DEVELOPMENT OF PROFESSIONAL COMPETENCE OF STUDENTS - FUTURE TECHNOLOGISTS OF CHEMICAL INDUSTRY

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A great deal of attention is currently being paid to improving the educational process at the university. This is facilitated by the rapid development of new knowledge-intensive technologies, which puts society before the objective need to transfer an increasing amount of knowledge to young specialists. However, there is a contradiction between the complication of the content of vocational education due to the achievements of science and the advanced experience of enterprises and the reduction of training periods. This contradiction can be solved by using modern approaches in training that would provide training to highly qualified technologists.

INTRODUCTION, LITERATURE REVIEW AND DISCUSSION

The analysis of the professional activity of future chemical industry technologists, along with the study of the list of professional competencies in the state standard, made it possible to identify the need to supplement the content of training of Bachelors of Technology with new professional competencies in the national research university.

The introduction of professional chemical-technological competence is justified by the bachelors' lack of ability to determine the optimal conditions for chemical reactions taking into account technological requirements and environmental consequences in the process of studying general chemical disciplines.

At the formation of professional competence methods of experimenting because of their multifunctionality at studying chemical disciplines are of great importance. Chemical experiment performs the most important functions: education, upbringing (moral, spiritual, labor, aesthetic, economic, etc.) and development (including memory, thinking, motives, etc.). The role, content and structure of training of specialists in various fields with the use of laboratory and practical exercises are disclosed in the dissertations of K.E. Sevastyanova, D.D. Iskhakova, G.N. Akhmetzyanova, B.N. Mukhametova. Many teachers, including K.Ya. Parmenov, V.N.Verkhovsky, A.D.Smirnov, V.P.Garkunov, V.Ya.Vivyursky, M.S.Pak, L.A.Kazantseva, I.Ya.Kuramshin and others were engaged in the organization and conduct of the laboratory experiment in chemical disciplines.

Despite the versatility and breadth of the conducted researches, methods and means which promote actualization of professional orientation of practical occupations at studying of general chemical disciplines in higher education institution remain not revealed. Microscience experiment as a form of organization of laboratory and practical classes, which is based on the combination of theoretical aspects of chemistry with practical tasks of production, reduces the transition from knowledge-based training to practical activities. Besides, trainees can experiment not only in specially organized conditions but also independently. Independent work of students in the form of the solution of a complex of competence-oriented tasks with the application of microscience experiment, including the necessary technological and calculation tasks, presented as a means of education and control in general chemical disciplines,

also contributes to the development of components of professional competence of bachelors of technological profile.

Thus, the following contradictions have been revealed between: the actual needs of modern chemical production in highly qualified specialists and the lagging behind these requirements of the level of mastery of the program in the discipline "General and inorganic chemistry" for bachelors of the technological profile; the need of practicing teachers in scientific and methodological support of the process of formation of professional competencies and the failure to develop pedagogical conditions for their development at the bachelors of the technological profile; the growing volume of the program "General and inorganic chemistry".

Selected contradictions have determined the research problem: what are the pedagogical conditions for the formation of professional chemical-technological competence in the study of the discipline "General and inorganic chemistry".

Formation of the professional chemical-technological competence at the bachelors of technological profile in the process of chemistry study will be more successful if: the necessity of introduction of the professional chemical-technological competence as an educational result of the training program in the discipline "General and inorganic chemistry" is grounded, its structural components, indicators and formation possibilities are defined; pedagogical conditions are realized: application of the complex of methods of problem teaching, based on the competence and possibilities of formation of the professional chemical-technological competence.

The requirements to results of training of the bachelors of the technological directions caused by the introduction in manufacture of modern high technologies, in addition to designated in the state standard are defined

There has been developed and carried out systematization of the components of professional chemical-technological competence, which are to be assimilated by bachelors of technological direction in the study of general chemical disciplines; to determine the indicators and levels of formation of professional chemical-technological competence of future chemical industry technologists.

To reveal and experimentally grounded a set of pedagogical conditions providing efficiency of the formation of the professional chemical-technological competence of students. The system of control over the formation of the professional chemical-technological competence of bachelors and test it in the conditions of practical training in chemistry has been developed.

Ideas and theories are used as a theoretical and methodological basis for the research:
The substantiation of the use of the competence approach in modern pedagogical science can be found in the works of V.I.Baidenko, B.A.Bolotov, V.V.Serikov, E.F.Zeyer, E.E.Simanyuk, B.D.Elkonina, I.A.Zimney, A.M.Novikov, K.V.Serikov. G.Mitrofanov, Yu.G.Tatur, A.B.Khutorskiy, etc.; models and methods of competence formation at students - future specialists of various fields of industry are stated in O.F.Zeera's dissertation researches. V.Varnikova, O.V.Shemet, L.L.Nikitina, G.A.Matveeva, O.E.Gavrilova, D.I.Fahertdinova, etc.; the problem teaching of M.I.Mahmutov, I.Y.Lerner, T.V.Kudryavtsev, L.A.Kazantseva, I.Y.Kuramshin, etc.; the implementation of the competence approach in teaching chemical disciplines is considered in the works of M.I.Kuramshin. M.Shalashova, N.A.Zagranichnaya, C.A.Gerus, O.V.Shemet, V.N.Kochurova, D.F.Khaibrahmanova, E.A.Irtuganova, O.Yu.

B.Vorozhtsova, I.A.Zimney, E.V.Bondarevskaya, V.V.Serikov, A.A.Pligin, Yu.K.Babansky, V.S.Lednev, I.Ya.Lerner, M.N.Skatkin, G.I.Shchukina and others. The training of chemistry based on the activity approach was considered in detail by O.S.Zaitsev, V.V.Sorokin, and also in the works of L.I.Bozhovich, V.S.Ilyina, N.M.Tarasova, M.S.Pak, N.M.Tarasova, etc.; the evaluation of the levels of competence formation is presented in the scientific, pedagogical research of E.G.Bulatova, M.M.Shalashova, G.R.Garafutdinova, etc. The evaluation of the level of competence formation is presented in the scientific, pedagogical research.

The research consists of the following:
1. The professional chemical-technological competence, which means the ability and willingness of the bachelor to use knowledge about the types of chemical reactions, their energy and kinetic parameters to solve production problems, to possess the skills to choose the optimal conditions of the chemical process, taking into account technological requirements and environmental consequences of its implementation, has been introduced and disclosed, 2. Pedagogical conditions of effective formation of professional chemical-technological competence of bachelors in the process of general chemical training have been substantiated, which include methods of problem training ("heuristic research" of programmed actions with professionally-oriented content based on the provisions of competence and activity approaches that contribute to the formation of professional chemical-technological competence of bachelors and the formation of personal and professional qualities.
2. The pedagogical conditions for the effective formation of professional chemical and technological competence of bachelors in the process of general chemical training, which include: methods of problem training (heuristic, research, programmed actions) with vocational-oriented content, based on the provisions of competent and active approaches, which contribute to the formation of professional chemical and technological competence of bachelors and the formation of personal and professional qualities of the future chemist-technologist, reflecting the integration of technical knowledge, skills and abilities; the form of organization of laboratory and practical training in the form of a micro-scientific experiment, a distinctive feature of which is the combination of the theoretical foundations of chemical science and the laws of chemical reactions with practical production tasks; diagnostics of the formation of professional chemical and technological competence in the process of training, carried out by solving competently oriented tasks aimed at developing components of professional competence of students-technologists.
3. A structural matrix was developed and tested, built taking into account the relationship of the theoretical aspects of the course "General and Inorganic Chemistry" with other related disciplines, as well as with specific branches of chemical production, based on which a complex of competent-oriented tasks was created using a micro-scientific experiment as a means of training and control in general chemical disciplines, including the necessary technological and calculation operations.

The theoretical importance of the study is that the theory and methodology of professional education are enriched by introduction and disclosure of the essence of the concept of "professional chemical-technological competence", its structural components (knowledge, activity and motivation) and definition of the levels of its formation; substantiation of the process of formation of professional chemical-technological competence using a structural matrix, which includes the content, indicators and criteria for evaluation of a certain level of learning.

The results of the research can serve as a theoretical basis for solving the problem of the formation of professional competences of future chemical industry specialists in the process of professionally oriented educational activity.

The practical significance is that the presented structure and content of the general chemical training of bachelors allows students to study in this field at a level that meets the requirements of modern knowledge-intensive production with constantly changing information support; developed a teaching and methodological complex of the discipline "General and Inorganic Chemistry," as well as methodological guidelines for laboratory and practical exercises (in the form of laboratory workshops) recommended for students of technological specialties; a set of competency-oriented tasks has been developed; it is possible to transfer the proposed theoretical provisions and methodological recommendations to other related or related fields of training of graduates and other universities.

The validity and reliability of scientific provisions, results and conclusions obtained during the study are ensured by initial methodological positions; reliance on fundamental pedagogical concepts; using a set of empirical and theoretical methods corresponding to the set goals, objectives, research subject; direct participation of the author in experimental work; observance of norms, rules and requirements for pedagogical research; the results of experimental work that confirmed the study hypothesis.

The formulated professional chemical and technological competence for bachelors of the technological profile is aimed at the formation of the ability to determine the optimal conditions for chemical reactions, which is an element of the future professional activity of a chemist-technologist. Professional chemical and technological competence includes components: knowledge, activity and motivational, assessed through appropriate indicators (control of academic performance, pedagogical testing, control of the level of assimilation of educational information in the form of a complex of competently oriented tasks) and levels of formation (threshold and increased), which allows you to correct the educational process at various stages of it.

The formation of professional chemical and technological competence of bachelors is carried out with the implementation of a set of pedagogical conditions: the use of problematic methods based on competent and operational approaches, with elements of vocational-oriented content; the use of a micro-science experiment in laboratory chemistry classes, orienting the student to future professional activities; solving competency-oriented tasks of interdisciplinary nature, in which it is necessary to use small-format equipment that performs the function of training and control in general chemical disciplines; aimed at developing the professional qualities of the future technologist.

Diagnosis of the formation of components of professional chemical and technological competence, based on the introduction of a structural matrix that reflects compliance of indicators and criteria with the levels of learning information, which implements the principle of inter-object relations and is used to create a set of multifunctional competency-oriented tasks, allows students to determine the level of formation of professional chemical and technological competence.

1. The analysis of the standard showed that the requirements for bachelors of technological direction in the field of studying the discipline "General and Inorganic Chemistry" are not limited only to the indicated set of general cultural and professional

competencies. We have determined that the holistic structure of general professional chemical training of bachelors needs to be adjusted and supplemented.

To characterize the system of requirements for knowledge acquired in the process of studying at a university, we developed a professional program in the form of a matrix based on the results of comparing categories: to have an idea, to know, to be able, to have skills to achieve the indicated corresponding goal: the topics of the course "ONX."

We have developed a scheme of inter-object and inter-cycle bonds of the course "General and inorganic chemistry." The scheme reflects and describes in detail the topics of the studied discipline, which have structural and semantic relations both with the combined cycles of disciplines and with specific subsections of the subject components of each cycle.

The system of inter-object and inter-cycle relations of the course "General and Inorganic Chemistry" determined the meaningful aspect of the developed structural-semantic model of basic general chemical training for technological students. The latter includes dividing the course "General and Inorganic Chemistry" into modules, each of which, in turn, consists of several narrower topics.

After a detailed study of the list of competencies defined in the standards in the area of "Chemical Technology," we formulated professional chemical and technological competence as an option for filling the corresponding standard within the framework of the capabilities of a technological university. A passport and a program for the formation of professional chemical and technological competence at bachelor's in the field of training "Chemical Technology" have also been developed.

A professional chemical-technological competence has been introduced and disclosed, which means the ability and readiness of a bachelor to use knowledge about the types of chemical reactions, their energy and kinetic parameters to solve production problems, to possess skills in choosing optimal conditions for the chemical process, taking into account technological requirements and environmental consequences of its implementation.

The pedagogical conditions for the effective formation of professional competencies among technological students in the study of general chemical disciplines are defined: the use of problem learning methods based on competent and active approaches with elements of vocational-oriented content for the formation of professional chemical-technological competence; the use of a micro-scientific experiment in laboratory chemistry classes that orient the student to future professional activities; solution of competently oriented tasks of interdisciplinary nature, in which it is necessary to use small-format equipment, performing the function of training and control in general chemical disciplines.

We evaluated the knowledge component of professional chemical and technological competence according to the level of academic performance and educational success in the assimilation of the general chemical disciplines "General and Inorganic Chemistry" and "Chemistry," in which the final semester control is set off and examination tests.

The level of formation of the activity component of the updated professional competence was diagnosed when performing laboratory-practical classes in general chemical disciplines using a micro-scientific experiment, as well as when solving competent-oriented tasks directly related to the use of small-format chemical equipment. A structural matrix was developed that

reflects the compliance of indicators and criteria with the levels of assimilation of educational information, implementing the principle of inter-object relations in the study of chemistry by bachelor of the technological profile, based on which a complex of competently oriented tasks was created.

The implementation of the developed pedagogical conditions for the formation of professional competencies has made it possible to increase the level of development of the following professional qualities of future workers in the chemical industry: activity, organization and the ability to make a balanced decision; the ability to solve the tasks, the ability to independently, clearly and competently pose questions that should be answered by solving technological problems; the ability to choose the optimal conditions for the chemical process and logically explain all comparisons; technical thinking skills.

In the course of the study, an analysis of the specifics of the training of students-technologists in the field of general chemical disciplines was carried out, which allows us to determine the theoretical prerequisites for the formation of professional competence among students - future technologists of the chemical industry: modern problems related to insufficient classroom time, low level of material and technical support of the laboratory workshop were identified; the conditionality of training future technologists in modern chemical technologies with production requirements has been proved; defined requirements for future employees of the chemical industry (personal and professional qualities of the future chemist-technologist, a list of competencies characterizing the degree of personal development and reflecting the integration of technical knowledge, skills and abilities, motivation for professional improvement)depending on the needs of the regional labour market, taking into account the problems of environmental management, as well as industrial ecology, an analysis of the existing methods of teaching chemistry at various educational levels was carried out, which necessitated the formation of professional competencies.

It is determined that chemical training in different countries differs in the list of disciplines included in it, in the sequence of their implementation, in the academic time allotted for their study, and depends on the profile of the university. Foreign states, carrying out reforms in the system of higher professional education, strive to bring the fundamental theoretical knowledge of students closer to their future work activities by profiling secondary school and strengthening the professional orientation of laboratory and practical classes at the university. The single direction in the formation of the structure and content of the chemical cycle is to increase the share of laboratory exercises, as well as to improve the methods and means of conducting them, to form professional competencies.

A scheme has been developed based on comparing the requirements for the professional activities of a chemical technologist with a list of professional competencies indicated in the standards, which allows you to distinguish the content of the formed professional chemical-technological competence.

A professional program has been developed that characterizes the system of requirements for knowledge acquired in the process of studying at a university, presented in the form of a matrix based on the results of comparing categories: to have an idea, to know, to be able to have skills, with means of achieving the indicated corresponding goal: topics of a general chemistry course

A structural-semantic model of basic general chemical training for students-technologists, a scheme of inter-subject and inter-cycle relations of the general chemistry course was developed,

which allows you to orient the content of the discipline in the direction of forming general professional chemical competence of bachelors.

In the course of our research, professional chemical and technological competence was introduced and disclosed, which refers to the ability and willingness of a bachelor's degree to use knowledge of the types of chemical reactions, their energy and kinetic parameters for solving production problems, to possess skills for choosing optimal conditions of the chemical process taking into account technological requirements and environmental consequences of its implementation formed by the main educational program of the university, aimed at updating knowledge in the study of the discipline "General and inorganic chemistry."

Following the approach adopted in the standard, the constituent structures of professional chemical and technological competence are identified: know, be able to own. Levels (threshold and increased) of the formation of professional chemical-technological competence in bachelors of technological direction in the process of general chemical training are indicated and disclosed.

The necessary content of education to ensure the formation of university students is presented in the form of the basic knowledge structure required by the student to form a professional chemical and technological competence.

The pedagogical conditions for the effective formation of professional chemical and technological competence in bachelors of technological profile in the study of general chemical disciplines determined: methods of problem training (heuristic, research, method of programmed actions) with elements of vocational-oriented content, based on the provisions of competent and active approaches, which contribute to the formation of professional chemical-technological competence of bachelors and the formation of personal and professional qualities of the future chemist-technologist, reflecting the integration of technical knowledge, skills and abilities; the form of organization of laboratory-practical classes in the form of a micro-scientific experiment, which is based on the combination of theoretical aspects of chemistry with practical tasks diagnosis of the formation of professional chemical and technological competence in the process of training by solving competently oriented tasks aimed at developing components of professional competence of student technologists.

Within the framework of the formation of each level (threshold and increased), component qualitative indicators of the formation of professional chemical and technological competence were developed and the necessary and sufficient means and methods of assessment were presented. Control of academic performance in the discipline, which includes incoming control, frontier control, current and final types of control, dynamics of the quality coefficient of training in general chemical disciplines, serve as a means of assessing the level of formation of the knowledge component of professional chemical and technological competence. The activity component was evaluated by diagnosing the degree of assimilation of training information using a system of competent-oriented training tasks, based on the results of laboratory-practical work performance and protection using a micro-scientific experiment. The level of formation of the motivational component of professional chemical and technological competence can be assessed by a questionnaire, as well as by a system of pedagogical tests (determining the prevailing style of thinking, the level of development of generalization operations, the level of development of technical thinking, the level of self-esteem and introspection of activities).

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