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METHODOLOGICAL APPROACHES TO DEVELOPING METAPROFESSIONAL COMPETENCE IN STUDENTS IN THE PROCESS OF TEACHING PHYSICS

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Abstract

This article presents a scientific and theoretical analysis of methodological approaches to developing students' metaprofessional competence in physics education. Drawing on the theoretical and practical potential of physics, the article explores the role of competency-based, student-centered, activity-based, systemic, and integrative approaches in the educational process. The study's findings demonstrate that the harmonious use of these approaches in physics education contributes to the development of students' critical thinking, problem-solving skills, and scientific reasoning.

Key word

physical education, meta-professional competence, methodological approach, competence-based approach, personality-oriented approach, systems approach, integrative approach, virtual laboratories, interdisciplinary integration.

МЕТОДОЛОГИЧЕСКИЕ ПОДХОДЫ К РАЗВИТИЮ МЕТАПРОФЕССИОНАЛЬНОЙ КОМПЕТЕНТНОСТИ У СТУДЕНТОВ В ПРОЦЕССЕ ПРЕПОДАВАНИЯ ФИЗИКИ.

Аннотация

В данной статье представлен научно-теоретический анализ методологических подходов к развитию метапрофессиональной компетентности студентов в процессе обучения физике. На основе теоретических и практических возможностей физики раскрывается роль компетентностного, личностно-ориентированного, деятельностного, системного и интегративного подходов в образовательном процессе. Результаты исследования показывают, что гармоничное использование этих подходов в процессе обучения физике способствует развитию у студентов критического мышления, навыков решения проблем и научного мышления.

Ключевые слова

физическое образование, метапрофессиональная компетентность, методологический подход, компетентностный подход, личностно-ориентированный подход, системный подход, интегративный подход, виртуальные лаборатории, междисциплинарная интеграция.

Introduction. In the modern education system, physics, as a fundamental science, plays an important role not only in explaining natural phenomena, but also in forming scientific worldview, logical thinking, and problem-solving competencies in students. Today, one of the main tasks of physics education is to develop not only subject-specific knowledge in students, but also metaprofessional competencies that are used in various professional activities. It is urgent to reconsider methodological approaches to teaching physics and effectively implement them in the educational process.

Main part. The pedagogical content of metaprofessional competence in physics education In the process of teaching physics, metaprofessional competence is manifested through such skills as analyzing scientific problems, interpreting experimental results, mathematical modeling, using information technologies, and conducting scientific communication. The process of studying physical phenomena encourages students to observe, conduct experiments, and draw conclusions, which serves to develop the main components of metaprofessional competence. We will consider the following methodological approaches to the development of metaprofessional competence in teaching physics.

Competency-based approach: The competency-based approach in physics education is aimed at linking theoretical knowledge with real problem situations. For example, by applying physical laws to the analysis of technological and environmental problems, students develop problem-solving and practical thinking competencies. The competency-based approach is not a completely new phenomenon for the education system of our country today. The approach aimed at the formation of skills and generalized methods of activity in the educational process has existed historically. However, in modern times, this approach is being studied more comprehensively and systematically, based on the innovative educational environment and new socio-economic requirements of society. At the same time, for the effective implementation of the competency-based approach, it is important to rely on international experience, taking into account national educational traditions and current needs. Based on this approach, it is advisable to improve standard curricula based on current educational requirements, develop mechanisms for developing competency-based education, and implement innovative projects that incorporate modern technological requirements that serve to form various competencies in learners and educators.

The competency-based approach is recognized as one of the important conditions for the development of modern society and the education system, providing for the formation of comprehensive competence in the activities of the individual. This requirement also directly applies to the professional activities of teachers, who are the main subjects of the educational process. In the current conditions of globalization and modernization of education, one of the priority areas of the development of world education is the widespread introduction of an activity-oriented approach in the educational process. This approach allows learners to develop a holistic and systematic perception of existence, life and professional activity, to effectively operate in various conditions, as well as to independently solve new problems and tasks.

The main essence of competency-based education is to direct the knowledge, skills and qualifications acquired by students in the process of education and upbringing, organized in vocational subjects, to the formation of competencies that will allow them to apply them in their personal lives, as well as in their future professional and social activities. Students must have the necessary basic competencies to enter into personal, social, economic and professional relationships, take their place in society, solve problems encountered in this process, and most importantly, be competitive in their field and profession [2].

Person-centered approach. This approach allows taking into account the individual interests and level of preparation of students in the study of physics. Differentiated tasks, individual projects and independent research work form the creative and reflexive competencies of students. One of the priority aspects of the person-centered approach methodology is to ensure the flexibility of the educational process and implement differentiated education taking into account the individual characteristics and needs of the student. One of the most important aspects of the person-centered approach methodology is the flexibility of education and the introduction of a differentiated approach in accordance with the student. This method makes a significant

contribution not only to the acquisition of knowledge, but also to the formation of their own independent professional path [1]

This approach effectively supports not only the acquisition of knowledge by students, but also the process of determining and developing their independent professional direction. This methodology, based on the principles of person-centered education, includes a set of innovative pedagogical approaches, interactive teaching methods, and experimental and pedagogical research aimed at the formation and development of professional competence in students. As a result, a modern and effective educational model is formed that serves to ensure the personal and professional development of students.

The activity-based approach is implemented in physics education through laboratory work, virtual experiments, problem-solving and project activities. This approach develops students' scientific research, collaboration and communicative competencies. The activity-based approach is an approach that focuses on the independent actions and practical activities of the student in the educational process, rather than on the acquisition of ready-made knowledge. This approach to teaching physics in modern pedagogy of 2026 includes the following important aspects: the main idea of the approach is that the student becomes not just a “listener” or “observer” in the lesson, but a “knowledge creator” subject. Physical laws are not told by the teacher, but are “discovered” by the student in the process of experiment, research and analysis. The implementation stages in physics lessons are motivation and goal setting, the student is given a life problem, for example, “Why should a building be earthquake-resistant?” The choice of methods of action is up to the student to determine which physical laws (mechanics, vibrations) and tools are needed to solve this problem. Practical activity is not based on instructions, but rather, the student designs and conducts laboratory work to test his own hypothesis. The results are analyzed, and errors are worked on.

Through an activity-based approach, the following metaprofessional skills are formed in the student:

Independent search for information and decision-making;

Questioning and checking the results obtained;

Working in a group, justifying one's opinion in physical terms;

Analyzing one's own activities and understanding where one made a mistake.

The advantages of the activity-based approach are that a person remembers better what he has done and applied in practice, that is, knowledge is consolidated. The student does not perceive physics only as a theory, but learns how to apply it in production and technology. The student develops the confidence that “I could do it myself” and interest in science, and a positive emotional atmosphere is created. The activity-based approach serves to implement the formula “knowledge + skills + experience” in teaching physics.

Systemic approach. The system approach is a modern system technology of education and upbringing, which allows its introduction into educational practice[5]. There will be significant changes in education itself: increasing its efficiency, while requiring a sharp reduction in the duration of education. The systemic approach involves organizing the content of the physics course in a logical sequence. Physical concepts and laws are studied in an interconnected manner, forming a holistic system of knowledge, which develops the competence of systematic thinking in students. The systemic approach to teaching physics is a fundamental methodological direction that considers the content of education as a whole complex of interconnected elements. This approach serves to form in students the physical picture of the universe not in a fragmented form, but in the form of a holistic and hierarchical system. The systemic approach defines the physics course as a set of logically interconnected components (concepts, principles, laws and theories). In this case, each new piece of knowledge acquired builds on the previous one and

becomes the basis for the next. For example, the concept of "energy" is continuously complicated from mechanics to thermodynamics, from electrodynamics to quantum physics, and forms a holistic system. This approach develops the following intellectual operations in students: the ability to see general laws (for example, conservation laws) behind individual physical phenomena, to identify the elements that make up a complex system and the connections between them, and to represent real objects in the form of physical models while preserving their essential properties.

At the metaprofessional level, a systematic approach forms the student's skills of systematic analysis. This competence allows the future specialist to view professional problems not as an isolated element, but as part of a broader context; analyze the impact of changes in one area on other related areas; and ensure optimal management of complex production and technological processes.

Integrative approach. An integrative approach requires the integral connection of physics with mathematics, computer science, chemistry, and engineering. Interdisciplinary integration allows students to solve complex problems and form universal competencies. The integrative approach lies in interdisciplinary connections. The use of interdisciplinary knowledge contributes to the integration of education, the harmonization of the relationship between man and nature through the assimilation of a modern scientific picture of the world. It is important for students to comprehensively use knowledge and critically evaluate the phenomena being studied[6].

Educational effectiveness of using methodological approaches The combination of methodological approaches in the process of teaching physics develops not only the level of students' knowledge in the subject, but also the main components of metaprofessional competence. In particular, the use of virtual laboratories, simulations, and digital educational platforms significantly increases educational effectiveness.

Conclusion. It is worth noting that the development of metaprofessional competence in students in the process of teaching physics relies on effective methodological approaches. The combination of competency-based, person-oriented, activity-based, systematic and integrative approaches ensures the scientific thinking, creativity and professional flexibility of students.

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