, can not objectively exist. The level of the interdisciplinary integration and its size depends on the student's future careers.

In the process of learning physics experiment is important to introduce students to the experimental methods of knowledge of the world and their role in the design of facilities engineering and manufacturing processes. The important role is played by the experiment in the devel-

opment of physical and technical thinking, in the ability to observe the flow of real processes. The teaching of physical experiment should disclose the technical objects and technological processes, develop design and research skills, the ability to analyze the results critically.

Different types of learning experiments are complementary and expand the opportunities for the formation of students' ability to observe the physical laws of technical objects and phenomena.

The integrated physical training experiment aims to serve as an objective evidence of fair laws of physics, to create a problematic situation, to explore patterns in physics and engineering, to form students' observation, the ability to see (distinguish) the essential features of the physical process or facility maintenance process, to form the physical and technical way of thinking.Students are introduced to the basic physical devices and equipment during the demonstrations. In such way, the introduction occurs at the level of physical principles and at the level of technical ideas, which is important in training of specialists in technology.

In carrying out laboratory practical work, students are introduced to more sophisticated equipment, they improve their practical skills of physical and technical measurements. The main focus is on the practical application of the laws of physics in engineering, technology, life and the environment.

Students experiment simulating natural phenomena and the work of technical projects, develop and reinforce practical skills, check the validity of laws and formulas, exhibit properties of bodies, familiar with experimental methods of learning through training. The issue of quality of learning physics is solved and generalized skills are formed when conducting a physical experiment based on internal substantive integration. The application of the instruments and equipment in teaching contributes to a unified measurement skills through the provision of generalized types of experimental activity during the physical experiment.

The summarized activities are generated through numerous repetition and stretch over time to form strong skills of the educational physical experiments. The formation must be carried out in stages.

The first stage. The focus turns to the formation of basic measuring skills, ability to use measuring devices, the ability to transfer the acquired skills to different types of experiment. The formation of the skills of the educational physical experiments mainly occurs under the direct supervision of the teacher.

The second stage. The students themselves determine the methods, means, the sequence of measurements, acquire skills of indirect measurements of various physical quantities.

*The third stage***.** The students plan independently the consistency and methodology of the experiment. At this stage of training the students, the research of processes and phenomena are preferred that students had not previously encountered.

*The fourth phase***.** The experimental work of students associated with the research facilities and technology elements in terms of their physical nature. The training physical experiment form students' skills to measure physical characteristics of technical objects that are used in production. The ability is emerged to carry out a research work in research laboratories in various fields at this stage. Students will acquire skills in research design and maintenance of scientific and technical creativity of children.

The practice of learning and the results of our research of students who learn physics in majors technological and pedagogical universities indicates that the integrated form of knowledge should be begun with internal disciplinary integration (Fig. 2).

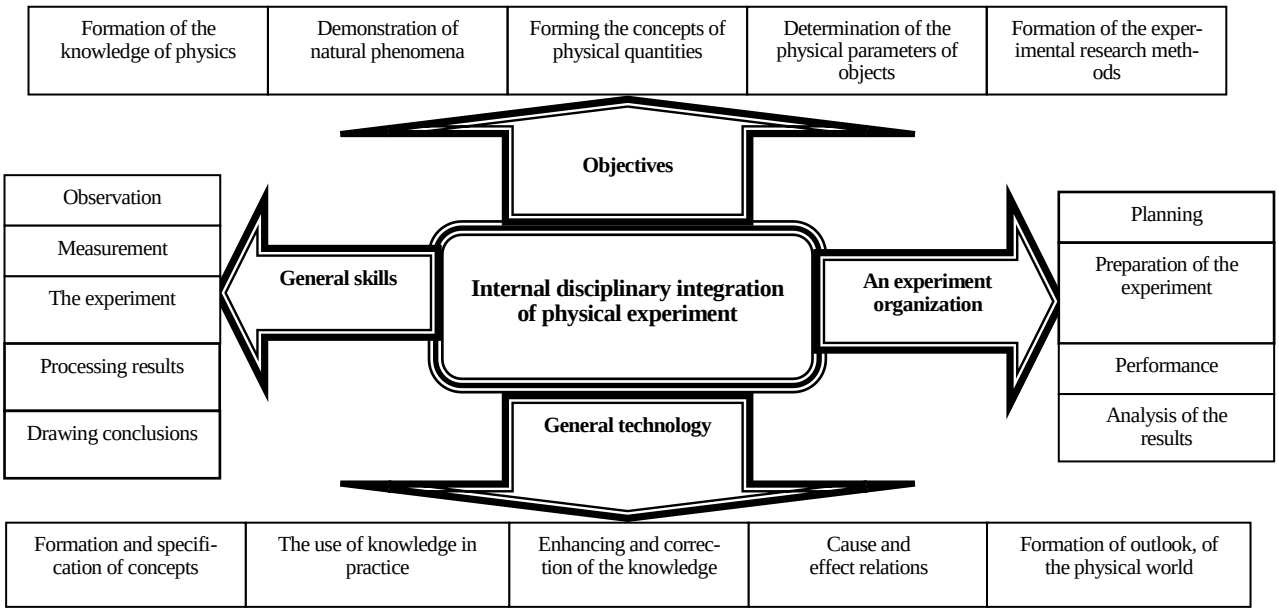

Fig. 2. Structure of internal disciplinary integration of educational experiment

The specification of earlier acquired theoretical knowledge occurs, the shared skills and abilities of the organization and carrying out the experimental work form the basic concepts through physical training experiment. The comparative analysis of the knowledge obtained in the study of physics, vocational subjects and practical training cycle of the specialists lead to an understanding of cause-effect relationships, the formation of a scientific outlook, physical and technological world view.

The study of physics integrated learning experiment af-

fects the formation of the physical and technical images of suitable studied material in the students' mind, stimulates interest in the study of physics as the basis of technical sciences. The use of oriented laboratory work with the technical content in teaching practice contributes to a common measurement and research skills necessary for further professional activities. The student understands the importance of the knowledge of physics in mastering modern technology.

A problematic integrated demonstration plays a significant role in enhancing the cognitive functions in the study of physics. Such demonstrations shape a motivation of students of other specialties to learn physics. Distressed demonstrations that reflect the physical nature of the work of technology nodes, create the positive emotions. The student is more interested in deepening their knowledge of physics and technology.

For these reasons, optimal conditions for the combination of a physical phenomenon that demonstrates the principles of operation of equipment and facilities as close as possible to their future profession must be created during the laboratory and demonstration experiments.

Different tools, both traditional and modern to realize these goals are required. It is important to clarify the integrative role of these tools to achieve the specific goals and to select on this basis those that contribute to the improvement of educational physical experiments and ensure the integrity of the educational process.

We have developed a set of tools for the implementation of educational physical experiments based on the above objectives, we have developed a number of instruments for laboratory work, we have created a set of multilevel laboratory work for students of technical specialties of pedagogical universities [1; 5; 7].

Conclusion. The consider action of objectively existing integrative nature of the educational process, interdisciplinary connections of the taught subjects and development of appropriate learning tools that provide optimal conditions for interdisciplinary, intra-disciplinary, interpersonal and intra personal integration during the implementing of the integrative learning physics experiment, will promote the comprehensive development of future teacher of technology, will form his professional skills, motivation of learning, will rise more effective the physics teaching and the quality of training.

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Шишкин Г.А. Роль физического эксперимента в формировании интегрированных знаний

Аннотация. В статье рассматривается проблема формирования интегрированных знаний при обучении физике будущих учителей технологий. Обосновывается эффективность формирования физико-технических знаний средствами учебного физического эксперимента. Предлагается концепция проведения учебного эксперимента направленного на формирование интегрированных знаний по физике и дисциплин профессиональной подготовки. Предлагается интегративный подход и структура ученого физического эксперимента.

Ключевые слова: *профессиональная подготовка, эксперимент, интеграция, физика, наглядность.*