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THE STUDENTS 'EDUCATIONAL METHODS IN THE PROCESS OF CHEMISTRY EDUCATION

LOS MÉTODOS DE ORGANIZACIÓN DE LOS ESTUDIANTES EN EL PROCESO EDUCATIVO DE LA QUÍMICA

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ABSTRACT

The modern strategy of higher education is aimed at training a competent specialist, which involves a shift in emphasis on the interests of the student, on the maximum possible realization of the abilities, on the activity of learning. The principle key of competency-based training is focusing on results that are significant for future professional activities. It is impossible to effectively solve these problems with a standard approach to training. It is necessary to reorganize the educational process from the passive assimilation of knowledge and skills, which the traditional lecture-seminar system teaches, into an active process of their acquisition and further application using intensive teaching technologies. Many university teachers do not have enough teaching methods in their subject. The bulk of professional chemistry teachers are trained at pedagogical universities, so there is no urgent need for another university to train a qualified teacher and teacher. The article discusses the main specific features of teaching chemistry in higher education. Practical recommendations for higher education teachers are given.

Keywords: Teaching methods, organization of chemistry training, chemical education, modernization of higher education, higher school.

RESUMEN

La estrategia moderna de la educación superior está dirigida a capacitar a un especialista competente, lo que implica un cambio en el énfasis en los intereses del estudiante, en la máxima realización posible de sus habilidades, en su actividad en el aprendizaje. El principio clave de la formación basada en competencias se centra en los resultados que son significativos para futuras actividades profesionales. Es imposible resolver eficazmente estos problemas con un enfoque estándar de capacitación. Es necesario reorganizar el proceso educativo a partir de la asimilación pasiva de conocimientos y habilidades, que enseña el sistema tradicional de conferencias y seminarios, en un proceso activo de su adquisición y posterior aplicación utilizando tecnologías de enseñanza intensiva. Muchos profesores universitarios no tienen suficientes métodos de enseñanza en su materia. La mayoría de los maestros profesionales de química están capacitados en universidades pedagógicas, por lo que no hay necesidad urgente de que otra universidad capacite a un maestro y maestro calificado**.** El artículo analiza las principales características específicas de la enseñanza de la química en la educación superior. Se dan recomendaciones prácticas para maestros de educación superior.

Palabras clave: Métodos de enseñanza, organización de capacitación en química, educación química, modernización de la educación superior, escuela superior.

INTRODUCTION

As one of the natural scientific fundamental disciplines, chemistry occupies an important place among other sciences in the training of a specialist. Among the natural fundamental sciences, chemistry plays one of the key roles in the development of students' intellectual abilities, and also contributes to the formation of flexibility of thinking. All of the above is the main task of high-quality training of a future specialist in higher education. There is not a single branch of production that would not be associated with the use of chemistry. In addition, in any sphere of human activity, one inevitably has to deal with the chemical properties of different substances - the ability to interact with other substances, strength, and also with the change in the above properties with changes in temperature, pressure and other factors.

It is worth noting that the process of teaching chemistry in modern conditions in higher education is a difficult task. Due to the fact that in recent years, the school system has undergone significant changes, the qualitative level of training of applicants entering universities has changed. Therefore, from the first days of classes, many students encounter difficulties in studying chemistry. We will identify the main problems of teaching chemistry in higher education based on the analysis of the content of chemical education. Throughout the entire period of the existence of a chemistry course, 3 key factors have influenced and also have an impact on the change in the content of a chemical education: the level of development of chemical knowledge, the policy pursued in the field of education and the achievement of pedagogical science (Khamitova & Ivanov, 2006).

An analysis of the above factors and the existing system of teaching chemical disciplines in higher education revealed a number of basic contradictions (Bezrukova, 2006). There are:

- contradictions between the decrease in the level of chemical training of school graduates caused by the crisis and the volume of chemical knowledge that grows as a result of scientific and technological progress, which must be reflected in the process of teaching chemical subjects at a university;
- contradictions between the need for modernization of chemistry education and the insufficient development of its theoretical and methodological foundations;
- contradictions between the didactic capabilities of modern innovative technologies and the level of their practical use in teaching chemical disciplines in higher education;
- contradictions between the importance of chemistry in the formation of a chemically and environmentally competent personality of a future teacher and the reduction in hours for studying it, provided for by the state educational standard.

Therefore, at present, the urgent task is to modernize training, which involves changing the principles of designing the content of training, scientific and methodological approaches to the organization of training and educational and cognitive activity in this process.

METHODOLOGY

A lot of works of both domestic and foreign teachers are devoted to the methods of teaching chemistry in higher education.

In responsible didactics, the method of modular technologies was dealt with. The principles of consistency are described in the work of Sidakova (2016). Interdisciplinary communication in the process of applying the modular approach was developed by Lyapina & Zhukova (2016).

In foreign literature, teachers note the effectiveness of this approach to learning. For example, Kulkarni & Vartak (2019), take a modular approach in teaching freshmen with critical reading. Educators note the effectiveness of the module structure, student assessment methodologies, learning outcomes, and student feedback.

Other educators Deb, Fuad & Irwin (2019), have developed stand-alone learning modules for specific basic courses in computer science teaching and also note the effectiveness this approach. The purpose of the study is to find an effective method of organizing the educational process of students in the discipline "Chemistry" at a technical university.

RESULTS

The modernization of the system of higher professional education that is being carried out today requires the intensification and intensification of the educational process - the creation of didactic conditions that will lead to the intensive assimilation of theories, laws and concepts of chemistry with the active participation of students. An important role in creating these conditions is played by the forms of organization of training. Consider the features of the forms of organization of teaching chemistry in higher education. The forms of organization of chemistry education in the course of its development went through 5 stages.

The first stage of the organization of chemistry training was accompanied by the definition of requirements for visual aids, a lecturer, a demonstration experiment, as well

as a scientific requirement for the material presented and the beginning of lecturing in Russian.

The second stage of the organization of chemistry education is the formation of laboratory and practical classes. Practice at the workplaces of enterprises and practical classes were supposed to promote a conscious attitude to training and increase interest in theoretical knowledge, and also aimed to give practical skills in the workplace. The second stage is characterized by the development of laboratory and practical classes on the topics of the course with the emphasis on studying the properties of compounds, as well as methods for their processing and production.

The third stage of the organization of chemistry training was accompanied by an increase in the importance of laboratory and practical classes, as well as the emergence of new types of practices. This stage was a reflection of the complex method and the method of projects in higher educational institutions. During this period, many universities canceled lectures, recognized the negative role of continuous practice. At the end of the period, lectures return to higher educational institutions, as well as elements of seminars are introduced. In the third period, the main forms of organization of chemistry education are determined: laboratory and practical classes, seminars, lectures.

At the fourth stage of the organization of chemistry education at the school, lectures and seminars are introduced. Laboratory and practical classes at the school in the study of chemistry at this time are well developed. The system of independent work on individual topics of the course is also investigated. At the fifth stage, the forms of organization of chemistry education are considered as a system, and laboratory, seminar, and lecture classes are developed. Today, the sixth stage is brewing (Khamitova & Ivanov, 2008) in the development of forms of organization of chemistry education. This stage is objectively due to a reduction in the time devoted to the study of chemistry; changes in engineering activities; a change in the content of chemical education. At present, when teaching chemistry in higher education, according to work programs, 4 main forms of organization of study are distinguished.

When analyzing these forms of organization of chemistry education, lectures pay special attention to themselves. At the present stage, a feature of lectures in the teaching of chemistry in higher education is the use of multimedia technologies.

It is worth noting that the use of multimedia technologies is especially relevant for technical disciplines, because it allows you to demonstrate complex tables and diagrams, derive formulas and equations, and also illustrate theoretical positions with examples. In addition, students have the opportunity to write foreign words and complex terms, while in the traditional presentation of the material this often causes difficulties. This aspect is positively evaluated by teachers (Khamitova & Ivanov, 2006).

Also, a feature of teaching chemistry in higher education at present is a significant reduction in hours devoted to the study of the disciplines of the natural science cycle, which is associated with an increase in the number of hours devoted to independent extracurricular work of students. Improving the status of self-education is currently associated with a high degree of competitiveness and independence of the future skilled worker, which is a key task of higher education.

It should also be noted that the teaching of a chemistry course in higher education institutions is traditionally conducted in the 1st year, when students are not yet adequately prepared for the perception of conceptually complex concepts. Therefore, the practice and methodology of the educational process must be directed towards overcoming the psychological barrier of the impossibility of knowledge of chemistry.

The specificity of teaching chemistry in higher education is also that the center of gravity of teaching shifts from the presentation of material in the finished form of knowledge to the formation of a meaningful perception of the material and the development of a scientific approach to the processes under study for subsequent implementation in special courses in the chosen specialty. The key moment in the implementation of the above principles is the active participation of students in obtaining knowledge, impossible without persistent and persistent independent work, as well as solving non-standard creative tasks. In conclusion, I would like to note that, based on the study of the science of chemistry, it is possible to psychologically prepare students and future specialists for solving practical problems in everyday life and in production. You cannot become a qualified specialist in the field of technical sciences and all the more capable of mastering knowledge and a creative person if you do not master the basic chemical concepts and ideas, since the connection of chemistry with professional technical tasks is of great importance. This is a serious basis for the study of chemistry in the formation of professional knowledge in any technical higher educational institution.

When choosing a learning method, we settled on modular learning as the most promising direction in the methodology of teaching chemistry in higher education.

The module program defines goals at all stages of training, structured training material in accordance with the goals.

For example, under the Chemistry program for students in the Oil and Gas Business field, a structured system is as follows (Table 1):

Table 1. Modules in the discipline "Chemistry" for students of "Oil and Gas Business".

DISCIPLINES	THE CONTENT OF THE DISCIPLINE
General and inorganic chemistry	Chemical bond and substance structure Classes of Inorganic Compounds Methods for expressing the concentration of solutions Equilibrium in Electrolyte Solutions General properties of solutions Redox reactions Complex compounds Chemical properties of elements and their compounds
Physical chemistry	Fundamentals of Chemical Thermodynamics Chemical kinetics and catalysis Chemical equilibrium Electrochemical processes
Analytical chemistry Analytical chemistry	Theoretical Foundations of Analytical Chemistry Qualitative Chemical Analysis Quantitative analysis Physical-chemical methods of analysis
Colloid chemistry	Surface phenomena and adsorption Dispersed systems Colloidal solutions Properties and use of colloidal solutions
Organic chemistry, polymers	Fundamentals of Organic Chemistry Types of reactions of organic compounds Organic and Inorganic Polymers Polymer Production Methods The structure and properties of polymers Biopolymers

The independent work was divided into modules.
Such a division of the educational process into modules involves constant monitoring of students' academic achievements, which allows you to adjust the learning process in the future (Table 2).

Table 2. Modules of independent work of students in the discipline "Chemistry".

Topic Title	Types of control
1 term	
Classes of inorganic compounds.	Presentation of laboratory work No. 1, test "Classes of inorganic compounds"
Ways to express the concentration of solutions.	Presentation of laboratory work No. 2, test "Methods for expressing the concentration of a solution"
Atom structure, periodic system, chemical bond.	Test "Atom structure, periodic system, chemical bond"
Thermodynamics of chemical reactions. Problem solving	Test "Thermodynamics of chemical processes"
The rate of chemical reactions.	Presentation of laboratory work No. 3, test "Speed of chemical reactions"
Chemical equilibrium.	Presentation of Laboratory Work No. 4, Chemical Equilibrium Test
2 term	
Complex compounds.	Protection of laboratory work No. 3, test "Complex compounds"
Properties of solutions.	Protection of laboratory work No. 2, test "Colligative properties of solutions"
The quantitative composition of the solutions.	Protection of laboratory work No. 1, test "Quantitative composition of solutions"
Surface phenomena and adsorption.	Protection of laboratory work No. 5, test "Adsorption"
Properties of dispersed systems.	Protection of laboratory work No. 4, test "Dispersion systems"
The main provisions of organic chemistry. Polymers	Protection of laboratory work No. 6, test "Classification and nomenclature of organic compounds", "High molecular weight compounds"

The main characteristics of modular training include flexibility, completeness, completeness, and logical structure of educational material.

We adhere to the definition of modular training as the target functional unit, which combines educational content and ways to master this content. Thus a module is an action plan (functionality), a databank (training content), and a methodological guide to achieve your goals.

From the above tables, on the basis of the principles of modular training, we have identified the following modules of the educational program: "General and Inorganic Chemistry", "Physical Chemistry", "Analytical Chemistry", "Colloid Chemistry", "Organic Chemistry. In the modules, we distinguished smaller sections, including approximately 1 lecture and laboratory work. The training material inside the modules is structured as a system of training elements.

When compiling the modules and developing criteria for assessing the level of formation of knowledge, abilities and skills of students, we took into account the following principles of modular training:

- level of complexity of educational material;
- choice of tasks that contribute to personal and professional development;

- opportunities for students to independently acquire knowledge.;
- educational and methodological support of the educational process.

At Tyumen Industrial University, the assessment of the quality of assimilation of educational material occurs according to a point-rating system. Assessment of the results of mastering the discipline in a 100-point system for students is made up of three current certifications, a set of reward points is also expected. In preparation for laboratory work and testing, it is necessary to pay attention to the presented test items. When solving test tasks, they should use the literature. The list of which is presented at the end of the guidelines for the discipline. Tests are presented in order to study the above topics in chemistry, questions are typical and also presented for testing in the EDUCON system (Shepelyuk, 2014, 2015, 2017). A set of assessment tools for testing students to learn the material fully covers the entire content of professional activity in this discipline, is closely related to the theoretical material that provides the solution to the problem, it reflects the most significant parameters of the topics under consideration. Typing tasks allows you to fairly systematize students' knowledge, control the level of assimilation of the material, and keep track of typical errors. Identify insufficiently learned topics (Table 3).

Table 3. Learning Material Evaluation Indicators.

Points	Criteria
91-100	the student demonstrates the formation of disciplinary competencies at the final level, discovers a comprehensive, systematic and in-depth knowledge of the educational material, has mastered the basic literature and is familiar with additional literature, is able to freely carry out the practical and test tasks provided for in the program, freely operates on acquired knowledge, skills, applies them in situations of increased complexity.
76-90	the student demonstrates the formation of disciplinary competencies at an average level: basic knowledge, skills are mastered, but minor errors, inaccuracies, difficulties in analytical operations, transfer of knowledge and skills to new, non-standard situations are allowed.
61-75	the student demonstrates the formation of disciplinary competencies at a basic level: during control measures, significant errors are made, a lack of individual knowledge, skills in certain disciplinary competencies is manifested, the student experiences significant difficulties in operating with knowledge and skills when transferring them to new situations.
0-60	the student demonstrates the formation of disciplinary competencies at a level below the base, manifested the lack of knowledge, skills.

We believe that the modular technology used in the pedagogical process of studying the discipline "Chemistry" in higher education allows you to organize students 'independent work, allows you to create an algorithm for the students' learning process and objectively evaluate the quality of learning material in the classroom and in the process of independent work.

CONCLUSIONS

The forms of organization of chemistry training in the process of its development went through 5 stages. Today, the sixth stage is brewing in the development of forms of organization of chemistry education. This stage is objectively due to a reduction in the time devoted to the study of chemistry; changes in engineering activities; a change in the content of chemical education. A feature of lectures in teaching chemistry in higher education is the use of multimedia technologies.

The peculiarity of teaching chemistry in higher education at present is a significant reduction in hours devoted to the study of the disciplines of the natural science cycle, which is associated with an increase in the number of hours allocated to independent extracurricular work of students.

The teaching of a chemistry course in higher education institutions is traditionally conducted in the 1st year, when students are not yet adequately prepared for the perception of conceptually complex concepts.

The specificity of teaching chemistry in higher education is also that the center of gravity of teaching shifts from the presentation of material in the finished form of knowledge to the formation of a meaningful perception of the material and the development of a scientific approach to the processes under study for subsequent implementation in special courses in the chosen specialty.

Based on the study of the science of chemistry, it is possible to psychologically prepare students and future specialists for solving practical problems in everyday life and at work.

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