IMPLEMENTATION MODELS OF THE BASIC COURSE IN PHYSICS IN THE CONTEXT OF THE NEW EDUCATIONAL STANDARD OF UKRAINE

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Abstract. *The article analyzes the models of implementation of basic education in physics within the context of the introduction in Ukraine of a new educational standard of the third generation, which is focused on the expected learning outcomes that meets the modern paradigm of competence training. It is emphasized that the priority in the formation of the basic course in` physics is the requirements for mandatory learning outcomes, aimed not so much at mastering the content of the natural educational field, but above all at the formation of competencies that important for the successful further educational and cognitive activity of the individual and his interaction with nature and society.*

Variant models of the implementation of the component in physics of the science education field at the basic level have been determined: as an independent educational subject; an integrated sectorial course that logically combines science subjects; interdisciplinary integrated course.

The functional possibilities of applying the subject-integrative approach as to the formation of the content of the basic physics course are substantiated.

Keywords: *basic education in physics, educational standard, key competencies.*

One of the important stages of the implementation of the "New Ukrainian School" reform was the approval of the State Standard of Basic Secondary Education of the Third Generation (2020), which defines its basic secondary education as the development of students' natural abilities, interests, talents, and the formation of competencies necessary for their socialization and civic activity, a conscious choice for a further life path and self-realization, continuing training at the level of specialized education or acquiring a profession, fostering a responsible, respectful attitude towards family, society, the natural environment, national and cultural values of the Ukrainian people.

Special emphasis is placed on such value orientations as: respect for the student's personality, his interests, his own choices and aspirations; ensuring equal access of every student to education; compliance with the principles of academic integrity in the interaction of participants in the educational process; formation of the student's free personality, support of his independence, entrepreneurship and initiative, development of critical thinking and self-confidence; formation of a culture of a healthy lifestyle of a student; affirmation of human dignity, honesty, mercy, kindness, justice, empathy, mutual respect and mutual assistance, respect for human rights and freedoms, students' ability to constructively interact with each other and with adults; forming an active civic position and patriotism in students.

In contrast to the previous editions, in which the system-creating function was mainly played by the content, the new educational standard completely relies on the expected results. This is more fully in line with the modern paradigm of competence training, since it is the conscious applying of knowledge and skills that is an important condition for the formation of competences [1].

The requirements for mandatory learning outcomes are defined on the basis of a competency-based approach. Accordingly, a list of key competencies which form in basic education students is defined: fluency in the state language; the ability to communicate in native (if different from the state one) and foreign languages; mathematical competence, which involves the ability to develop and apply mathematical knowledge and methods to solve a wide range of problems in everyday life; competences in the field of natural sciences, engineering and technologies, which involve the formation of a scientific worldview, the ability and willingness to apply the appropriate set of scientific knowledge and methodologies to explain the natural world; innovativeness, which involves the student's ability to respond to changes and overcome difficulties, openness to new ideas; ecological competence, which involves awareness of the ecological foundations of nature use, the need for nature protection, compliance with the rules of behavior in nature and economical use of natural resources; information and communication competence, which involves the confident, critical and responsible use of digital technologies for personal development and communication, the ability to safely use information and communication tools in education and other life situations; lifelong learning, which involves the ability to identify and assess one's own needs and resources, as well as apply them to develop competencies; civic and social competences related to the ideas of democracy, justice, equality, human rights, well-being and a healthy lifestyle, with awareness of equal rights and opportunities; cultural competence, which implies a persistent interest in mastering the cultural and artistic achievements of Ukraine and the world, a respectful attitude to the cultural traditions of Ukrainians and representatives of other states and peoples; entrepreneurship and financial literacy, which involve initiative, the ability to use opportunities and implement ideas, create value for others in any sphere of life [3].

Physics, together with astronomy, biology, geography and chemistry, is included in the natural educational field. The result of mastering the physics component by students of basic education should be the assimilation of basic physical concepts and laws, a scientific worldview and style of thinking, awareness of the basics of physical science, development of the ability to explain natural phenomena and processes, apply the acquired knowledge when solving physical problems, and improve the experience of conducting experimental activities, forming an attitude to the physical picture of the world, evaluating the role of physics knowledge in human life and social development.

In accordance with the goal of the science education field, the standard defines mandatory learning outcomes (general and specific), requirements for them, as well as benchmarks for evaluation, on the basis of which the level of achievement of learning outcomes by students is determined.

The main requirements for mandatory learning outcomes for students in the field of natural science education provide that the student of basic education gets to know the natural world by means of scientific research, processes, systematizes and presents information of natural content, is aware of the laws of nature, the role of natural sciences and technology in human life; behaves responsibly to ensure the sustainable development of society, develops his own scientific thinking, acquires experience in solving problems of natural content individually and in cooperation with others.

General results, in particular, assume that the student identifies and formulates a research problem; determines the purpose and task of the research and formulates a hypothesis; plans research; investigates (observes, experiments, models); analyzes results, formulates conclusions, presents the results of research; carries out self-analysis of research activities; processes, systematizes and presents information of natural content; searches for information, evaluates and systematizes it; presents information in various forms; realizes the laws of nature, the role of natural sciences and technology in human life; distinguishes between scientific and non-scientific thinking; is aware of problems and knows how to analyze and solve them, work in a group to solve problems, evaluate his/her own and group activities, etc.

Thus, the requirements for mandatory learning outcomes for students of basic education in the field of natural sciences are aimed not so much at mastering its content, but at the formation of competencies which are important for successful further educational and cognitive activities and interaction with nature and society. At the same time, the priority of competence-oriented training is not the volume of knowledge and the depth of its assimilation, but the ability of the individual to apply the acquired knowledge in various life situations adequately to the existing problem and goals that's been set [5].

With this in mind, the state standard focuses primarily on learning outcomes, while the content benchmarks are minimal and set through the basic knowledge. For the component in physics, these are: physics as a science; physics and technology; physical foundations of modern technologies and production; physics in everyday life; matter and field; substance structure; properties of substances in different aggregate states; movement, types of movement; basic movement parameters; oscillations and waves; sound; light; optical phenomena; interaction of bodies; force, types of forces; energy; thermal movement; types of heat exchange; phase transformations; electric current; electromagnetic interaction; basic physical laws that determine the course of mechanical, thermal, light, electrical, magnetic and nuclear phenomena; laws of conservation.

Hereinafter, this approach significantly expands the possibilities of developers of model curricula, textbooks, and individual teachers as to the use of the most optimal models, technologies, methods and options of implementing basic physical education.

Possible models for the implementation of the basic course of physics, which will be introduced in 2024 (as well as the other components of the science education field) are set by the Standard Educational Program for grades 5-9. According to it, the formation of the content of course subjects and integrated courses is carried out by arranging in a logical sequence the learning results of individual components or the educational field as a whole, as well as several educational fields. Accordingly, the physics course can be implemented as an independent subject, as well as in the content of sectoral and interdisciplinary integrated courses.

Thus, in the second cycle of basic education (grades 7–9), physics can be implemented as an independent subject. At the same time, the main concept of building such a course should be orientation towards learning outcomes and content design as a tool for their achievement. With this approach, it will be possible to ensure the flexibility of the structure of the basic physics course, along with the variability of its composition, in contrast to the traditional one.

At the same time, it is necessary to take into account the principle of continuity in the development of the content of education, in particular, the peculiarities of the implementation of the physical component in the first (adaptive) cycle of basic education in grades 5-6, which performs a propaedeutic function. In the 2022/23 academic year, the introduction of model curricula and textbooks for the 5th grade from integrated courses for the natural educational field "Getting to know nature", "Environment", "Natural sciences" (2 study hours each) began.

In view of this, the models of deployment of the content of physics education in grades 7–9 through sectoral and interdisciplinary integrated courses are promising and innovative (the scope of the sectoral integrated course can be 7.5 hours per week, and the scope of the interdisciplinary course is determined by the educational program of the educational institution). The subject-integrative approach is decisive in the construction of such courses. The result of its application is an optimal combination of the means of individual subjects of the natural education field in order to achieve mandatory learning outcomes. However, today it is quite difficult to build a solid science course at the level of basic education, which would ensure a deep learning integration of science subjects in the traditional sense (integration of content).

Despite the possibility of arbitrary distribution of study hours between the components of the science education field within the sectoral integrated course, there is a tendency towards the traditional subject system with a significant difference (for example, the volumes of individual subjects in the 7th grade are as follows: biology – 2.5 hours, physics – 2 hours, chemistry – 1 hour), which significantly complicates the possibilities of integration in educational practice. In addition, a solid integrated course will be difficult to implement at the level of educational support (in particular, the volume of a single textbook will be too large), as well as at the level of personnel support (the process of training natural science teachers who are capable of fully teaching such a course is still being developed).

At the same time, it is worth noting that the subject-integrative approach does not deny a sufficiently high degree of independence of individual components of the science education field. Therefore, the model of an integrated course is more relevant in practice as a dynamic set of relatively independent modules united by the general goal of the science education field and common educational goals. Implementation of such an integrated course will be provided by separate textbooks created according to a single concept (for example, "Natural Sciences: Biology", "Natural Sciences: Physics", "Natural Sciences: Chemistry"). A tighter integration of individual components in the textbook (for example, "Natural Sciences: Physics-Chemistry"), etc., is not excluded.

An important feature of such a model is the expediency of implementing in individual textbooks end-to-end content-cognitive lines, which determine the common methods of activity for mastering the content of various components of the science education field (for example, a motivational block, blocks of thematic generalizations, cross-cutting projects, etc.) [2].

For such a model, it will not be so much the integration of the content, but, above all, the means of individual components as to achievement the common educational goals of the natural sciences. At the same time, the integration of knowledge can take place on the basis of interdisciplinary connections, when the knowledge formed by individual components of the natural field is used to study this or that phenomenon. Thematic integration of knowledge is also possible during the study of natural phenomena and objects from the standpoint of biology, physics, chemistry (for example, energy processes) [4].

Another model of the basic physics course is also interesting, which involves its implementation in interdisciplinary integrated courses, for example, "Physics and fundamentals of technology. 7-9 grade". At the same time, the amount of study hours for their study is determined by the educational program of the educational institution. The feasibility of interdisciplinary integrated courses is determined by the fact that they provide an opportunity to form the new operational relationships on the basis of physical knowledge and apply subject competence in physics (knowledge, skills, attitudes) to develop technological knowledge as the basis of practical activity of an individual [5].

Thus, the new educational standard defines the conceptual guidelines for the formation and implementation of the basic course of physics, the key of which is the orientation: on the mandatory learning outcomes of students (both general for the science education field and specific, determined by the specifics of the educational subject); formation of key competencies that are important for the further development of the individual; variability of models of basic physical education and its educational and methodological support.

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