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USING INTERACTIVE METHODS TO UNIVERSITY STUDENTS**

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**METHODOLOGY FOR TEACHING ANALYTICAL CHEMISTRY
USING INTERACTIVE METHODS TO UNIVERSITY STUDENTS.**

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Abstract: The purpose of the study is to develop a methodology for teaching analytical chemistry to students of higher educational institutions using interactive methods. In teaching analytical chemistry, several interactive methods have been developed, how and in what part of the lesson they should be used. In the course of the study, innovative technologies for teaching "Analytical Chemistry" were developed, and based on the improvement of the application algorithm, technologized educational data was carried out using interactive methods. The results of monitoring the effectiveness of motivational skills in educational and cognitive activity of students were determined through a scientific and pedagogical experiment, the results obtained were analyzed mathematically and statistically, and in this regard, proposals and recommendations were developed.

Key words: interactive, discussion, brainstorming, work in small groups.

**UNIVERSITET TALABALARIGA INTERFAOL USULLARDAN
FOYDALANGAN HOLDA ANALITIK KIMYONI O'QITISH METODIKASI.**

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Annotatsiya: tadqiqotning maqsadi interaktiv usullardan foydalangan holda oliy o'quv yurtlari talabalariga analitik kimyo o'qitish metodikasini ishlab chiqishdan iborat. Analitik kimyoni o'qitishda bir nechta interfaol usullar ishlab chiqilgan, ulardan darsning qanday va qaysi qismida foydalanish kerak. Tadqiqot davomida "analitik kimyo" ni o'qitishning innovatsion texnologiyalari ishlab chiqildi va dastur algoritmini

takomillashtirish asosida interfaol usullardan foydalangan holda texnologik ta'lim ma'lumotlari amalga oshirildi. Talabalarning o'quv va kognitiv faoliyatida motivatsion ko'nikmalar samaradorligini monitoring qilish natijalari ilmiy-pedagogik eksperiment orqali aniqlandi, olingan natijalar matematik va statistik tahlil qilindi va shu munosabat bilan taklif va tavsiyalar ishlab chiqildi.

Kalit so'zlar: *interaktiv, munozara, aqliy hujum, kichik guruhlarda ishlash.*

МЕТОДИКА ПРЕПОДАВАНИЯ АНАЛИТИЧЕСКОЙ ХИМИИ СТУДЕНТАМ УНИВЕРСИТЕТОВ С ИСПОЛЬЗОВАНИЕМ ИНТЕРАКТИВНЫХ МЕТОДОВ.

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Аннотация: *Целью исследования является разработка методики преподавания аналитической химии студентам высших учебных заведений с использованием интерактивных методов. При преподавании аналитической химии было разработано несколько интерактивных методов, как и в какой части урока их следует использовать. В ходе исследования были разработаны инновационные технологии преподавания "Аналитической химии", и на основе усовершенствования алгоритма применения была проведена технологизация образовательных данных с использованием интерактивных методов. Результаты мониторинга эффективности мотивационных навыков в учебно-познавательной деятельности студентов были определены с помощью научно-педагогического эксперимента, полученные результаты были проанализированы математически и статистически, и в связи с этим были разработаны предложения и рекомендации.*

Ключевые слова: *интерактив, дискуссия, мозговой штурм, работа в малых группах.*

On a global scale, science and technology have become the main basis of global development. Both organizations continue to improve the quality of life as new

discoveries are made based on science and technology [1].

Political, social and economic changes in the life of our republic influence the natural process of vocational education, which is carried out in accordance with society's demand for highly qualified, strong and deeply educated, proactive and capable personnel [4; 97-98-p]. It is a fact that in developed foreign countries it is recognized that education is a social process that actively influences the internal politics of the country.

In this regard, the amount of funds allocated to economically support the needs of schools in foreign countries increases every year.

Currently, modern teaching methods are widely used in the educational process. The use of modern teaching methods leads to high efficiency of the educational process. When choosing teaching methods, it is advisable to proceed from the didactic task of each lesson [5; 552-557-p].

While maintaining the traditional form of the lesson, enriching it with methods that activate the activities of various students leads to an increase in the level of student learning. For this reason, the lesson process was organized rationally, and the teacher increased the interest of students. Their activity in the educational process should be constantly encouraged, the educational material should be divided into small parts, and the content into small parts, brainstorming, work in small groups, discussion, problem situation, text guide, project, role-playing game. playing, etc. encouragement is required [6; 82-85-p].

Purpose of the study. Formation of methods for teaching analytical chemistry to students of higher educational institutions using interactive methods.

The Decree of the President of the Republic of Uzbekistan dated August 12, 2020 “On measures to improve the quality of continuing education and the effectiveness of science in the field of chemistry and biology” No. PQ-4805 to radically improve the quality of education in the field of chemistry and biology, provides for the provision of educational institutions with modern laboratories and textbooks and other educational equipment. Decisions PQ-289 dated June 21, 2022 “On measures to improve the quality of teacher education and further development of the activities of higher educational

institutions for the training of teaching staff’ noted the systematic development of higher educational institutions for the training of teaching staff and the development of modern educational programs. The research we conducted partially serves to fulfill the tasks set in the above regulations and other regulatory documents.

Level of knowledge of the problem. There are many scholars in the world, including Hua-Jun Fan, Joshua Heads, Daniel Tran and Nnenna Elechi, L.A. Savchenko and others.

The issues of improving the quality of education in Russia, assessing the knowledge acquired by students in chemistry on the basis of information and pedagogical technologies, the advantages of computer technologies in teaching science, introducing student learning by combining effective methods of modern teaching by A.A. are considered. studied in scientific and methodological works of such scientists as Podgornova, A.S. Artemyeva, O.E. Gorbunov, N.S. Mikhailov [7; 62-68 p].

In Uzbekistan, many scientists have conducted scientific research on the use of computer technologies in the educational process. Aripov M.M., Abdugadirov A.A., Abdullaev A.Kh., Apatova N.V., Begimkulov U.Sh., Lutfullaev M., Tolipova Zh.O., Yunusova D., Eschanov E.Yu., Alimova F.A., Zaylobov L.T., Anvarova N.A. We can mention the research work of the Shernazarovs.

Teaching Chemistry with Computers by Hua-Jun Fan, Joshua Heads, Daniel Tran, and Nnenna Elechilar chronicles advances in software development to integrate science and computer-aided design as a new generation of undergraduate students becomes more tech-savvy and computer literate. reduces learning from books and written sources [20].

We present a variety of modules that you can use not only to teach chemistry to illustrate complex concepts, but also to provide hands-on experiences that allow students to draw conclusions based on their own information. The new generation of undergraduate students is different, they want to learn quickly and in general they have less patience for reading books [8; 1109-1111-p].

The literature and research consists of the following issues identified through case studies:

a methodology for teaching analytical chemistry to university students using interactive methods has not been developed;

Analytical chemistry was not studied with the integration of information, communication and pedagogical technologies in university classes;

it has been determined that the concepts of analytical chemistry have not been fully studied on the basis of information, communication and pedagogical technologies, and the formation of students' natural science literacy based on our choice of this topic and sources related to the topic is one of the pressing problems [9; 453-460-p].

Based on the identified problems, the goals and objectives of the study:

Improving the algorithm for the development and application of innovative technologies for teaching “analytical chemistry”;

development of methods for teaching analytical chemistry to students of higher educational institutions using interactive methods;

Materials and methods. Interactive methods mean methods that activate students and encourage them to think independently, with the student at the center of the educational process. When using these methods, the teacher encourages the active participation of the student. The student is involved throughout the entire process. The benefits of a person-centered approach include:

teaching-learning with higher educational effectiveness; high motivation of the student;

taking into account previously acquired knowledge;

adapting the intensity of training to the needs of the student; support for student initiative and responsibility; learning on the job;

creating conditions for two-way feedback [10; 44-52 p].

We will use the Brainstorming method from interactive methods of teaching analytical chemistry in universities.

Brainstorming is a method of collecting free ideas and opinions expressed by students on a problem and using them to arrive at a specific solution. There are written and oral forms of brainstorming.

Orally, each student expresses his opinion on the question asked by the teacher.

Students formulate their answers clearly and concisely.

In writing, students briefly and clearly record their answers to a given question on paper cards. Answers are attached to the board (using magnets) or the board (using pins). In the written form of the Brainstorming method, it is possible to group answers according to certain criteria. This method, when applied correctly and positively, teaches a person to think freely, creatively and outside the box [11; 425-432 p].

- 1) what reagent is used to isolate potassium cation?
- 2) What reagent is used to isolate sodium cation?
- 3) Write the equations for the reaction of cation dissociation?
- 4) write ionic, reduced ionic and molecular equations for the reactions of separation of ammonium, potassium and sodium ions.

When using the “Brainstorming” method, it becomes possible to involve all students, including the formation of a culture of communication and discussion among students. Students develop the ability to express their thoughts not only orally, but also in writing, logical and systematic thinking. The lack of evaluation of the opinions expressed leads to the formation of different ideas among students. This method serves to develop creative thinking among students [12; 1570-1577 p].

The “Brainstorming” method is implemented depending on the goal set by the teacher:

- When the goal is to determine students' background knowledge, this method is implemented in the introductory part of the lesson.
- When the goal is to repeat a topic or connect one topic to another topic, this is done by moving on to a new topic.
- Consolidation of the studied topic is carried out in the consolidating part of the lesson after setting the goal.

Opinions expressed are not discussed or evaluated.

- Any opinions expressed will be taken into account, even if they are incorrect.
- Every student must be present. The stages of the Brainstorming method are as follows:

- Students are asked a question and asked to provide their responses (opinions,

ideas and reasoning) to the question;

- Students express their opinion on the issue;
- students' ideas are collected (on a tape recorder, videotape, colored paper or board);
- Ideas are grouped by certain symbols;
- A clear and correct answer to the above question has been selected. Advantages

of the Brainstorming method:

- lack of assessment of results leads to the formation of different ideas among students;
- all students participate;
- ideas are visualized;
- there is an opportunity to test the basic knowledge of students;
- arouses students' interest in the subject. Disadvantages of the Brainstorming method:

- the teacher's inability to ask the question correctly;
- The teacher is required to have a high level of listening skills.

The “Work in small groups” method is creative work in the classroom, aimed at mastering educational material or completing an assigned task, dividing them into small groups in order to activate students [13; 1578-1582 p].

When using this method, the student will be empowered to work in small groups, actively participate in the lesson, take on leadership roles, learn from each other, and appreciate different points of view.

When using the "small group work" method, the teacher has the opportunity to save time compared to other interactive methods. Because the teacher can simultaneously involve and evaluate all students [14; 471-477 p].

For example: reactions for separating the second and third groups of cations in analytical chemistry are one of the most effective methods for separating reactions in the laboratory and studying their qualitative reactions. To isolate cations of the second group in a laboratory lesson, students are divided into 2 or 3 groups. The number of students can be from 3 to 6 people in 1 group [15; 9-22 p].

Students in the group are given a pre-prepared mixture of the second group of cations (salt solutions) and the methods for separating cations and the sequence are checked. The resulting reaction equations are expressed in acidic form and described in a laboratory notebook, and after receiving the results, they are checked and evaluated by the teacher.

Of this method, the most effective research method is often laboratory. Because it is wrong to evaluate several students based on their results at the same time.

Advantages of the “small group work” method:

- leads to better assimilation of training content;
- improves communication skills;
- there is an opportunity to save time;
- all students are involved;
- Self-assessment and peer-assessment will be available. Disadvantages of the

“small group work” method:

- since some subgroups have weak students, there is a possibility that strong students will also receive low grades;
- the ability to control all students will be low;
- mutual negative competition between groups may arise;
- Conflict may arise within the group.

The “discussion” method is a teaching method conducted in the form of discussion and exchange of ideas with students on a topic [16; 73-77 p].

This method is used on the condition that any topics and issues are discussed based on existing knowledge and experience. The task of leading the discussion can be assigned to one of the students, or the teacher himself can lead the discussion. It is necessary to conduct the discussion freely and try to involve every student in the discussion.

When implementing this method, it is necessary to immediately try to eliminate conflicts that arise between students [17].

When conducting the “discussion” method, the following rules should be observed:

- create opportunities for all students to participate;
- compliance with the “right hand” rule (raise your hand and speak after receiving permission);
- culture of listening to ideas;
- non-repetition of expressed ideas;
- mutual respect for each other. The stages of the “discussion” method are as follows:

1. The teacher chooses a topic for discussion and develops questions about it.
2. The teacher asks students a question about the problem and invites them to discuss.

3. The teacher writes down the given answers to the question asked, that is, various ideas and opinions, or appoints one of the students as a secretary to complete this task. At this stage, the teacher creates conditions for students to freely express their ideas.

4. The teacher groups, summarizes and analyzes thoughts and ideas expressed together with the students.

5. As a result of the analysis, the optimal solution to the problem is selected [18; 1-5 p]. Advantages of the “discussion” method:

- encourages students to think independently;
- students are given the opportunity to try to prove the correctness of their opinion;

- Helps students develop listening and analysis skills. Disadvantages of the "discussion" method:

- requires high management skills from the teacher;
- it is necessary to choose a subject that is suitable and interesting for the level of knowledge of the students.

For example: Introducing analytical chemistry into the summary portion of lectures in the debate method is a very effective method. Students are given reaction equations for separating these mixtures from each other and identifying cations and anions in solution. The answers to each question are written on the board. Reaction

equations are represented by molecular, ionic and reduced ionic equations.

Analyzing the results using reactions, it was found that a number of cations and anions contained in the solution were isolated. Based on the results of answering the questions, each student must write a report, which is given in the form of a task, what substances can replace the reagents necessary for reactions in cations [19; 147-149 p].

The method of “problem situations” is a method aimed at developing in students the ability to analyze the causes and consequences of problem situations and find ways to solve them.

The complexity of the task chosen for the “problem situation” method should correspond to the level of knowledge of the students. They must be able to find a solution to a given problem, otherwise failure to find a solution will result in students losing interest and self-confidence. When using the “problem situation” method, students learn to think independently, analyze the causes and consequences of a problem, and find its solution [20; 514-522 p].

The stages of the “Problem Situation” method are as follows:

1. The teacher selects a problem situation on the topic, determines goals and objectives. The teacher explains the problem to the students.
2. The teacher introduces students to the purpose, objectives and conditions for completing the assignment.
3. The teacher divides the students into small groups.
4. Small groups study a given problem situation. They identify the causes of the problem and each group makes a presentation. After each presentation, the same points are summarized.
5. At this stage, within a given time, they present their opinion on the consequences of the problem. After the presentation, the same points are summarized.
6. Discuss and analyze various possibilities for solving the problem. They develop ways to solve a problem situation.
7. Small groups make a presentation of a solution to a problem situation and offer their options.
8. After all presentations, the same solutions are collected. Together with the

teacher, the group selects the most appropriate options for solving the problem situation.

Advantages of the “Problem Situation” method:

- develops independent thinking skills in students;
- students learn to find cause, effect and solutions to a problem;
- a good opportunity is created to assess the knowledge and abilities of students;
- Students learn to analyze ideas and results. Disadvantages of the “problem

situation” method:

- high motivation of students is required;
- this task must correspond to the level of knowledge of students;
- takes a lot of time.

THIS METHOD CAN BE USED AS NEEDED.

For example. After explaining the topic of separation of group 4 cations in lectures, in the general part we will use the method of problem situations. The solution is prepared by dissolving in water a mixture of water-soluble salts containing all cations of group IV. The sequence of separation of cations in the resulting solution is given to students in the form of questions and answers.

For example, where could the problem be?

Think about what cation is released from this solution first and what reagent is used to isolate this cation?

Determine which cation is ultimately released and why?

If the interactive methods mentioned above were used in every lesson in higher education institutions, the effectiveness of the lesson would be higher.

RESULTS: An analytical chemistry course was taught to university students using the above interactive methods. 3rd year students took part in the experiment and received the following results. The groups that took part in the experimental work were divided into two groups.

The potential of students in both groups was equal. Students of the first group form the experimental group, and students of the second group form the control group. In the experimental group, classes were conducted using the above interactive methods.

In the control group, classes were organized using traditional methods (lectures). To analyze the acquired knowledge, both groups were given the same tasks, and their results were analyzed. Based on the results obtained, the following result was achieved.

Quality indicator

Groups	Number of students	Excellent rating	Good rating	Satisfactory rating	Unsatisfactory	Quality indicator
Experimental group	24	15	7	2	0	91,7%
Control group	24	10	9	5	0	79,2%
Difference in results		5	-2	-3	0	12,5%

As a result, expressed in the above table, it was found that the science literacy of students in the experimental group was 12.5% higher than the science literacy of students in the control group.

DEBATE.

The purpose of the study is to develop a methodology for teaching analytical chemistry to students of higher educational institutions using interactive methods.

During the study, developments were prepared in analytical chemistry using interactive methods in developing students' scientific literacy.

The research objective has been completed. For example:

The algorithm for the development and application of innovative teaching technologies for “Analytical Chemistry” has been improved;

a methodology has been developed for teaching analytical chemistry to students of higher educational institutions using interactive methods.

During the course of the study, several interactive methods were studied and concepts such as correct interpretation, task execution, and scientific interpretation of tasks were mastered.

Recommendations based on the results of the study:

It is recommended to use interactive methods in chemistry lessons in higher education institutions.

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