

TEACHING MODELLING

Physical and technical simulations in educational process of pedagogical universities

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Abstract. This article is devoted to the problem of formation of physical and technical simulation skills while teaching students of physics and mathematics and technological specialties at pedagogical universities. It describes the dependence of students abilities to apply theoretical knowledge of physics in practice from skills to model technical objects and processes based on integrated knowledge from educational disciplines. It is proposing the concept of designing the structure and content of physics that aims to the improving methods of forming physical models of technical objects.

Keywords: skill, simulation, integration, teacher, educational process, the course of physics.

Introduction. Natural sciences in our time are the intellectual resource base for professional teachers of physics and technology, which in its importance surpasses material resources. In this regard, it's necessary to improve the methodology of teaching natural sciences and especially physics at pedagogical universities. The future teacher of physics and mathematics or technological profile must know not only the individual laws and physical phenomena, but also must see the whole physical world. This means that students are necessary to form the fundamental knowledge not by fragmented set of laws, but in complex depending on their life and professional needs. Along with the science of wildlife, social phenomena of physics had become an integral part of the forming process of a fully developed personality of future teachers.

Intensive development of science and technology requires vocational education the development of new approaches to the training of graduates of pedagogical universities. The problem of the ability of graduates to use the knowledge of physics in solving technical and technological problems can be solved by developing methods of formation of students not formal, integrated knowledge of physics and technological disciplines of cycle training.

The concept of forming integrated, practice-oriented knowledge, skills of simulating natural and technology phenomena and processes provides opportunities to improve basic and professional training of graduates of pedagogical universities.

However, in the context of improving the quality of teacher training are not investigated so important methodological problems such as designing course content of physics on the integration of disciplines. It remains unsolved problem of developing methods of formation not formal practice-oriented knowledges of physics and the influence of skills physical and technical simulations on the quality of students.

Overview of publications on the topic. Formation of readiness of students to use theoretical knowledge in professional activity is one of the urgent problems of modern psychology and pedagogy. The various aspects of this issue a proper attention was paid in works of A. Ukhtomsky, M. Vinogradov, B. Lomov, V. Pushkin and others.

Methods and ways of solving problems of teaching physics in secondary and higher education outlined in

researches of Ukrainian scientists such as P. Atamanchuk, V. Zabolotnyi, O. Lyashenko, M. Martyniuk, A. Pavlenko, M. Sadoviy, A. Sergeev, V. Syrotyuk, B. Sus and others.

The problems of improving the content and system of training future teachers of physics of various areas are outlined in scientific papers by A. Ivanytskiy, S. Velichko, A. Konovalov, V. Menderetskiy, I. Moroz, V. Sharko; forming physical and technical knowledge – I. Bogdanov, V. Vovkotrub, A. Kaspersky.

In preparing future teachers of physics and technology, educational system aimed at creating generalized, holistic knowledge of natural science, engineering and technology disciplines training. The final goal of professional knowledge formation is the construction in the minds of students of professional physical and technical model of the environment, which will continue to be a landmark in the practice of the future expert. This model is based on scientific and physical models of the world.

The scientific and methodological literature often identify such concepts as "scientific module of the world" and "physical model of the world" because of the nature of the fundamental physical theories and laws. On the other hand, the construction of "scientific model of the world" uses the basic terms and theories from other sciences.

For this reason, today among experts there is no unity of views in the approach to building scientific model of the world and understanding its nature. Some see it as a branch of philosophical knowledge, others – as a cognitive phenomenon in physics, and others – give it an intermediate position between the natural and philosophical knowledge. Some believe that the scientific world plays a significant role in the formation of new fundamental theories, others argue that it is the result of the sum of encyclopedic knowledge [3].

The basis of the scientific world structure consists of two main components: conceptual and sensuously shaped. The first is associated with the philosophical and fundamental knowledge, laws and principles, and the second – a set of visual representations of nature.

The physical picture of the world based on the initial philosophical concepts and categories, concepts of matter, space and time, movement and interaction, physical theories and principles that express the relationships between them. These components are discussed in detail in papers [1], [2], [4].

In a number of studies, analyzing the relationship between theory and physical world, authors come to the conclusion that physical theory is the most important component of the physical model of the world [2].

Other authors argue that the physical model of the world is completely part of the physical theory as its conceptual foundation is the link between physics and philosophy [5, p. 57].

However, analysis of the educational process in physics in the training of future teachers and of their competences makes possible to conclude that the level of physical and technical knowledge of the graduates of pedagogical universities do not always meet the requirements of social order to graduate is qualifications and his personal needs.

The purpose of article: consider the possibility of increasing the efficiency of teaching physics by forming readiness of students to construct physical models of processes of technical objects, natural phenomena based on the analysis of psychological and educational literature and our studies.

Materials and methods. In order to identify the impact of physical and technical skills of modeling in the study of physics on the quality of mathematical physics education and level of professional knowledge in the preparation of future teachers of physics and technology of reasons to attract students to the physical and technical work over the years 2014-2016, we conducted educational research. For research we formed an expert group, composed of scientists and teachers of secondary schools dealing with methods of teaching physics. The experts were asked to evaluate the survey questionnaire developed by us for teachers and students, aimed at determining the level of implementation and effectiveness of the skills formation methods of physical and technical modeling of students at pedagogical universities. Validity of questionnaires was evaluated by peer review group [6].

Key indicators that in our opinion should be included in the questionnaires determined pilot studies. Decision of the Working Group of Experts was established the validity of the questionnaires was equal to 0.63.

Given that the validity of the values obtained over the limit ($B \geq 0,63$), these figures were included in profiles for later use in our research and educational studies.

Results and their discussion. Students formed corresponding idea about the world based on subjects they are studying. On the other hand, regardless the future professional activity of an expert, students should form a representation of reality from the standpoint of natural and social sciences, in the form of general model of the world.

In preparation technology teachers', "professional model of the world" can serve as a "physical and technological" model of environment transformative activity.

This model is a synthesis of professional knowledge through the integration of disciplines of professional and practical, mathematical and natural-scientific training of future specialists. The core of this model, in our opinion, can serve physics as a fundamental basis of modern machinery and technology. The basis for building physical and technological model of reality can serve general scientific, technical and physical model of the world.

The physical model of the world is part and consequence of general models. Under a physical model of the world implies some idealized model of nature. The model includes the general laws, principles and concepts of physics, which are fundamental to its development. Physical picture of the world specifies philosophical definition of matter and motion, space and time relationship and interaction.

The ability of students to build physical models of processes and phenomena that studied, we associate with the involvement of students for technical work. In its turn, the level of student's skills to build models affect the ability of students to apply knowledge of physics in practice. Thus the desire of students to engage in physical and technical creativity and involvement in this activity affects the ability to build physical models. In its turn, the ability to build models affect the level of skills of graduates to apply theoretical knowledge and professional practice.

The level of training graduates to use fundamental knowledge in practice we determined by testing students and teachers studying thoughts.

Our results [7] of the competence of the graduates to use the knowledge of physics in a practical and professional activities, according to teachers, presented in Fig. 1. Responses to the questionnaire measured at 9 – point scale. In some cases, to simplify the processing of the results obtained answers were evaluated as low (1 to 3 points), average (4 to 6 points), high (7 to 9 points).

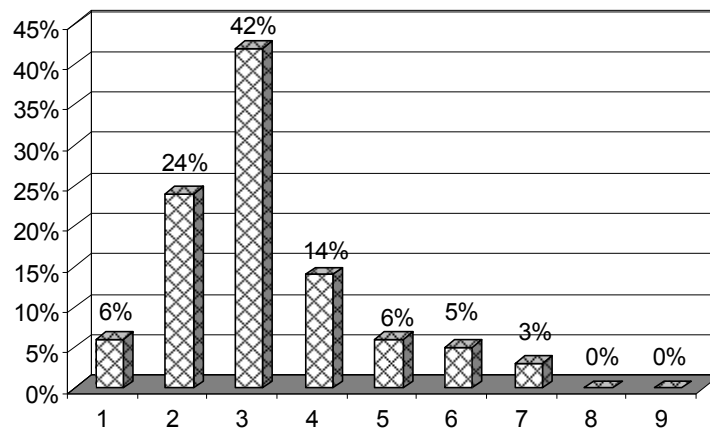


Figure 1. The competence level of graduates to apply knowledge of physics in practice

Our studies have shown that 72% of students of physico-mathematical and technological professions universities have teaching skills of applying knowledge of

physics in practice at a low level; 25% – on average; and only 3% – on a high.

The number of students involved in the technical work to assess the teachers presented in Fig. 2.

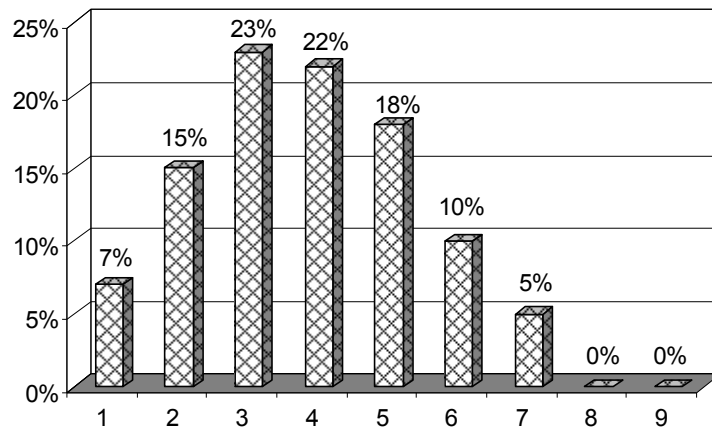


Figure 2. Number of students involved in physical and technical creativity

Analysis of the results of our studies (Fig. 2) indicates that 45% of teachers of pedagogical universities assessed as low to attract students to the physical and technical design activity as the average – 50% and as high – 5%.

A large number of surveyed teachers (53.8%) and students (40%) suggest that to improve the skills level of students to simulate technical facilities is necessary to construct the course “General Physics” based on the integration of disciplines like science and scientific and objective training cycles [7].

To improve the quality of physical education, students of technical and physical skills of pedagogical universities especially need to enhance ideological significance of physics. Recently, the problem worsened due to the fact that the trend of reduction of classes that is given to the study of physics at pedagogical universities. First-year students in the study of specific laws and phenomena do not see the holistic physical world. We have to deal with students who believe that physics is not necessary for them in their professional activity, even though they are going to be teachers of technologies. This reduces the learning motivation, reduces the quality of learning both of natural science and of professionally oriented disciplines.

In the study of physics at pedagogical universities we need to pay more attention to the consideration of the role of physics in modern science, technique, technology. The main purpose of the first lectures on physics is as follows.

1. To show the place and the role of physics in the development of fundamental science.
2. To show that physics is the fundamental basis of modern technology and innovative technologies and identifies promising areas of development.
3. To show the place and the role of physics in the educational field “Technology”.

Almost all the subjects studied by students of any field of study, have a scientific and nature unity. This unity is manifested in the fact that the study of natural phenomena, objects, equipment, technologies uses universal method of knowledge, which is called modeling.

Each physical theory is based on the corresponding physical model. Creating models allows a person to understand how exactly better to adapt to the world and to modify it, improving his live.

Our studies showed that the ability to build physical models of natural phenomena, technical facilities, processes greatly increases motivation and level of learning physics disciplines and technological training [7], [8].

Physical and technological model describes the environment that is created as a result of human activity and is based on the integration of the three pictures of the world: physical, technical and scientific. Physical and technological model describes the technical facilities, processes from the standpoint of the general laws of physics and engineering theories. In the educational environment, this model can perform an integrating function that enables you to theoretically provide quality formation of a coherent picture of objects studied, from the perspective of different disciplines (various disciplines): physics, engineering and technology. In its turn, physics and other disciplines of natural-mathematical cycle function as the foundation for deeper mastering specific disciplines of professional and practical training cycle.

The ultimate goal of training future teachers of physics and technology should be the formation of students of natural and technological environment model. This model is based on the integration of natural sciences and mathematics vocational training cycles. By teaching physics in the minds of students forms physical-technical model of the world, which is based on the integration of physical and technical models of the world. [8]

With the increasing role of technology in society and its complications is necessary to attract young people earlier to the development of technique, modern technology. This requires appropriate training of teachers in pedagogical universities.

Technique, technology processes are based on fundamental laws of nature, and especially on the laws of physics. Any technological project can not be carried out,

if it contradicts these laws. Ignoring the laws of nature not only leads to unfulfilled projects, but tragedies.

To form skills of physical and technical modeling and increase the practical orientation of training may be effectively realized with appropriate content and structure of building physics course.

Constructing the content of physics and technical physics education system takes into consideration some teaching and some methodological principles. The most important for us are fundamental principles of professional orientation and training.

To implement these principles we proposed the concept of a four course structure physics [7]. Model of a content module of curriculum course "General Physics" can be represented as a fundamental core of physical knowledge; invariant shell of basic knowledge, which can change depending on the acquisition of new knowledge in physical science; variation cover of natural science theories that contains application knowledge and disciplines defined by natural and scientific training of students; variation cover of technical and technological knowledge, which is determined by scientific and academic disciplines training.

Contents of variant covers largely depends on the profile of training of future specialists. The core and cover of the basic fundamental physical knowledge are responsible for the formation of ideology student and forming a physical model of the world. Variation cover of natural scientific knowledge contributes to forming a model of humanization and education of future teachers. Variable cover of vocational training is responsible for the formation of physical and technological world model and the model of modern technosphere created by mankind [8].

The core and the fundamental cover provide future teachers with strong knowledge that an expert can use throughout professional activity and that allow to learn new knowledge and modern technologies.

Variable cover, based on integrated knowledge in the disciplines of professional training, needs regular updating in line with technique and technology development. The fundamental basis of science remained unchanged for a long time. Aspects of applied sciences change fast enough in comparison technology and technique. Therefore, when designing the content of training courses of disciplines, it is necessary to determine the fundamental unchanging core discipline and variables cores that can be easily adapted to the demands of society.

Conclusions. This concept of designing the structure and content of physics allow consistently implement of all stages of the methodology of forming of future teachers in technology to use integrated knowledge in practice. The study of the dynamics of formation practice-oriented knowledge and its application in the design of physical models of natural phenomena, technical facilities, technology processes allows to identify and mobilize new quality reserves in the making of the future teachers of physics and technology.

It is proved that the problem of improving the quality of teaching physics and forming skills of applying knowledge of physics in professional activities can be solved by forming the students' design skills and technical physical models of real processes. Developing methods and methodological support of developing abilities to construct models of technical objects in the study of specific sections of physics at pedagogical universities needs further studies.

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Физико-техническое моделирование в учебном процессе педагогических университетов

Г. А. Шишкин, И. Г. Косоков, В. Я. Коробченко.

Аннотация. Статья посвящена проблеме формирования навыков физико-технического моделирования при обучении физике студентов физико-математических и технологических специальностей педагогических университетов. Обосновывается зависимость уровня умений студентов применять теоретические знания по физике в практической деятельности от умений моделировать технические объекты и технологические процессы на основе интегрированных знаний по учебным дисциплинам. Предлагается концепция конструирования структуры и содержания курса физики который направлен на совершенствование методики формирования физических моделей технических объектов.

Ключевые слова: умение, моделирование, интеграция, учитель, учебный процесс, курс физики.