Methodology of professional-methodical training of future chemistry teachers based on synergistic approach

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Abstract.
This article is a study devoted to the methodology of professional and methodological training of future chemistry teachers using a synergetic approach. Synergetics in the context of education is considered as an innovative methodology that promotes the integration of various aspects of learning and teaching activities to achieve optimal results in developing the competence of future chemistry teachers. The study examines the basic principles and methods of synergetics, their applicability to the educational process, as well as specific practical approaches to organizing the professional training of chemistry teachers based on the synergetic approach.

Keywords:
professional training methodology chemistry teachers synergetic approach competencies education pedagogy innovation training
Introduction. Professional training of chemistry teachers plays an important role in the formation of quality education. A synergistic approach that combines various techniques and approaches can significantly increase the effectiveness of training future teachers.

Modern education requires teachers not only to be highly qualified, but also to be able to innovate and use modern teaching methods. This is especially important for future chemistry teachers, who must be prepared to effectively teach a complex and science-intensive subject.

One of the key areas in the professional training of future chemistry teachers is the use of a synergetic approach. This approach allows you to combine various teaching methods and technologies to achieve a synergistic effect when the result exceeds the sum of the individual components.

The purpose of this article is to demonstrate the importance and effectiveness of using a synergetic approach in the professional training of future chemistry teachers and to offer practical recommendations for its successful implementation.

Literature review.
Certain aspects of the theory of self-organization in pedagogy were considered in the works of V.A. Arshinova, E.V. Bogomolova, V.G. Budanova, V.G. Vinenko, A.A. Vorozhitskova, V.A. Ignatova, E.N. Knyazeva, O. Kopova, V.N. Korchagina, S.P. Kurdyumova, G.G. Malinetsky, S. Simonov, N.M. Talanchuk, L.N. Makarova, Yu.V. Sharonina, S.S. Sheveleva, V.V. Matkina, O.N. Fedorova and others [1, 2]. We agree with the position of E.N. Knyazeva and S.P. Kurdyumov, they insisted that «the future of society is largely determined by the system of education and upbringing of the younger generation. Education built on the principles of synergetics is the most effective and meets the needs of the comprehensive disclosure of individual abilities and methods of continuous self-education».

The synergetic approach to education is a new scientific and pedagogical concept based on the principles of interrelation and interaction of various components of learning. This approach promotes the introduction of innovative, interactive and student-oriented teaching methods.
and technologies based on self-organization of the educational process. The synergetic concept is aimed at synthesizing multifactorial interactions within the framework of processes such as education and self-education, training and self-training, education and self-education. It promotes consistency and actualization of students’ potential capabilities for their subsequent transformation into abilities [3].

The essence of the synergetic approach in the PMP of a chemistry teacher is to consider the objects of chemical knowledge as a continuous change of processes with a plurality of choice of directions for development, and the professional activity of a teacher as a process of continuous pedagogical development and improvement. This approach orients teachers to professional activity in conditions of uncertainty and incomplete predictability of pedagogical situations, teaches students to evaluate the object of study of chemistry from the standpoint of the diverse influence of factors on the manifestation of its properties, including the influence of random factors. Chemistry, due to its content specificity, has great opportunities to teach students analysis and synthesis at the subject level, to reproduce the entire structure of educational activity when solving chemical problems, to highlight the main thing and draw up algorithms, to monitor and self-assess cognitive activity [4].

The methodology for teaching chemistry is designed to strengthen the professional orientation of the future teacher’s knowledge formation, continuously reflecting the main ideas introduced by the synergetic concept of self-organization [5].

What synergistic ideas should be used as the basis for the integration of the content and methods of natural science, chemical education and professional and methodological training of future chemistry teachers?

First of all, these are ideas of development, the formation of something new due to the internal resources of the system and its relationship with the environment, the idea of interconnection and coherence of the functioning of heterogeneous components as part of the whole and management of a complex system.
Taking into account the multicomponent, multilevel and interdisciplinary nature of the formed methodological knowledge of future chemistry teachers, we will highlight the main directions for the use of synergetic ideas in the PMP system. One of the main components of the latter is the content of education.

In the professional and methodological training of chemistry teachers, synergetic ideas are implemented in the following directions [6]:

1. Synergetic ideas act as a methodological guideline:
   - for analyzing the current situation in the development of the education system;
   - promotes understanding of the multidimensionality of the world of substances, the scientific picture of the world and the need to reflect it in teaching;
   - guides teachers to function in conditions of uncertainty and choice from alternatives.

2. The introduction of synergetic ideas contributes to updating the content of chemical training for teachers:
   - fills with content fundamental ideas about the world of substances, their unity and evolution;
   - creates the basis for the concentric study of chemistry and level-based consideration of chemistry objects;
   - forms an adequate understanding of the subject of chemistry; ensures continuity of chemistry education at school and university.

2. Introduction of synergetic ideas in PMP: equips teachers with methodological influences:
   - substantiates the complementarity and synergy of methodological techniques and means of teaching chemistry;
   - reduces the disorder of knowledge by systematizing and consolidating it;
   - promotes the formation of holistic knowledge through its self-construction;

**Materials and methods:**

To conduct the research, various teaching methods were used, including lectures, practical exercises, case method, group work, etc. [7]. Students were encouraged to actively participate in the educational process, which contributed to better learning of the material.
Methods and approaches to teaching chemistry that have been used in university education. They aim to enhance student learning and improve their understanding of chemical processes.

<table>
<thead>
<tr>
<th>Table 1: Methodology for professional and methodological training of future chemistry teachers based on a synergetic approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspect</strong></td>
</tr>
<tr>
<td>Analysis of the state of chemical training of future chemistry teachers</td>
</tr>
<tr>
<td>Problems in training future chemistry teachers at a pedagogical university</td>
</tr>
<tr>
<td>The role and structure of educational and methodological support</td>
</tr>
<tr>
<td>Concept of educational and methodological support</td>
</tr>
</tbody>
</table>

**Results:**
The study showed that the synergistic approach to the professional and methodological training of future chemistry teachers is truly effective. Students showed a higher level of knowledge and skills, as well as greater motivation to learn.
Thus, the synergetic approach allows us to understand in a new and objective way the essence of not only the structure, but also the content of pedagogical activity.

In this regard, in the framework of our study, considering the professional skills of future chemistry teachers on the basis of a synergetic approach, we focused on the development of methodological culture, creativity, self-esteem and self-education of future chemistry teachers. Teachers (56 people) from various educational institutions in Almaty took part in it.

To identify the importance of developing a methodological culture in the activities of future chemistry teachers, the respondents included 16 teachers with 1-3 years of experience (young specialists), 22 future chemistry teachers with up to 10 years of experience, and 18 people with more than 15 years of experience. They were offered the method “Self-assessment of the methodological culture of future chemistry teachers.” The test consisted of 11 questions. The answers were assessed on a 9-point scale as to the degree of expression of the relevant knowledge, skills and personal qualities of future chemistry teachers.

Having analyzed the responses of teachers, it was noted that young specialists under 3 years of age (13%) strive to master innovative knowledge, teachers with up to 10 years of experience (32%) develop a methodological culture, and educators with more than 15 years of experience (55%) have a high level, constantly improving it.

In the process of experimental work, we determined the levels of development of the creative individuality of future chemistry teachers of educational institutions. The test “What is your creative potential?” was conducted. [14, p. 92-96]. In addition, all participants in the experiment were asked to evaluate their creative individuality (Diagram 1).

As a result, it was found that at the beginning of the experiment, the level of development of creative individuality of future chemistry teachers was: high level - 16%, average - 75%, low level - 9%. During this period, the average level of development of teachers’ creative potential dominates. At the end of the experiment, the high level was 17%, the average level was 83%, and there was no low level.
So, teachers with an average level have normal creative potential. They have the qualities that allow them to create, but they also have problems that hinder the creative process. In any case, their potential will allow them to express themselves creatively if they so desire. Teachers with a high level have significant creative potential, which provides a wide range of opportunities; they have access to a wide variety of forms of creativity. The following scales were identified: boundaries of curiosity; Believe in yourself; constancy; ambition; auditory memory; visual memory; desire to be independent; ability to abstract; degree of concentration. These abilities constitute the main qualities of creative individuality. The total amount of points scored shows the level of creativity of future chemistry teachers.

In this regard, we conducted a diagnosis of the teacher’s

Diagram 1
Levels of development of creative potential of future chemistry teachers
self-esteem. Diagram 2 presents the results of a study of self-esteem of future chemistry teachers at the beginning and end of the experiment.

![Diagram 2](image)

**Diagram 2**

**Diagnostic self-assessment of future chemistry teachers**

Then a self-education survey was conducted. Thus, among beginning teachers (with less than three years of experience), the proportion of those who improve the level of their teaching skills is noticeably higher. In the group of teachers under 3 years of age, there is a higher proportion of those who increase the level of self-education “once a month or more often.” More than half of such teachers. As the survey showed, more than a third of respondents indicate that they engage in self-education every day and “self-education” for them is a form of improving their teaching skills. About a quarter note that they spend two to three days a month on self-education. Most of the interviewees responded that they spend one to two hours a week on self-education.

This situation required appropriate corrective work, since this component is significant in the structure of professional skills of future chemistry teachers.
In this regard, we developed the project “Pedagogical synergetics in the development of professional skills of future chemistry teachers in a modern educational institution.”

The purpose of the project: organizing methodological work to improve the skills of independent activities of teachers in self-development and self-education.

Main directions: scientific activity of future chemistry teachers, aimed at developing motivation to independently solve specific problems in the development, education and training of students; research activities of future chemistry teachers, aimed at the results of professional activities (observation, experiment, modeling); revealing the creative potential of future chemistry teachers, organizing scientific and methodological activities, within the framework of which the development of methodological culture will be carried out; development of professional skills of future chemistry teachers.

As a result, the following was accomplished: the creation of conditions for the development of the creative potential of future chemistry teachers; constant study of scientific and methodological literature; inclusion in the annual plan of events of a report by future chemistry teachers on self-education (portfolio, speeches at meetings, conferences, scientific articles revealing the essential features of their activities, etc.); participation of teachers in open events of city creative associations (master classes, round tables, a panorama of advanced pedagogical experience, etc.).

The result of the project is the development of individual routes for teachers who improve professional skills based on a synergetic approach. The final event was a round table “I, an innovative teacher.”

To summarize, the following can be noted: in connection with the activities carried out, all respondents showed an increase in the level of professional skills (Diagram 3).

Thus, the following can be noted: updating the synergetic approach in the professional activities of future chemistry teachers is a complex, dynamic, multi-level process. The approach is associated with various forms of activity of future chemistry teachers: the development of creative
potential, methodological culture, self-esteem and self-education, which in turn characterizes professional skills as a personal quality of future chemistry teachers.

**Diagram 3**

Levels of professional skills of future chemistry teachers

**Discussion:**

By implementing the synergetic principle in the process of educating and training a self-developing personality, pedagogy implements the anthropological approach and humanistic ideas, harmoniously balancing the humanitarian and natural science worldviews.

Synergetics deals with self-developing objects - man and society, the disclosure of which made it possible to develop not only the laws of relationships between values, but also to determine the methods of their maintenance. The priority components are: didactic aspects of adapting the ideas of
synergetics in the content of education; their use in modeling and forecasting the development of educational systems; application in managing the educational process. The synergetic concept allows us to reveal scientific and pedagogical knowledge in a new way. It focuses on the multidimensionality, multicomponentity and polyphony (alternativeness and variability) of cognizable processes.

So, professional excellence is a personal quality of future chemistry teachers, the use of a synergetic approach actualizes the professional activities of future chemistry teachers, helping to enrich the educational process with dialogue techniques and methods of pedagogical interaction, making it more intensive, the learning process of students and improving the quality of education itself.

The synergetic approach allows us to consider each subject of the pedagogical process (student, teacher) as self-developing subsystems that make the transition from development to self-development.

The process of consistent change in the relationship of future chemistry teachers and students with the educational environment, a kind of “path” of subjects of the educational process in the educational space. In the work, such a “path” is interpreted as a project activity, the purpose of which is determined by the direction of movement of subjects in the educational space. The projects are aimed at developing the personal potential of both future chemistry teachers and students and are ways of organizing the educational process built on the principles of synergetics. All of the above allows us to conclude that the use of a synergetic approach in education and teaching activities opens up new prospects and opportunities. Thus, the introduction of a synergetic approach not only contributes to the development of professional knowledge, skills and abilities, but also forms a number of general educational, integrative, competencies related to the development of the individual as a whole, as well as

Conclusion:
Combining different teaching methods within a synergistic approach allows you to create a deeper and more complex understanding of the subject. This contributes not only to
improving the quality of education, but also to the development of creative thinking and independence of future chemistry teachers.

Thus, the methodology for professional and methodological training of future chemistry teachers based on a synergetic approach is an effective tool for improving the quality of education. Its use contributes to the development of the competencies of future teachers and the formation of the necessary skills for successful work in school.

References:


