Modern educational formats: technology of flipped chemistry teaching

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Abstract. The article substantiates the need for the use of modern educational technology of blended learning flipped classroom in school education. The solution to the research problem is based on theoretical, methodological and practical issues that are considered in the research. The authors focus on the achievements of both modern sciences based on the formation of the natural science paradigm and the achievements of modern pedagogy aimed at the formation of natural science thinking. The study of chemistry at school is realized by the methodological potential of competence-based and personality-oriented approaches. The model of teaching chemistry consists of updated content, interactive methods and organizational forms, traditional and distance learning tools and a set of organizational and pedagogical conditions. The obtained results of the pedagogical experiment allow us to assume that the use of the flipped classroom blended learning technology has increased the level of internal motivation of students to study chemistry. This technology allows us to individualize and activate the educational process.

1. Introduction
The modern educational paradigm as a new image of pedagogical science involves the creation of an education system focused on the development of a competent creative personality of a student. In connection with the modernization of the educational system in the Russian Federation (informatization, the introduction of the Federal state educational standards), the use of modern pedagogical technologies aimed at creating an intellectual product with educational potential and contributing to an increase in the level of motivation and effectiveness of teaching chemistry in modern school.

The restructuring of modern education places teachers in the search for new ways and means to optimize the learning process and form natural science thinking [1]. Achieving a high level of development of information and communication competence is carried out in the process of using the flipped classroom blended learning technology in chemistry classes.

The technology allows to most effectively implementing the requirements of the standards of the International Society for Technology in Education and teaches students to understand the specifics of learning in the digital world, think critically and solve educational problems in new ways [2].

2. Problem Statement
Using the flipped classroom blended learning technology in teaching chemistry raises a number of problems of theoretical, methodological and practical content. In particular:
• the lack of a theoretical and methodological justification for the problem of using the flipped classroom blended learning technology in teaching chemistry in school education;
• insufficient attention to the use of modern pedagogical technologies in teaching chemistry;
• the lack of experience in using of the flipped classroom blended learning technology in teaching chemistry in school education.

Consider in detail each of the problem.

2.1 The lack of theoretical and methodological justification for the problem of using the flipped classroom blended learning technology in teaching chemistry in school education

The experience of modernizing Russian school science education convinces us that chemistry is an integral component of a full-fledged natural science training of students in secondary schools. At the same time, the contradictions between the established traditions of the natural science training of schoolchildren and the destruction of the conditions in which the developing potential of natural science education in schools could be manifested still persist. Conceptual justifications for the use of competence-based and personality-oriented approaches in teaching chemistry are not taken into account. The main task of the teacher is to reveal the inner resources of the personality of students and their potential capabilities, the formation of natural-scientific thinking.

2.2 Insufficient attention to the use of modern educational technologies in teaching chemistry

In solving the problems of chemical education, the practice of using modern educational technologies based on competence-based and personality-oriented approaches has not become widespread, which orient teachers towards individualization as one of the main trends in education in the 21st century. This problem leads to the following contradictions:

• between the need to develop the individual and personal qualities of students in the process of studying chemistry at school and the lack of development of the theoretical foundations for the individualization of teaching in the conditions of the classroom system of a general education school;
• between the requirement for the implementation of competence-based and personality-oriented educational approaches, indicated in the Federal State Educational Standard, and the insufficient development of organizational and pedagogical support in the methodology of teaching chemistry for this process.

2.3 The lack of experience in using of the flipped classroom blended learning technology in teaching chemistry in school education

The practice of work at school shows that when using the interactive technology of blended learning flipped classroom, the pedagogical conditions for organizing the process of teaching chemistry are not determined, modern methods, means and organizational forms of teaching chemistry are not actively used.

3. Research questions

The study raised the following questions.

What are the ways of integrating modern technologies for teaching chemistry and the traditional educational system which provide students with the formation of natural scientific thinking and the individual development of personally significant qualities?

What modern methods, means and organizational forms are advisable to use in teaching chemistry?

How does the use of flipped classroom technology affect the quality of teaching chemistry?

4. Purpose of the Study

It is assumed that the answers to the posed research questions will help to achieve the goal and contribute to the development of a methodology for the use of flipped classroom technology in teaching chemistry for teachers.
5. Research Methods

5.1 Analysis of modern literature on the research problem

Modern trends in the development of natural science education imply a revision of approaches to the organization of the educational process and the introduction of new principles of creating the educational process at school [3]. Modern science is focused on the formation of a natural science paradigm, modern pedagogy is aimed at the formation of natural science thinking in students [4].

The study of chemistry at school is carried out in the process of learning a single natural-scientific picture of the world within the framework of a new scientific paradigm and is implemented on the basis of competence-based and personality-oriented approaches in the system of school science education. These approaches provide for the use of interactive forms and methods of teaching in the educational process, the search for new organizational forms and educational technologies. The flipped classroom blended learning technology is an interactive technology. It is believed that this technology represents a new way of thinking, the goal of which is to optimize classroom work with students through extracurricular activities aimed at in-depth study of the subject [5]. A new system of chemical knowledge is acquired in the process of joint activities of the teacher and students through the dialogue. It is necessary to create pedagogical learning conditions under which the interaction between the subjects of the educational process, the exchange of information, the joint modeling of situations, the assessment of one's own behavior and the actions of others, immersion in the real atmosphere of business cooperation in solving a specific educational problem.

5.2 Modeling the process of teaching chemistry based on the technology flipped classroom

The model of teaching chemistry based on the flipped classroom technology consists of the following components: updated content, interactive methods (brainstorming method, method of case-study), organizational forms (lesson-project, lesson-discussion, lesson-business game, lesson-research, web-lesson, web-quest and analytical lesson), means of traditional and distance learning and a complex of organizational and pedagogical conditions.

This technology allows the teacher to provide material for self-study at home and in the classroom, practical consolidation of the previously obtained theoretical material is carried out. Educational material for preliminary study can include podcasts (audio lectures), as well as vodcasts (video files) that the teacher sends to learners by email. Homework includes watching a video lecture or listening to an audio file, reading educational texts, considering explanatory drawings, diagrams, tables, and also passing texts for the initial assimilation of the topic of the lesson. Class work is devoted to the analysis of complex theoretical questions and takes 25-30% of the lesson time and is mainly aimed at performing practical tasks of a creative and research nature.

5.3 Pedagogical experiment

The pedagogical experiment was attended by 46 students of Michurinsk schools (the Tambov region, the Russian Federation).

The effectiveness of using the flipped classroom blended learning technology was assessed on the basis of a diagnostic technique that determines the level of formation of educational and cognitive interest, the level of internal motivation of students' educational activities [6].

We carried out primary testing of students in order to determine the level of development of motivation for educational activities of students in the study of chemistry. We used the methodology for diagnosing the orientation of educational motivation (the author is T.D. Dubovitskaya) which can be used as an indicator of the effectiveness (quality) of the teaching method (technology) used by the teacher.

This diagnostics allowed us to single out groups of students depending on the orientation of the motivation for studying chemistry (with the dominance of external motivation and with the dominance
of internal motivation), made it possible to identify students with different levels of intrinsic motivation and also to qualitatively assess the interest of students in studying the subject.

Analyzing the obtained results, we came to the conclusion that internal motivation to study chemistry was formed in 26 students (56.53%), external - in 20 (43.47%).

The following groups can be distinguished according to the level of internal motivation: the lower level - 15 students (32.6%); the average level - 24 students (52.2%); the higher level - 7 students (15.2%).

The qualitative analysis of the results was assessed according to the following three criteria: the value of knowledge, independence in activities in chemistry lessons, interest in the subject.

The higher indicator of the value of knowledge in chemistry was noted by 12 students (26.1%), the average - by 26 students (56.5%), the lower indicator - by 8 students (17.4%).

Independence in the study of chemistry at the higher level is manifested only in 4 schoolchildren (8.7%), the average level was noted in 14 students (30.4%), the lower level in 28 students (60.9%).

12 pupils (26.1%) showed interest in studying chemistry at the higher level, 21 (45.6%) on the average level and 13 pupils (28.3%) at the lower level.

Analyzing the results of the ascertaining stage of the experiment, we can conclude that half of the students have formed an internal motivation to study chemistry, 26.1% of the students show interest in its study, only 12 students are aware of the value of knowledge in the field of chemical sciences.

At the final stage of the pedagogical experiment, we carried out repeated diagnostics of the students in order to identify the dynamics of the level of development of internal motivation for educational activity.

After the formative experiment, the number of the students with an internal level of motivation increased.

If before the pedagogical research the number of the students with an internal level of motivation to learn was 26 people (56.53% of the respondents), then after the experiment their number increased to 30 people (65.2%). This indicates an increase in the cognitive needs of the students.

The level of motivation of several students did not change. These are children with different levels of motivation: lower, average and higher.

Analyzing the results of the control experiment, we determined that the level of intrinsic motivation increased from average to higher in four students, and the level of motivation in five students increased from lower to average level.

A qualitative analysis of the results of the control experiment also confirmed the positive dynamics in the degree of manifestation of the analyzed criteria (the value of knowledge, independence in the study of chemistry, interest in studying chemistry).

Of the three indicators we analyzed, the most positive dynamics can be traced in an increase in interest in the study of chemistry.

The number of the students with the higher level of interest in the natural sciences increased by 13% and the number of students with the average level of interest in the study of chemistry increased by 8.6%. The number of students with the lower level of interest in the subjects studied decreased from 13 to 6 people (by 15.2%).

The indicator of the value of knowledge in chemistry increased for three students from the lower to the average level (by 6.6%) and for two students - from the average to the higher level (by 4.4%).

The higher level of independence in the study of chemistry began to show 8 people (before the experiment was 4 students), the lower level of independence as a result of the control experiment was revealed in 20 students (before the experiment - 28 students).

6. Findings
The flipped classroom technology is a new approach to learning where classroom and extracurricular activities are reversed [7]. Intersecting also with problem-oriented learning, this technology is more flexible and provides greater involvement of students in the educational process, allows you to form a dynamic and creative environment in which students learn to think critically and work together to work out the assigned tasks [8]. This technology allows you to individualize and activate the educational
process even within the framework of group training. Traditional lessons are replaced by interactive forms of organizing chemistry teaching. It contributes to the optimization of the educational process as a whole. The solution of practical chemical problems with creative and research potential is carried out under the supervision of a teacher.

The obtained results of the pedagogical experiment allow you to assume that the use of the flipped classroom blended learning technology has increased the level of internal motivation of students to study chemistry. One can conclude about the positive effect of using this technology in the educational process.

7. Conclusion
Natural science education should be focused on the formation of a new person who is able to live in harmony with the environment. The study of chemistry at school is implemented on the basis of competence-based and personality-oriented approaches in the system of school natural science education.

The introduction of the interactive technology of the flipped classroom technology in the study of chemistry at school contributes to an increase in the level of internal motivation of students, the acquisition of a system of new chemical knowledge, the formation of natural-scientific thinking.

The proposed educational technology in teaching chemistry provides students with the opportunity to acquire competencies that will significantly simplify their future professional activities. The creative nature of the interactive technology of the flipped classroom technology allows you to create a learning environment, including in its space all students who strive for creative search, self-expression, self-development.

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