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Methodological fundamentals of humanization of chemistry teaching in teachers' training universities

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Abstract- The research is aimed at scientific substantiation of such methods for teaching the chemical disciplines that ensure the chemistry knowledge and skills and they will favor the formation of professional competences of the future chemistry teacher, his/her proactive approach to life.

As the theoretical basis, the humanization methodology, namely, humanitarian, competency-based and environmental approaches, is used. By a comparison and grouping method, the research analyzed a series of essays made by 324 students of from 17-20 years.
It was detected that among the students, during teaching of whom, the methods, which are based on the humanization methodology, were used, 90.63% reached a "sufficient" level, showing the results in mastering the content as well as in application of the received knowledge to the chemistry teacher profession, in a value-based attitude to the received education, the professional self-development, while in the control group only 40.76 % reached the same results.
The chemistry teaching humanization is considered through the priority of humanistic values in organizing the teaching and implementing the methods turned to the student personality. The authors described four groups of the chemistry teaching methods, which are based on the humanization methodology: methods for creating a positive motivation, methods for organizing the interactive educational cognitive and practical activities of the student, reflective-estimating methods, methods for developing the personal educational environment of the teaching.

Keywords: humanization of education, humanitarization of teaching, chemistry teaching, education technologies, interactive teaching.

I. INTRODUCTION

In teaching chemistry to the students including the future chemistry teachers, in the main, the subject knowledge and skills are formed, the primary focus is on the content: composition, structure and properties of the matter, the basic notions, theories and laws of chemistry. But when the education is oriented, on the whole, to the achievement of the universal and professional competences, training of the graduating student as a responsible and active personality, the university teachers face a question: how to ensure their formation through the chemistry subject?
The humanization of education, which is understood as the teaching process orientation "to development and self-development of the personality, to the priorities of the universal human values, to the optimization of interaction of the personality and the society" (Vishnyakova, 1999) is a global tendency since the end of the XX century, spreading to all the education levels.
In a more narrow sense, the humanization of education is creation of the conditions of educational interaction between the educational processes subjects, which imply the fullest development of the personality. Humanization is amending the used educational technologies. Knowledge about the inter-subject interactive communications and implementation of this knowledge at the academic studies are the priorities for the teachers. The personal attitudes play an important role in establishing the trust relations between the educational process participants (Rogers, 1983).
The humanization of education includes the following methodological aspects 1) humanization of teaching; б) creation of the humanitarian educational environment in the educational institutions; 3) fundamentalizationof education (Basharimov, 2015).
Special emphasis is laid on the humanization of the teaching education (Yanhui Li, 2009), since the teaching education ensures the translation of the knowledge as well as the humanistic values, the respect for the personality. The chemical-teaching education humanization strategy is implemented through humanizing each academic discipline including chemistry (Osmanov, 2013; Rogovaya, 2019; Beisekova, 2018).

Fundamental provisions of the professional pedagogics, research of the process of the education humanization, research of the chemistry teaching methods at a level of the higher education are forming the theoretical basis of studying the methodological fundamentals of humanization of the chemistry teaching in the teachers' training universities (Berulava, 2016; Yanhui Li, 2009; Babanskiy, 1992; Bashirova, 2003; Bespalko, 1989; Gershunskiy, 1997; Sjöström, 2014).

Research hypothesis. The teaching of the chemical disciplines to the teaching baccalaureate students will favor the training of the future chemistry teacher as a professionally competent active creative personality realizing a responsibility for his/her own activities, if the activities are based on the chemistry teaching humanization methodology.

II. MATERIALS AND METHODS

The chemistry teaching humanization methodology is based on the following methodological approaches: humanitarian, competency-based and environmental approaches.

The humanitarian approach to the chemistry teaching is related to various interpretations of the notion "humanitarization of teaching": from identification with the "humanization of education" to representation of the humanitarization as a means of the humanization. Many researchers agree with each other that the humanization covers the whole education system including the issues of its organization, while the humanitarization has to do only with the teaching process (Kasyan 1998; Maruseva, 2008). Relying on the methodological substantiveness of these notions, the author (Elkanova, 2017) proposes introducing a new term "all-humanitarian basis of education".

Initially, the humanization of teaching was considered only as a characteristic of the content. In this view, the chemistry teaching content humanitarization is associated with the introduction of:

- historical-chemical material: biographies of scientists (Lavoisier, Pristley, Kekulé), information about the history of discovering the chemical elements (nitrogen, oxygen and others), discovering the laws (law of multiple proportions, periodic law), creating the theories (theory of the organic matters structure);
- ecological material: the matters influence upon the environment, including the chemophobia prevention;
- Literary material: analysis of the chemical content in the literary works (Arthur Conan Doyle "The Hound of the Baskervilles": Jules Verne "The Mysterious Island") and the sayings ("Speech is silver, silence is golden");
- art study material: a role of chemistry in creating the works of world art (paints on the basis of the inorganic pigments, smalts for the mosaic, metals in the sculpture, photosensitive materials (Greenberg & Patterson, 2008);
- philological material: etymology of names of the matters, chemical elements ("aqua regia", "formic spirit").

In addition, the chemistry teaching humanitarization is not so much the content enlargement through a variable component, as a full-fledged integration of the chemical and the non-chemical in order to cover a role of the chemical knowledge in the daily life, the scientific achievements, the production progress, in culture and art. The authors attribute the chemistry teaching content change, while introducing the humanitarian content, to the primary humanitarization function.

The teaching content change inevitable entails the change in the methods, means, technologies of the teaching (the secondary humanitarization function). In the modern education, virtually all teaching technologies are humanitarian, since they are aimed at the personal educational results. In the chemistry teaching methods in the teachers' training universities, the humanitarian educational technologies were also substantiated, developed and used (Beisekova, 2018).

The competency-based approach in the chemistry teaching humanization is driven by the fact that the educational programs are oriented to the graduating student competence formation. The chemistry teacher competence is understood as an integral characteristic of the personality expressed in his/her ability, on the basis of the received knowledge, skills, values, to carry out the professional activities with account taken of the student's demands and interests. The humanitarity of the competence-oriented technologies of the chemistry teaching is determined by a versatility of the teaching influence at an individual-personal level, or their interactivity. At present, the teachers consider as interactive the teaching built on the student's interaction with the academic surroundings, the educational environment that serves as a field of the experience gained (Klarin, 2000).

The environmental approach to the chemistry teaching in the teachers' training university is closely related to the notion "educational environment". The humanitarian orientation of the educational environment is implemented "through including the knowledge, which is of importance to a person, and using the comfortable teaching technologies that are accepted by the students" (Kozyrev, 2004). In many respects, this is related to developing the information-educational interactive teaching environments (Moore, 2016; Gavronskaya, 2012;).

This way, the teaching humanization methodology is setting a benchmark for the use of the interactive teaching technology based on the active productive interaction of a student with the humanitarian educational environment of the chemistry teaching. The chemistry interactive teaching includes the stimulating the various kinds of feedback, the group work, teaching through play (Shaver, 2010).In a technology of the chemical disciplines interactive teaching, the authors consider four groups of methods that are correlated with the stages and phases of the technological cycle.

The methods of creating the positive motivation correspond to an orientating-motivational stage. These methods are the building of the professional prospects system, the emotional stimulation, the taking into account of personal academic achievements, the creation of psychologically comfortable conditions of teaching. The methods of organizing the interactive educational cognitive and practical activities of the student (discussions, problem-based teaching, solving the problems on the basis of an analysis of specific situations, chemical experiment, projects, academic research) correspond to the operational-performing stage. The reflective-estimating methods (an analysis of the control and self-control results, a diagnostics of the academic difficulties, assessing the significance of the knowledge and skills gained) correspond to the reflective-estimating stage. The methods of developing the personal educational environment of teaching (the attraction of the student's personal experience, the practical orientation, the open planning of teaching, the work with additional sources of information) are of importance at all the stages of the didactic cycle, since they are "responsible" for developing the cycle in vertical direction.

In the methodology of humanizing the chemical disciplines teaching, these methods are acquiring the certain peculiarities consisting in the general orientation to forming the professional competences and the subject-subject strengthened interaction in the vertical and horizontal direction.

In the below-mentioned example, by means of a problem, the student is impelled to independently study the self-oscillating reactions and one of the methods of determining the activation energy — a method of transforming the kinetic curves.

The Problem. In the middle of the last century an extremely interesting class of chemical reactions — self-oscillating reactions – was discovered. Belousov-Zhabotinsky reaction was one of the first reactions, where in the system "malonic acid–$KBrO_3$-KBr-H_2SO_4-$Ce(SO_4)_2$" the periodic changes in coloration, which are driven by the transition of the catalyst Ce^{3+}(yellow)/Ce^{4+}(colorless). Then such a reaction was carried out with other organic acids and catalysts. Study this class of reactions independently, form your own opinion about a possibility of using the material about oscillating reactions in the chemistry teacher work. Determine the activation energy of Belousov-Zhabotinsky reactions, using the table data about the time of oscillation (the reactions were carried out with various initial reagent concentrations).

Acid	Time of five oscillations	
a) Malonic acid	5 minutes 21 second (20°C)	2 minutes 32 seconds (30°C)
b) Citric acid	5 minutes 40 seconds (20°C)	3 minutes 14 seconds (30°C)
c)Tartaric acid	6 minutes 1 seconds (25°C)	2 minutes 22 seconds (35°C)

Solution.

Setting the problems. The available knowledge is not sufficient do describe a mechanism of the self-oscillating reaction. A famous method for calculating the activation energy requires the information about temperature dependence of the velocity constant, in this case, the velocity constants are unknown.

Strategy.To form an idea about the self-oscillating reactions and the prospects of using the information about them in the chemistry teacher profession. To study the possibilities of determining the activation energy, except the methods based on the Arrhenius theory.

Tactics. Search for information 1) about the self-oscillating reactions, 2) about the methods for calculating the activation energy of reactions in the absence of the information about the temperature dependence of the velocity constant; 3) conclusion about the prospects of using the received knowledge in the chemistry teacher work.

Conclusions within the academic discipline"Inorganic chemistry": The self-oscillating reactions are the complex successive reactions including the branched and autocatalytic stages. In the classic case, this is a catalytic oxidation of various restoratives by the bromic acid HBrO3, which occurs in the self-oscillating mode. In addition, there are oscillations of concentrations of the oxidized and restored forms of the catalyst, which have different colors.

A method of transforming the kinetic curves is fit for calculating the activation energy of the complex successive reactions. This method calculation does not require the knowledge of the velocity constants and the process mechanism. The activation energy of the self-oscillating reaction with the malonic acid is as follows:

The work-related conclusion: The self-oscillating reactions can be used in the profile school and in the out-of-school activities. There is a great deal of literature on this topic, which is understandable to the teachers and the schoolchildren, including the video presentations, for example on http://ru.wikipedia.org.
Conclusion about forming the professional competence of the future chemistry teacher: The student can find the information, which is necessary for the professional activities, understands the limits of its use, can assess its significance for the science development and the prospects of its use in the professional teacher activities.
Experimental base. The teaching experiment was carried out in 2017-2018, 2018-2019 and 2019-2020 academic years during teaching the inorganic chemistry to the first-year pedagogics students of 5B011200-Chemistry of Abai Kazakh National Pedagofical University, K. ZhubanovAktobe Regional State University, Korkyt Ata Kyzylorda State University, the Republic of Kazakhstan.The experiment involved 324 students and three university teachers.

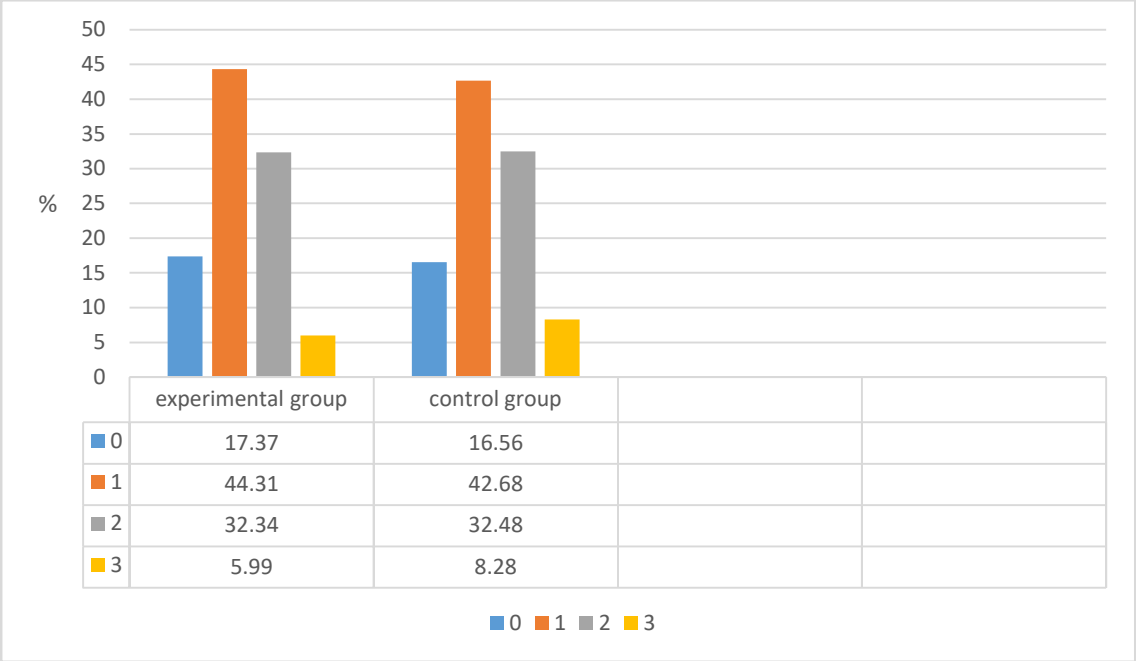
III. RESULTS AND DISCUSSION

For implementing the methodology of humanization of teaching the chemistry to the pedagogics students, the authors used the interactive teaching methods. The results were assessed by maturity of the subject (inorganic chemistry) professional competences that are directly related to the future professional activities of the teachers' training universities students. The maturity of professional competences was determined by the scaling method (Table 1) when assessing the essay.

Table 1. Scale of measuring the professional competences formed in studying the discipline "Inorganic chemistry" by the pedagogics students

Grade	*criterion*
0	He/she does not see a connection of the content of the Inorganic chemistry discipline with professional activities of the chemistry teacher
1	He/she calls the topics or the sections of the basic chemistry course of the secondary school, which are based on the content of the Inorganic chemistry discipline.
2	He/she describes the topics or the sections of the school chemistry course, which are related to the modules of the content of the Inorganic chemistry discipline
3	He/she selects the teaching content for the school chemistry lessons. He/she cites the examples of inorganic matters, their structure and properties, which are understandable to the schoolchildren. He/she selects additional information sources to make the schoolchildren more interested in chemistry.

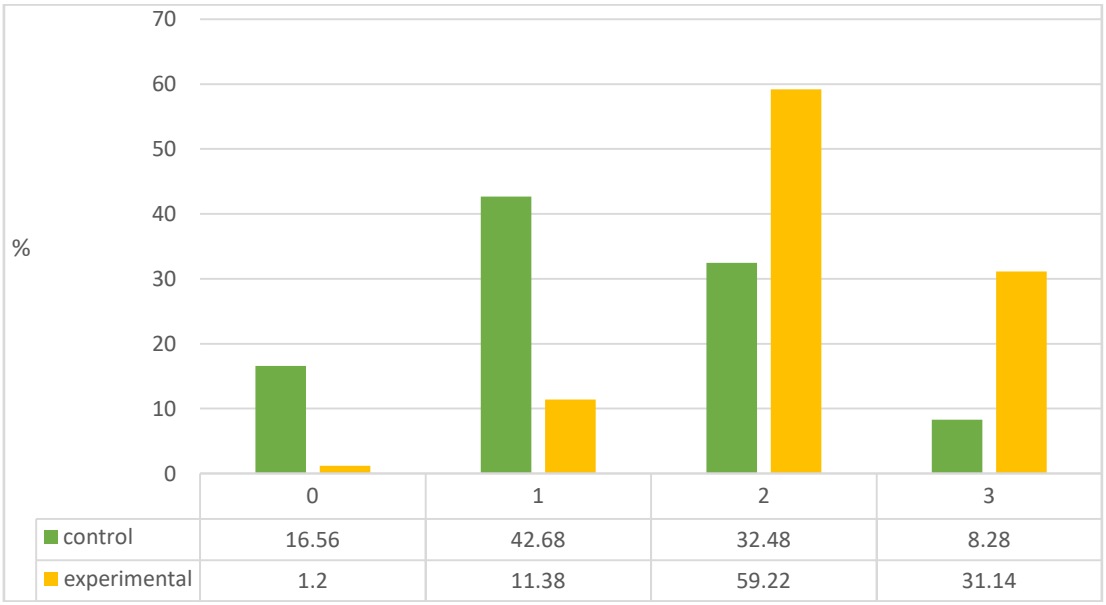
At first, the essay was assessed, which all the students were asked to write before studying the inorganic chemistry ("What do I expect from the Inorganic chemistry course?"). It should be noted that the first year students relied on their recent school experience to a great extent and they wrote that the teacher must have a good command of inorganic chemistry, for example, to answer the student's "difficult" questions. On the whole, the assessment showed that the students could sort out separate connections of the content of the chemistry teaching in the school and the inorganic chemistry teaching in the university at a level 1-2 according to the above-mentioned scale.
The statistical results processing showed the trustworthiness of similarity of the investigated groups by the study years, on the whole in the sample (Figure 1), which made it possible to sort out the students of K. ZhubanovAktobe Regional State University (157 students) into a control group, and to consider the students of Abai Kazakh National Pedagofical University and Korkyt Ata Kyzylorda State University (167 students) to be an experimental group.



	experimental group	control group		
0	17.37	16.56		
1	44.31	42.68		
2	32.34	32.48		
3	5.99	8.28		

Figure 1.Results of assessing the students' work in the control and experimental groups before studying the inorganic chemistry course.

In the experimental group, the inorganic chemistry studies with the first year students were carried out with the use of the interactive teaching technology and the use of the methods for creating the positive motivation, organizing the interactive educational cognitive and practical activities of the students, reflective-estimating methods, the methods of developing the personal educational teaching environment. In the control group the students were taught by traditional methods. The managers of both groups watched the students, talked and interviewed the students and the teachers. After the course finished, the students wrote the essay on the topic of "What gave me, as the future teacher, the inorganic chemistry course". According to the results of ordering the expert assessments of the essays by the scaling methods (Figure 2), it is possible to conclude about a positive influence of the chemistry teaching methods, which are based on the humanization methodology, upon forming the professional competence of the future chemistry teachers.



	0	1	2	3
control	16.56	42.68	32.48	8.28
experimental	1.2	11.38	59.22	31.14

Figure 2. Results of the teaching experiment in the control and experimental groups

The experimental group students took a strong interest in mastering the teaching content as well as in applying the received knowledge and skills to the chemistry teacher profession, their value-based attitudes to the received education and the professional self-development changed. In the analyzed essays

they wrote that they were going to use the received knowledge about chemical matters, laws and theories, as well as a new type of interaction of the students, the teacher and the information in the future professional activities. In Figure 2 this is shown by a shift of the scaling results from positions 1-2 in the control group to positions 2-3 in the experimental group. After accepting, in the ranking, grades 1 and 2 as a "insufficient" level, and grades 3 and 4, as a "sufficient" level, it is possible to conclude that the experimental group has more than twice as many students, who has reached a sufficient level (90.63%) as in the control group (40.76 %).

The statistical processing showed that the trustworthiness of differences of characteristics of the experimental and control groups, according to the statistical Wilcoxon-Mann-Whitney test, is equal to 95%. Apart from that, the trustworthiness of similarity of the control group results, before the experiment and after it, is coinciding with the 0.05 significance level.

IV. CONCLUSIONS

The research detected the methodological foundations of humanization of the chemistry teaching to the pedagogics students. The methodological approaches in question, namely, the humanitarian, competency-based and environmental approaches, made it possible to conclude about the priority of the technology of the interactive teaching of the chemical disciplines to train the future chemistry teacher.

Under the influence of four groups of the teaching methods, which were introduced in the inorganic chemistry course (methods of creating the positive motivation, methods of organizing the interactive educational cognitive and practical activities of the student, reflective-estimating methods, methods of developing the personal educational teaching environment), the first year pedagogics students changed their personal perception of studying the inorganic chemistry from orientation only to the subject content to understanding of its significance in forming their own professional competence.

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