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**CREATIVE INTEGRATION OF THEORY AND PRACTICE IN
CHEMISTRY TEACHER EDUCATION**

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Abstract

At the present stage of the development of education, it is often seen the inability of young teachers of natural sciences to show mobility and creatively apply theoretical university knowledge in school practice. The aim of the research is to work out the pedagogical conditions the creative integration of theory and practice in the system of university training of a new type of chemistry teacher. The leading approach of the study is an integrative approach. It performs a system-forming function between theory and practice in chemical and pedagogical education, provides selection of content and forms, methods and technologies of instruction in accordance with the goals and objectives of university pedagogical education. The paper presents the concept of practice-oriented learning in application to chemical and pedagogical education. Its essence is determined by the construction of the learning process on the basis of the unity of the emotional-figurative and logical components of content with the aim of acquiring new practice-oriented knowledge, skills and competencies. The emphasis was on the presence of a practice-oriented educational environment. The pedagogical conditions for the creative integration of theory and practice in the system of university training of a new type of chemistry teacher have been revealed and theoretically substantiated. This is the elaboration of practice-oriented courses of methodical disciplines; the development of electronic educational resources for teaching methods of solving tasks of various levels of complexity; continuous interaction of students with the school environment; publication of practice-oriented teaching aids.

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1. Introduction

The increase of the theoretical level of the educational natural science disciplines content has led to aggravation of the contradictions between the general goals of education and the real capabilities of future teachers to solve applied problems. At the present stage of the development of education, when students are becoming more interested in applied engineering research (Gilmanshin, Kashapov, Gilmanshina, & Galeeva, 2016) and natural science disciplines, it is often seen the inability of young teachers of natural sciences to show mobility and creatively apply theoretical university knowledge in school practice. Practical-oriented education in the system of university preparation of new type teacher of natural science disciplines is has been a serious issue (Gilmanshina, Sagitova, & Gilmanshin, 2016). In connection with this, it is required to clarify the concept of practice-oriented teaching of chemistry and pedagogical conditions for the creative integration of theory and practice in the system of university training a new type of chemistry teacher.

2. Problem Statement

As a result of the analysis of various methods and techniques of explanation in chemistry (Gilmanshin & Gilmanshina, 2017), it is revealed that teaching the application of integrated knowledge in practice contributes to the formation of a creative, competitive person. A special place here is to identify the methodological features of the integration of theory and practice in the teaching of chemistry (Gilmanshina & Khalikova, 2016). There are various concepts and approaches to the integration of theory and practice in the system of teacher training (Valeeva & Gafurov, 2017), modern pedagogical technologies of teaching at the university - project and practice-oriented training in engineering disciplines (Gilmanshina & Gilmanshin, 2015) and others.

However, for practice-oriented teaching of chemistry of future teachers of a new type with the use of modern information technologies, such developments are clearly not enough. In addition, according to the literary empirical data of psychologists (Konogorskaya, 2015; Korobkova, 2015), there are gender differences in spatial thinking in favor of men due to the peculiarities of combinations of verbal and spatial components of thinking. Many scientists believe that the difference begins with adolescence and increases with the age, which requires the consideration of the individual characteristics of students in the integration of theory and practice in chemical and pedagogical education.

However, there is no doubt that in the process of developing the pedagogical conditions for the creative integration of theory and practice in the system of university training of a new type of chemistry teacher, it is necessary to rely on the view taken in science on the activities of the teacher (Zimnyaya, 1997) and the professional development of personality (Klimov, 2004; Gilmanshin & Gilmanshina, 2016).

3. Research Questions

What are the pedagogical conditions for the creative integration of theory and practice in the system of university training of a new type of chemistry teacher.

4. Purpose of the Study

To work out the pedagogical conditions the creative integration of theory and practice in the system of university training of a new type of chemistry teacher.

5. Research Methods

The leading approach of the research is the integrative approach and, in combination with it, the activity approach.

The integrative approach fulfills the system-forming function between theory and practice in chemical and pedagogical education, provides selection of content and forms, methods and technologies of instruction in accordance with the goals and objectives of both the general education school and the university pedagogical education. Within the approach implement the correspondence of the content of chemical and pedagogical preparation with its objectives, as well as principles of practice orientation, continuity and succession.

The activity approach proves the uselessness of the expertise, knowledge and skills that are not realized in the productive activity. The basic position of the activity approach is due to the fact that a man's psychological abilities are the result of the transformation of external objective activity into internal mental activity through successive changes. The development of personality is determined, first of all, by the nature of the organization of their educational and extracurricular activities. The activity approach is well combined with modern educational technologies, such as information and communication technologies, project activities and problem-based learning.

6. Findings

6.1. The concept of practice-oriented teaching of chemistry of gifted youth.

In Kazan Federal University, an innovative distributed model of training subject teachers of new type in profile institutes is being implemented. Teachers of chemistry, respectively, are trained at the Alexander Butlerov Institute of Chemistry. More in detail (Gilmanshina, Sagitova, Gilmanshin, & Kamaleeva, 2017). Whereby, the methodical preparation of students for work in the school is considered as an integral part of the general pedagogical preparation of the future teacher of a new type, since in the process of teaching chemistry, schoolchildren are provided not only for comprehensive development, but also for the creative qualities of the individual. Accordingly, the issue of practical orientation of the education of future teachers of chemistry as a natural science discipline is acute.

As the university prepares future teachers for work in the school, we will consider in more detail the concept of practice-oriented teaching of chemistry of gifted youth in the IT Lyceum of the Kazan Federal University. It is based on four theses: "acceleration, deepening, enrichment, problematisation" (Khalikova & Gilmanshina, 2017).

The first thesis of the concept - "acceleration" allows to take into account the needs and opportunities of the lyceum students, distinguished by the accelerated rate of development. A tutor teaches them on the subject. He accompanies the education of the lyceum student, helps to highlight his characteristics and develop an individual trajectory of learning. Subsequently, he tracks the results of the student's activity, creates a data bank. In addition, the tutor participates in the development of an innovative educational

program. The program includes the following components: goals, thematic planning, substantive (Olympiad) component of the program, use of innovative pedagogical technologies in the learning process. The developed subject (profile) individual trajectory of the student development presupposes monitoring of his development taking into account his individuality.

Realization of the second thesis "deepening" implies a more in-depth study of topics or different fields of knowledge, taking into account the interests (profile) of the student. The deepening of the material is achieved by working in small groups, where dialogue is the basis of activity. Dialogue serves as a means of identifying the problem and the ways to solve it. At this stage, a full cycle of research activities is carried out - from the allocation of the study and research problem and obtaining the necessary in-depth subject knowledge to its applied solution.

The third thesis of the concept - "enrichment" - requires the use of innovative pedagogical technologies. The study of many topics takes place in accordance with the principle of integrating the profile subject with other subjects of the natural and humanitarian cycle. For example, integrated lessons of chemistry and English are conducted.

The implementation of the fourth thesis of "problematization" actualizes the development of the personality of the student by searching for new meanings, alternative interpretations, and the development of reflection. The lyceum must be aware of the importance of the problem of professional and social self-determination of young people in the context of the continuity of secondary and higher education. He should be informed that for the implementation of the innovative individual educational trajectory for him all conditions are created.

An important factor in the implementation of the developed concept is the availability of a practice-oriented educational environment. Practice-oriented environment, in our opinion, influences the formation, realization, disclosure, self-improvement of gifted youth. In general, the practice-oriented education is aimed at acquiring practical experience in order to achieve professionally and socially significant competencies. This ensures the motivation and involvement of students in the study of theoretical material for the successful solution of the practical problem.

In general education, the experience of activity implies a greater degree of experience in teaching and cognitive activity in lessons. The acquisition of experience is carried out within the framework of the traditional didactic triad of "knowledge - ability - skills" by developing practical skills in students. In practice-oriented learning, this triad is supplemented by a new didactic structure: "knowledge - ability - skills - experience".

Undoubtedly, the knowledge acquired by young people in chemistry is characterized by the so-called "situational dependence". Otherwise, the knowledge of students does not belong to them, but to the situation in which they are usually required. In order for knowledge to become own, "subjectivation" is necessary. This means applying knowledge in non-standard situations. In general, the use of knowledge involves teaching students to solve tasks, both in typical and in new non-standard situations. In the conditions of practice-oriented learning, the skills of using new knowledge on the subject are formed to solve tasks of various difficulties in non-standard situations.

Consequently, the essence of the concept of practice-oriented learning is to build an educational process on the basis of the unity of the emotional-figurative and logical components of content in order to acquire new practice-oriented knowledge, skills and competencies. An important point is the formation of

practical experience in using this knowledge to solve specific vital problems. In this case, takes plays the inclusion of subject knowledge in the system of human values, which allows you to freely use them in the process of life.

In general, the developed concept in (Khalikova & Gilmanshina, 2017) is based on the following principles: training in the context of vital problems, professional and applied orientation, interdisciplinary connections that allow implementing the theses "acceleration, deepening, enrichment, and problematisation" in the university teaching process in preparation teachers of chemistry. The implementation of these theses in the concept is seen as the interaction of the teacher with the student as two interlocutors, partners who have the right to make their own decisions. As a result, motivational, synthetic (constructive), innovative stages are always highlighted on the lesson. The presence of these interconnected stages allows satisfying the interests of students and with left-brain thinking (the material presented in the form of schemes, tables, algorithms is preferable), and with right-brain thinking (the form of presentation of the material in the form of images, associations, analogies).

Thus, the developed concept of practice-oriented learning uses logical and figurative thinking, which contributes to the enhancement of the student's personal status. Training becomes motivated, individually oriented. The social function of education is realized, students are provided with applied knowledge and skills. The formation of a practice-oriented educational environment is provided by the developed practical-oriented situational tasks. These tasks begin with the problematic "why". The process of solving such tasks significantly increases the interest of students in natural science disciplines and chemistry, including, they are easily involved in the discussion, the dialogue.

6.2. Elaboration of pedagogical conditions for creative integration of theory and practice in the system of training chemistry teacher of a new type.

The conducted researches made it possible to distinguish four pedagogical conditions for the creative integration of theory and practice in the preparation of chemistry teacher of a new type.

The first condition is the development of practice-oriented courses of methodical disciplines. For this purpose, in the curriculum for the preparation of a new type of teacher in the course "Pedagogical Education, Chemistry" in addition to the traditional disciplines "Theory of Chemistry Teaching" (1 course) and "The Chemistry Technique" (2, 3 courses), new disciplines have been included: "Methods of the solution tasks of the universal state exam in inorganic chemistry" (1 year), "Methods for solving tasks of increased complexity" (1 course), "Methods for solving Olympiad tasks on chemistry" (1 year), "Peculiarities of teaching chemistry in rural schools" (2 year) "The variability of chemistry education" (2nd year), "Methods of solving problems of the universal state exam in Organic Chemistry" (3rd year), "Methods for solving problems of physcolloid chemistry in the school chemistry" (4th year), "Didactics of Chemistry" (4th year). The content of the above disciplines allows students - future teachers to actively use theoretical knowledge in practice in the process of solving computational and experimental tasks, oriented to the school chemistry course.

The second condition is the development of electronic educational resources aimed at teaching methods of solving chemical tasks of various levels of complexity, including the Olympiad level. The essence of it is that the structuring of this type of electronic educational resources is carried out in accordance with the principle of "from simple - to complex».

Further on, we will dwell in more detail on the author's electronic educational resource "Methods for solving problems of chemistry in the school", the work on which has not yet been completed. Structurally, the electronic educational resource (EOR) contains a zero block and five topics focused on an in-depth course of school chemistry (thermochemical calculation technique, chemical equilibrium calculation technique, kinetics and catalysis, electrolyte calculations, colloidal systems). The zero blocks includes metadata, the work program of the discipline supported by the electronic course, a brief summary of the syllabus, methodological instructions for the student and teacher, a list of basic and additional literature, assignments for final control. For each topic presented lecture material, glossary, tasks and exercises for independent work. Specificity of the course is related to the need for practice-oriented training of university students. For this purpose the course contains about 400 tasks of various levels of complexity - basic, advanced and Olympiad levels of complexity. Moreover, the Olympiad tasks are differentiated according to the levels of complexity of the municipal and final stages of the All-Russian Olympiad in chemistry of the past. The correctness of solving the problems of the basic and advanced level of complexity is automatically checked by the system. The decision of the Olympiad problems is checked by the teacher remotely. For each topic presented lecture material, glossary, tasks and exercises for independent work. Specificity of the course is related to the need for practice-oriented training of university students. For this purpose the course contains about 400 tasks of various levels of complexity - basic, advanced and Olympiad levels of complexity. Moreover, the Olympiad tasks are differentiated according to the levels of complexity of the municipal and final stages of the All-Russian Olympiad in chemistry of the past. The correctness of solving the problems of the basic and advanced level of complexity is automatically checked by the system. The decision of the Olympiad problems is checked by the teacher remotely. Moreover, the Olympiad tasks are differentiated according to the levels of complexity of the municipal and final stages of the All-Russian Olympiad in chemistry of the past years. The correctness of solving the problems of the basic and advanced level of complexity is automatically checked by the system. The decision of the Olympiad problems is checked by the teacher remotely. The correctness of solving the tasks of the basic and advanced level of complexity is automatically checked by the system. The solution of the Olympiad tasks is checked by the teacher remotely.

In general, the Department of Chemical Education of Kazan Federal University has been working on the development of electronic educational resources since 2010. At present, 10 authorial electronic educational resources are used in the educational process. Among them are e-courses, in which the integration of theory and practice of instruction takes place. This is the "General Theoretical Basis of Analytical Chemistry. Qualitative Analysis" (winner of the 2013 KFU competition), "Chemistry Practices", "Peculiarities of Teaching Chemistry in a Rural School", "Didactic Games in Teaching Chemistry", "Methods of Teaching and Education", "Methods of Teaching in Chemistry" and others. Electronic courses are placed on the site <https://edu.kpfu.ru/course/index.php?categoryid=369>.

In addition, for the admission committee of the Kazan Federal University, one of the authors of the article (S.I. Gilmanshina) developed an electronic educational resource for the preparation of a single state examination on general and inorganic chemistry (presented at the site of the Admission Commission), and for advanced training courses - an electronic educational resource "Perfection of professional competences of the teacher of chemistry" (course on the site <https://edu.kpfu.ru/course/index.php?categoryid=215>).

It should be noted that other electronic courses for teachers of mathematical and natural science disciplines (mathematics, physics, chemistry, geography, and informatics) are also presented in the system of professional development of subject teachers of the Kazan Federal University.

These e-courses are applied at a remote stage and contain control and measuring materials for the control before full-time education at the relevant courses.

All electronic resources are represented on the site "Distance Education of Kazan Federal University" <https://edu.kpfu.ru>.

It should also be noted that the introduction of e-learning harmoniously fits into the system of individual educational path of students with an emphasis on the integration of theory and practice.

The third condition is the continuous interaction of students-future teachers with the school environment in the course of practices, beginning with the first year. For this purpose, a series of pedagogical practices at schools are provided in the curriculum of the undergraduate: induction training (1 course); psychological and pedagogical (2, 3 courses); practice in obtaining professional skills (3 courses); production (pedagogical) practice (3, 4 courses).

The forms of organization of practices are different. The production (pedagogical) practice at the 3rd and 4th courses is held in concentrated form. During this period, students - future teachers are constantly at schools, conduct lessons on the subject and educational work with students, organize extra-hour activities for them, and participate in parental meetings. The rest of the practice is induction training at the first course, psycho-pedagogical at the 2nd and 3rd courses, as well as the practice of obtaining professional skills in the 3rd course are distributed. In the course of distributed practices, students attend school in their free time at the university. All forms of practice presuppose the keeping of a diary of the trainee and written reports. Written reports include the following: extended syllabus of five lessons in chemistry (process-mappings of the lessons); syllabus of extracurricular activities; analysis of lessons learned and self-analysis of all practices; tables of lessons attended and conducted independently, a video fragment of one lesson lasting 20 minutes; protocol of parent meeting; photo materials of lessons and extracurricular activities; practice diary; the feedback of the school teacher and director. In addition, the trainee students present the results of the psychological and pedagogical analysis of each student and class as a whole.

Before the beginning of the practice, an orientation conference is held, after the end of the practice - reporting conference with the invitation of university teachers, leading chemical-methodological and psychological-pedagogical blocks of disciplines.

The fourth condition is the publication of practical-oriented teaching aids based on the integration of the theory and practice of chemical education. For example, the textbooks published in the Department of Chemical Education of the Kazan Federal University are the tutorials that are winners of several grants: "Fundamentals of Analytical Chemistry" (theoretical material is integrated with its practical application in solving design and experimental tasks); "Methodology for solving the tasks of the universal state exam on general and inorganic chemistry" (the theoretical material is integrated with the methodology for solving computational and test tasks of various complexity levels).

Consider in more detail the specifics of the content of the noted manual in the studied key of the integration of theory and practice.

The main difference between these aids and others is connected with the decision of the task of active assimilation by the students of the studied teaching material through the creative integration of theory

and practice, developing the ability to think independently, relying on scientific chemical theories in solving chemical problems. For this each lecture is accompanied by a plan of presentation, methodical instructions, the organization of cognitive activity of students, the allocation of a comprehensive didactic purpose, as well as a list of recommended educational literature. In these aids, there are many special tasks for the training (typical tasks) and cognitive (creative tasks).

7. Conclusion

The pedagogical conditions for the creative integration of theory and practice in the system of university training of a new type of chemistry teacher have been revealed and theoretically substantiated. This development of practice-oriented courses of methodical disciplines; the development of electronic educational resources for teaching methods of solving tasks of various levels of complexity; continuous interaction of students with the school environment; publication of practice-oriented teaching aids.

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