METHODOLOGY OF USING THE INTEGRATION OF NATURAL SCIENCES IN THE DEVELOPMENT OF PROFESSIONAL COMPETENCE OF FUTURE CHEMISTRY TEACHERS

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Annotation

This article examines the theoretical and practical foundations of using the integration of natural sciences in the development of professional competence of future chemistry teachers. Globalization and increased interdisciplinary connections in the modern education system require future teachers not only to have a deep knowledge of their subject, but also to develop the ability to explain chemical processes in an inextricable link with such subjects as biology, ecology, technology, art, foreign languages, physics and geography, which is becoming one of the requirements of the current modern educational paradigm.

The article shows the integrated educational approach as an important factor in developing students' logical thinking, that is, cognitive abilities, as well as in forming a holistic scientific picture of the world and improving their professional skills. During the study, methodological methods for implementing interdisciplinary connections in chemistry lessons were analyzed, including the use of problem-based learning, project-based learning, and case study technologies. The impact of integrated educational tasks and laboratory exercises on the development of the components of professional competence of future chemistry teachers (methodological, special, and pedagogical) was also highlighted. At the

end of the article, practical recommendations are given for improving the methodology of teaching chemistry in higher pedagogical educational institutions. This methodology serves to increase the level of professional training of students and ensure their competitiveness in the labor market**.**

Keywords professional competence, integration, natural sciences, chemistry teacher, interdisciplinary communication, creative approach, integrated lesson.

Introduction.

Reforms in the modern education system require future chemistry teachers not only to have a wide range of theoretical chemical knowledge, but also to have comprehensive professional competence. Today, one of the main tasks is to create an image in the minds of students of teaching chemistry not as a separate system, but in an inextricably linked way with other disciplines. The formation of a methodology for using the integration of natural sciences to understand the integrity of natural phenomena and to fully convey the scientific picture of the world to young students has become a vital necessity.

Professional competence implies the acquisition by a specialist of the knowledge, skills and qualifications necessary for the implementation of professional activities and their high-level application in practice. Professional competence does not imply the acquisition of separate knowledge and skills by a specialist, but the mastery of integrative knowledge and behavior in each independent area. Also, “competence” requires the constant enrichment of specialized knowledge, the study of new information, the ability to understand important social requirements, the ability to search for new information, process it and apply it in one’s activities [1].

Foreign scientists D. McClelland, L. Spencer, S. Spencer have expressed competence; A. Khutorsky and I. Zimnyayalari have expressed a competency approach in pedagogy; A.H. Johnstone, K.S. Taber, J.K. Gilbert, J. Gilbert, D. Lee Shulman, J. Hattie, M. Niaz have expressed a historical-epistemological approach to the study of scientific concepts in chemistry education, and the professional

competence of a chemistry teacher has been expressed in scientific studies of general pedagogical competence. J. Hofstein and V. Lunetta have proven that laboratory exercises are the main indicator of a teacher's professional competence.

In our republic, the professional competence of a chemistry teacher is studied in the scientific research of B.A. Avezov, D. Abdullayeva, the competence of a chemistry teacher in the integration of disciplines is studied in the scientific research of N.N. Azimov, F.A. Alimova, I.E. Shernazarov, N. Temirov, A.Yu. Iskandarov, Sh. Kh. Shomurotova, the future chemistry**.** The methodology for the formation of creative pedagogical competence in a chemistry teacher was studied in the scientific research of Sh.A. Kadirova.

In the scientific literature (A.H. Johnstone, K.S. Taber, J.K. Gilbert), chemistry teaching is explained through a three-level model: macroscopic (observable phenomena), microscopic (atomic-molecular explanation), symbolic (formulas and equations) [6; 7]. Therefore, the competence of a chemistry teacher has a more complex structure than that of a teacher of other subjects [2]. J. Gilbert and D. Treagust scientifically substantiated that the main competence of a chemistry teacher is the correct use of modeling and analogies [2].

The structure of the professional competence of a future chemistry teacher

Based on the analysis, the professional competence of a future chemistry teacher is considered to consist of the following structural model:

1. Motivational component - pedagogical values, professional interest, positive attitude to teaching.

2. Cognitive component - chemistry theory, integrative knowledge (physics, biology, ecology), pedagogical and psychological knowledge.

3. Operational activity - component, lesson design, experiment organization, evaluation, modeling.

4. Reflexive component - analysis of one's own activities, identification of student errors, methodological decision-making.

5. Communicative component - pedagogical dialogue, cooperation, scientific explanation.

Summarizing the above scientific approaches, the following definition is proposed:

The professional competence of a future chemistry teacher is a system of integrated knowledge, skills, values, and reflexive experiences that allow the scientific, methodological, and psychological design, organization, and analysis of the process of teaching chemistry.[3]

Future chemistry teachers, that is, by teaching chemistry, physics, biology, and geography in a single system-integrated manner to personnel is a process of improving pedagogical skills. This method forms the skills of expanding students' worldviews, deepening their understanding of intersubject relationships, and explaining complex processes in nature to students in a holistic way.

In the modern education system, chemistry is not only a matter of laboratory experiments or formulas, but is also closely related to environmental problems, industry, and changes in living organisms. The integration of natural sciences (STEAM approach) develops the competencies of future teachers in this area of analytical thinking, critical thinking, and creative solutions to complex problems. The main essence of the methodology is aimed at preparing students not only as specialists in specialized fields, but also as universal specialists who reveal the interrelationships of natural phenomena.

From this it is clear that the integrated approach forms analytical thinking in future chemistry specialists and allows them to explain complex chemical processes through real-life examples. For example, studying the process of photosynthesis in combination with chemical reactions and biological laws broadens the student's worldview.

Methodological part.

Integrative chemistry is a modern approach to teaching chemical processes in connection with such disciplines as physics, biology, mathematics, and ecology.

This method serves to form in students not abstract concepts, but a single chain of phenomena in nature and society, that is, it is an innovative educational approach aimed at showing a single and inseparable chain of natural phenomena, expanding their worldview, and strengthening interdisciplinarity. This method encourages practical and scientific substantiation of the essence of phenomena instead of dry memorization and studying abstract concepts.

In traditional education, subjects are taught separately, which leads to the formation of knowledge in students' minds in a scattered state. An integrative chemistry lesson combines all natural and exact sciences into a single system. As a result, the harmony between matter and being is clearly manifested.

Future teachers acquire interdisciplinary skills in the process of teaching to explain topics across different disciplines. For example, when teaching the process of photosynthesis, it is necessary to combine biological properties, chemical reaction mechanisms and physical laws (light energy).

Designing and organizing integrative lessons forms practical skills in future chemistry teachers. This allows the future teacher to arouse interest in natural sciences in students.

The main areas of interdisciplinary connection:

Physics: Topics such as energy transfer in chemical reactions, thermodynamics, and atomic structure are explained through physical processes.

Biology: The synthesis of complex proteins, the process of photosynthesis, and metabolism in living organisms are explained in depth based on biochemistry.

Mathematics: Mathematics serves as a basis for balancing chemical equations, finding the concentration of solutions, and calculating relative masses and volumes.

Ecology: Problems such as industrial gases emitted into the atmosphere, the origin of acid rain, and water pollution are analyzed from an ecological perspective.

Below is an example of an integrated lesson;

Topic: Atmospheric Pollution (Chemistry + Ecology + Geography)

Method: Project-Based Learning

Objective. To form a methodology for teaching ecological chemistry.

Project assignment. “Determination of chemical air pollution in Tashkent and development of a lesson for school”

Stages: problem identification, identification of substances (CO_2, SO_2, NOx), writing chemical reactions, creating a task for the student

Presentation. Result

The student: creates a lesson based on a real problem, masters the methodology of teaching ecological thinking.

General methodological conclusion. Integrative lesson development forms the following professional competencies: methodological design, explanatory competence, diagnostics, interdisciplinary connection, and management of student thinking. Thus, integrative teaching methods form the future chemistry teacher not as a teacher, but as a pedagogue who designs the educational process, and this forms the methodological basis of experimental work.

The problem-based learning (PBL) approach develops critical and creative thinking in students. Solving real-life problems in integrative chemistry lessons (chemistry + biology + ecology), for example, working on problem situations such as "Acid rain and its impact on nature", forms research skills in students.

Results. Pedagogical experimental work confirmed that the methodology based on the integration of natural sciences increases the level of professional competence of future chemistry teachers, in particular, cognitive and practical skills. The results show that the integrative approach has formed the ability of students to connect chemical processes with ecological and chemical laws, and has achieved the development of professional motivation.

Conclusion. The integrated approach requires the widespread use of multimedia, virtual laboratories and problem tasks that meet the criteria of international assessment programs (such as PISA).

In general, the methodology of using the integration of natural sciences is the most effective means of improving the pedagogical and methodological competence of future chemistry teachers. This process guarantees that students will become competitive specialists who meet modern requirements, constantly work on themselves and can ensure the quality of education.

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