



World Conference on "Integrated and Life-long Education of Modernity"

## **Preparing Students for Scientific Activity in Higher Physics Education**

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**Abstract.** The issues of organizing physics education for undergraduate students in higher education institutions based on modern knowledge and preparing students for scientific research activities were discussed. It was emphasized that it is appropriate to bring the laboratory training in physics closer to the scientific research process.

**Key words:** elements of scientific research, creative activity, new knowledge, nanotechnology, scientific principle, independent education.

### **Introduction**

A new approach to education is a necessary task to prepare specialists who can work effectively in the present time, when new technologies are developing, global and man-made problems are appearing.

For a modern specialist, it is no longer enough to master the complex of knowledge in all natural and scientific fundamental and engineering sciences. Future professionals are required to creatively approach any technological, technical, engineering problems, to advance new innovative ideas related to production and to solve all other problems and tasks that arise in their implementation.

In the conditions of higher education, the formation of knowledge and skills of creative thinking, thinking and researching in students puts the task of effective use of innovative ideas of education before pedagogues.

In the process of education, it is of great importance to show and develop students' creative abilities, to strive for new knowledge, to form knowledge and skills in scientific research, research.

**Main Part.** It is known that physics serves as a fundamental basis for many natural and engineering sciences, which plays an important role in the development of these sciences and in creating a scientific picture of the universe. First of all, students receive new knowledge in physics, information about new scientific research being conducted in lectures. Based on the scientific principle of education, students should be presented with scientifically based, experimentally confirmed information, and at the same time, the newest achievements of science should be reflected in the content of higher physics education.

In order to form the knowledge and skills of scientific research in physics education, students

should first of all have information about the latest knowledge in science.

In recent years, the science of physics has developed rapidly, and a lot of knowledge about nature has been accumulated. But it is natural that information about new phenomena, laws and theories discovered during the development of science does not find its reflection in textbooks and science programs. The pedagogue is always aware of the news of science from the staff, and it is consistent with the requirements of the scientific principle of education to introduce students to this new knowledge during classes.

In recent decades, great progress has been made in modern physics in open systems physics, nanotechnology, condensed matter physics, nonlinear optics, high energy physics, quantum physics and other fields of physics. Amorphous structures of metals and their alloys with new fundamental electrical, magnetic and mechanical properties were created. Amorphous metallic ferromagnetic materials can be used for information recording and storage purposes, amorphous thin films can be used in high-sensitivity recorders, sensor devices, small-sized transformers and other devices. These devices can work in the most difficult conditions due to new features.

High- and room-temperature superconducting materials based on copper oxides are being researched. Studies have been conducted on manganates with high magnetoresistance. New methods of generating periodic domain structures with sufficient perfection in electrically and magnetically ordered materials have been developed and implemented.

These structures can be used to generate and modulate frequencies in the optical and acoustic range. In the field of semiconductor physics, research is being carried out on small-sized heterostructures - quantum "threads", "threads" and "dots". These nanostructures form the basic element base of future nanoelectronics. Among the new discoveries made in this field, the whole quantum Hall effect can be pointed out. The discovery and interpretation of the fractional quantum Hall effect suggests the existence of a new two-dimensional "quantum fluid" and quasiparticles with a fractional charge. In the field of condensed state physics, nanocrystalline ferromagnetic alloys, fullerenes, carbon nanotubes, nanocomposites, thin multilayer nanostructures, etc. have become research objects in recent years, and a new field of nanotechnology has emerged. Research is being conducted to create very high-power lasers, lasers and grazers operating in the range of X-ray and gamma rays. In the field of nuclear physics, research is being conducted on the synthesis of relatively long-lived heavy ( $Z \geq 114$ ) nuclei. The results obtained at the Large Hadron Collider with an energy of 14 TeV ( $10^{12}$  eV) allow to find answers to many questions collected in the fields of elementary particle physics and cosmology. For example, the experimental confirmation of the existence of the Higgs boson, the study of the properties of top quarks, the creation and study of the quark-gluon plasma state, the existence of "dark matter" and "supersymmetry" particles, as well as the conclusions of the standard theory and other "exotic" theories that serve to explain the structure of the Universe. verification, allows solving many other problems of elementary particle physics and cosmology.

One of the requirements of modern physics education is to train students to engage in scientific research, introduce scientific research methods, work independently with literature, analyze research results and draw conclusions. This, in turn, helps the development of students' creativity. Pedagogical observations of recent years show that students lack knowledge and skills in scientific research during the completion and defense of a qualified graduation thesis. In our opinion, it is necessary to pay more attention to the development of knowledge and skills of students during laboratory training. That is, in order to introduce "scientific-research elements" into the process of performing laboratory work, it is necessary to organize the lessons in a problematic manner. It is known that certain physical quantities

are determined during the performance of each laboratory work. In order to bring this process closer to the work of "small scientific research", students, especially talented students, can be given the necessary creative research tasks. Acquaintance with the methods of determining the physical quantity assigned to these tasks with the help of literature, comparing them, the physical conclusion based on the chosen method, learning the necessary laws, the operation of laboratory equipment, obtaining the results by performing independent measurement work under the supervision of the teacher, calculating and analyzing them, coming to the necessary conclusions, the results include the study of the influence of one or another external factors, the practical significance of the obtained results.

In many cases, if the technical possibilities of "complicating" laboratory work are limited or non-existent, it is possible to use information technology tools, for example, virtual laboratory methods, where laboratory work is modeled. As a result of such an approach to the educational process carried out in laboratory conditions, students strengthen the acquired theoretical knowledge, in addition to in-depth study of the essence of the laws and quantities of physical phenomena being studied, they develop knowledge and skills in creative scientific and research work, and creative activity increases.

The importance of independent work also increases in the development of research and creative abilities of students. Materials about new discovered phenomena, laws, created new theories that the curriculum did not cover can be presented to students for independent learning. Students can prepare these works as abstracts or presentations, or give lectures at "small scientific conferences" in the form of specially organized seminars. In such activities, independent scientific research helps them acquire the skills of expressing their opinions in scientific lectures.

### **Conclusion**

Thus, based on the requirements of the principle of scientificity, the problem-based presentation of materials enriched with scientific innovations on the basis of scientific evidence, based on reliable evidence, increases students' interest in new knowledge. The inclusion of scientific-research "elements" in laboratory training, the organization of independent work in the form of scientific research helps students to strengthen and apply the acquired theoretical knowledge in practice, and to form the skills of solving problems independently.

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