PEDAGOGICAL MODEL OF PROFESSIONAL COMPETENCE DEVELOPMENT BASED ON THE INTEGRATION OF NATURAL SCIENCES

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Abstract

One of the urgent tasks of the modern education system is to increase the professional competence of future chemistry teachers and prepare them to be competitive in the labor market. This article scientifically and pedagogically studies the issues of developing students' professional competence based on the integration of natural sciences such as physics, chemistry, biology and geography in higher and secondary specialized educational institutions. The possibilities of forming a holistic scientific picture of the world in students and developing their practical skills by ensuring interdisciplinary continuity are analyzed. The main goal of the study is to develop an effective pedagogical model based on the integration of natural sciences and to substantiate its practical significance.

The proposed pedagogical model includes several main blocks: goal-motivational, content-processual, organizational-technological and assessment-criteria blocks. Within the framework of the model, the didactic conditions for implementing interdisciplinary integration, innovative forms and methods of teaching, as well as mechanisms for using digital technologies are specified. It was

found that the interrelation of natural sciences develops students' ability to analyze problem situations, think logically, and make non-standard decisions.

The results of the pedagogical experiment showed that the system of integrated lessons and practical exercises significantly increases not only the theoretical knowledge of students, but also their motivation for professional activity. Based on the assessment-criteria block, the levels of professional competence of students (low, medium, high) were determined, and high indicators were recorded in the representatives of the experimental group. This pedagogical model serves as an important tool for improving the quality of education and forming independent research skills in students.

Keywords: natural sciences, integration, professional competence, pedagogical model, interdisciplinary connection, didactic conditions, innovative education, students.

Introduction

The modern world is changing rapidly. It is required to understand the interrelationship of disciplines and systematically solve complex problems. Improving the quality of teaching natural sciences is an urgent task, especially in the higher education system. Such subjects as physics, chemistry, biology and geography are highly effective only when they are taught not separately, but in connection with each other. Integration of natural sciences broadens the worldview of students. It forms a holistic picture of existence in them. This process develops students' logical, analytical and creative thinking abilities. As a result, it creates an opportunity to bring the professional competence of future specialists to a completely new level.

The concept of professional competence does not mean only possessing theoretical knowledge. It is the ability to correctly apply the acquired knowledge in practice, in non-standard situations. Today's education system should teach graduates to acquire knowledge independently, rather than giving them ready-made knowledge. Integration of natural sciences is one of the most effective tools

in this regard. Because real-life and production processes never obey the laws of only one science. For example, to solve environmental problems, knowledge of chemistry, biology and physics is needed at the same time. Therefore, it is necessary to strengthen interdisciplinary connections in the training of future chemistry specialists. This forms professional flexibility in students. However, a number of problems are emerging in the implementation of interdisciplinary integration in the traditional education system. Often, subjects are taught in isolation from each other, mechanically. An integrated approach is not systematically reflected in curricula and textbooks. The teaching staff themselves do not have sufficient skills in establishing interdisciplinary connections. To overcome these problems, a new approach to the educational process is needed. Creating a perfect pedagogical model for the development of professional competence based on the integration of natural sciences is a pedagogical necessity of today.

Main part

A future chemistry teacher must master not only chemical knowledge, but also the methodology of connecting it with other natural sciences. Because he must: explain biological processes chemically, relate physical laws to reactions, and explain ecological problems on the basis of chemistry. This forms an expanded view of pedagogically meaningful knowledge - integrative professional competence.[13]Here: chemical reactions are at the heart of all life processes (photosynthesis, respiration, metabolism, DNA replication) that occur in living organisms. A future chemistry teacher must not only give students a biological concept, but also be able to explain its essence at the molecular level. This forms the concept in students that "life is a complex chemical process."

Linking physical laws to reactions (Physical-chemical approach)

Note: The speed of chemical reactions, heat effect, energetics, and the structure of atoms and molecules are directly subject to the laws of physics (thermodynamics, quantum mechanics, electrostatics). A chemistry teacher must

be able to demonstrate physical laws (for example, the law of conservation of mass) using examples of chemical bonds and reactions. This ensures interdisciplinary continuity.

Explaining ecological problems based on chemistry (Ecological-chemical approach)

Note: Environmental pollution (greenhouse effect, acid rain, ozone layer depletion) are all chemical problems. Their solutions also go back to modern chemical technologies. The teacher should present chemistry not only as a laboratory science, but also as a tool for understanding and solving global ecological crises. This instills ecological culture and responsibility in students.

An integrated approach is an important didactic factor that increases the pedagogical effectiveness of chemistry education. It enhances knowledge acquisition, deepens understanding, increases learning motivation, and forms scientific thinking. The effectiveness of integration is based on the associative nature of human memory: knowledge is more firmly stored when it is interconnected. Therefore, the use of integrative methods in chemistry education is an important pedagogical condition for developing scientific literacy and increasing the intellectual potential of students [10].

The methodological essence of the model is as follows: the process of training a chemistry teacher is not only the acquisition of subject knowledge, but also the formation of interdisciplinary scientific thinking, the ability to design methodological activities, and the ability to manage student learning.

The pedagogical model consists of three interrelated blocks:

Target block → Content and process block → Result block

The implementation of this pedagogical model activates the ability of learners not only to accumulate theoretical knowledge, but also to apply it in real-life and professional situations. The integration of natural sciences broadens the worldview of students, develops ecological culture and creative thinking in them. This approach helps students see the laws of nature as a whole, which in the future

creates the basis for their non-standard decisions in scientific activities. As a result, students' learning motivation increases and their professional competence rises to a qualitatively new level.

The importance of any methodological approach in the educational process is determined by its practical effectiveness. In this regard, the issue of the effectiveness of the integration of natural sciences becomes a separate object of pedagogical research. Integrated education is not just a theoretically based methodological idea, but a didactic mechanism that brings about tangible changes in the quality of knowledge, thinking and attitude of students to educational activities.

Experimental studies and methodological observations on the organization of the educational process show that the integrative approach provides a number of important pedagogical results compared to traditional subject-based teaching. In particular, integrative education: increases the level of mastery, enhances the depth of understanding, stimulates learning motivation, and forms scientific thinking. These results are not accidental, but are explained by the psychological and didactic mechanisms of educational activities [14].

Conclusion

The model of professional competence development based on the integration of

natural sciences is an effective pedagogical tool for radically reforming the content of higher education and ensuring the integration of science and production. The proposed model can serve as a model for designing not only natural science areas, but also other educational processes. The target block is aimed at developing integrated thinking and systematic problem-solving skills in future specialists. The content block ensures the integration of the content of natural sciences such as physics, chemistry, biology and geography with areas of professional activity. Within the framework of the technological block, innovative interactive methods such as project-based learning, case studies and problem-based learning are

introduced into the educational process. The criterion-based assessment block allows monitoring the results achieved by students and assessing their level of professional training based on specific criteria. In the future, it is advisable to continue research in this area by creating a system of virtual laboratories using the capabilities of the digital learning environment and artificial intelligence, and further enriching the methodological support of interdisciplinary integration.

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