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APPLICATION OF THE "VENN DIAGRAM" METHOD IN DEVELOPING COMPETENCES IN ANALYTICAL CHEMISTRY

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Abstract

Modern pedagogical technologies play an important role in improving the quality of education. Pedagogical technology is a systematic method of designing, implementing, and evaluating the educational process, which is learner-centered, democratic, and ensures reproducible learning outcomes. Unlike traditional methods, pedagogical technology is not aimed at students simply memorizing and reproducing information, but rather at performing specific actions upon completion of the educational process . The use of pedagogical technologies in delivering lecture courses in analytical chemistry for students in the chemistry and biology fields contributes to the improvement of education quality. Until now, the Venn diagram has been used in teaching English, in teacher training , as well as in teaching mathematics and physics. However, this method has not been sufficiently studied in the context of lecture and laboratory sessions in analytical chemistry. This paper discusses the use of graphic organizers, particularly the Venn diagram, in teaching topics in medical physics.

The article highlights the effectiveness of using the Venn diagram method as one of the active learning strategies in developing competencies in analytical chemistry. It is shown that this method enhances the quality of learning, helps consolidate acquired knowledge, and is effectively applied in summary lessons. It is also noted that maintaining the traditional structure of a lesson while enriching it with methods that stimulate student activity contributes to a higher level of knowledge retention.

Keywords: Method, competence, Venn diagram, cations.

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Introduction

ПРИМЕНЕНИЕ МЕТОДА «ДИАГРАММА ВЕННА» В РАЗВИТИИ КОМПЕТЕНЦИЙ ПО АНАЛИТИЧЕСКОЙ ХИМИИ

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АННОТАЦИЯ

В повышении качества образования важную роль играют современные педагогические технологии. Педагогическая технология — это системный метод проектирования, реализации и оценки образовательного процесса, ориентированного на личность обучающегося, демократичного и обеспечивающего воспроизводимые результаты обучения. В отличие от традиционных методов, педагогическая технология направлена не на заучивание и воспроизведение знаний студентами, а на выполнение конкретных действий по завершении учебно-воспитательного процесса . Использование педагогических технологий при проведении лекционных занятий по аналитической химии для студентов химико-биологического направления способствует повышению качества образования. До настоящего времени диаграмма Венна применялась при обучении английскому языку , в подготовке педагогов , а также при обучении математике и физике . Однако при преподавании лекционных и лабораторных занятий по аналитической химии этот метод изучен недостаточно. В данной работе рассматривается использование графических органайзеров, в частности диаграммы Венна, при обучении темам по физике в медицинском направлении.

В статье раскрыта эффективность применения метода «диаграмма Венна» как одного из активных методов в развитии компетенций по аналитической химии. Показано, что использование данного метода способствует повышению качества обучения, закреплению полученных знаний и эффективно применяется на обобщающих занятиях. Также представлена информация о том, что сохранение традиционной формы занятия при одновременном обогащении его методами, активизирующими деятельность студентов, способствует повышению уровня усвоения знаний.

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Ключевые слова: метод, компетенция, диаграмма Венна, катионы.

Introduction

Current socioeconomic changes both globally and in Uzbekistan require a range of scientific and pedagogical research at all levels of the education system. This research addresses the goals, content, and outcomes of the educational process and aims to prepare future specialists who possess independence, competitiveness, creative initiative, and mobility. These requirements are reflected in state educational standards at all levels of education.

In the modern education system, it is especially important to train specialists with professional competencies that enable them to adapt to any professional environment. When solving chemistry calculation problems, students draw not only on their chemical knowledge but also on their knowledge of biology, physics, and mathematics. This, in turn, not only develops their creative abilities but also facilitates a more in-depth study of other subjects.

Purpose of the study

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

Presidential Resolution No. PP-4805 of August 12, 2020, "On measures to improve the quality of continuing education and the effectiveness of science in chemistry and biology," aims to radically improve the quality of education. This document provides educational institutions training specialists in chemistry and biology with modern laboratories, textbooks, and other educational equipment. Furthermore, Resolution No. PP-289 of June 21, 2022, "On measures to improve the quality of teacher training and further develop the system of advanced training for faculty at higher education institutions," notes the need for systematic development of a system of advanced training for faculty at higher education institutions and the development of modern educational programs.

Our research is partly aimed at fulfilling the tasks outlined in the above-mentioned regulatory legal acts and other governing documents.

Unlike traditional methods, pedagogical technology is aimed not at memorizing and reproducing knowledge by students, but at performing specific actions upon completion of the educational process [1]. The use of pedagogical technology in conducting lectures on analytical chemistry for students majoring in chemical

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biology contributes to improving the quality of education. Until now, the Venn diagram has been used in teaching English [2], in teacher training [3], and in teaching mathematics and physics [4].

The Importance of Analytical Chemistry

Analytical chemistry is the science that studies methods for determining the composition of a substance and its analysis. Case studies in analytical chemistry are designed to test biologists' knowledge and skills in the application of analytical methods. These problems simulate real-life situations that may arise when analyzing the composition of substances. Solving case studies requires logical thinking, an analytical approach, and the ability to apply appropriate analytical methods [5].

Enriching traditional learning methods with active learning methods. Maintaining the traditional lesson format while supplementing it with methods that engage students' activities helps improve student learning.

Classification of teaching methods by source of knowledge Teaching methods can be divided into three main groups:

1. Oral methods (verbal presentation of material).
2. Visual methods (use of illustrations, demonstrations).
3. Practical methods (completion of assignments, laboratory work).

A method is a set of techniques, methods, and approaches aimed at the theoretical and practical acquisition of knowledge, its assimilation, and application. In a philosophical sense, a method is a means of creating and substantiating scientific knowledge.

Division of teaching methods depending on the organization of students' thinking processes

In the educational process, teaching methods are divided as follows:

Lecture (conversational) method – transfer of knowledge through lectures and dialogue with students.

The method of practical work is the consolidation of knowledge through completing assignments.

Laboratory work method – conducting experiments for in-depth study of the material.

The method of independent work is the development of skills and abilities through independent study.

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Reproductive-heuristic method is a combination of knowledge reproduction with search elements.
Scientific research method – completing research tasks.
Problem-based research method – independent search for solutions to complex problems.
Inductive and deductive methods – development of logical thinking through conclusions from the particular to the general and vice versa.
The use of these methods in combination with traditional forms of teaching promotes the development of analytical thinking, creativity and independence of students.
There are 3 different methods for students' activities in the educational process.

Table 1 **Classification of methods**

Active	Passive	Interactive
Working with insertion, dominoes, chess board, cobwebs, beer 3/3, 4/4, 5/5 (glove), cognitive map, snowy box, diagram Venna, Red And green cards.	Lecture, story, explanation, demonstration, book Job, illustration, video method, discussion, four-step method, laboratory classes.	Zigzag, Job V small groups, impromptu, monitoring, step by step, step by step, grade, T-diagram, conceptual analysis, SWOT, resume, skeleton fish, problem situation, FSMU, project, metaplan, decision tree.

The criteria for choosing teaching methods are:
1. By learning objective
2. According to the number and capabilities of the student
3. By duration of study
4. According to material and technical conditions.
5. According to the teacher's abilities.

One of the active methods for developing analytical chemistry competencies is the use of the Venn diagram method to enhance learning, reinforce acquired knowledge, and utilize it in summarization lessons. Description: A diagram in the form of two intersecting circles is used to compare facts, events, ideas, and

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historical figures. A circular diagram. The spaces in each circle are used to record differences; the common area formed by the intersection of the circles serves to capture the common aspects of the two phenomena being compared (facts, concepts, etc.).

Areas of use

In teaching natural and specific sciences, it is used for both individual and group work when adapting questions to a specific academic topic and groups of students of any age.

Advantages

Develops critical thinking skills, helps to identify both differences and similarities between objects, events, etc. Method

A Venn diagram is used to compare two or more concepts and objects and depict the results in a diagram. It is named after the English logical theorist John Venn (1834–1923). It typically consists of two circles, each representing a set of properties of an object. If two objects have similar or identical properties, the circles representing these objects intersect. If they do not have the same or identical properties, the circles do not intersect.

In the intersection region shared by two circles, they share similar properties, while in other regions, the objects' properties differ. When comparing more than two objects, more than two circles are used.

Objective: The main objective of using the Venn Diagram method is to develop students' skills in comparing two or more objects or concepts, identifying their common and different characteristics.

Stages of method implementation:

1. Stage 1. Students are divided into two or more groups, and each group is given one object (concept or subject).
2. Stage 2: Two, three, four, or five intersecting circles are drawn on the board, and students are asked to divide them into groups.
3. Stage 3: Groups write the characteristics of their objects in the corresponding circles.
4. Stage 4. Once the characteristics have been recorded, it's necessary to determine whether two or more objects share common characteristics. Records

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of common characteristics are erased and combined into a single area.

5. Stage 5: Students analyze the resulting Venn diagram comparisons two, three, four or five objects. AgainThe focus is on the common and distinct characteristics of these objects. Example: In the analytical chemistry course on "Qualitative Analysis:" General characteristics anions I groups And their meaning V medicine"Let's consider the use of the "Venn Diagram" method.

Activation exercise:

First object: SO^{2}, SO^{2}, PO^{3}, CO^{2}, which are playingplay a major role in the human body and are important.

Second object: S O ², C O ² .

Third object: CrO^2, CrO^2, BO, BO^2.

Using a Venn diagram, it is necessary to determine the common and different characteristics of group I anions in the human body and their use in medicine.

Method implementation:

1. Students are divided into three groups:

First group: SO^2, SO^2, PO^3, CO^2Second group: S O ², C O^2

Third group: CrO^2, Cr O^2, BO, BO^2

2. Three intersecting circles are drawn on the board and students are asked to divide them into groups.
3. The groups write the characteristics of their objects in the corresponding circles.
4. Once the characteristics are recorded, the general characteristics of the objects are determined. The records of general characteristics are erased and combined into a single area.
5. Students analyze a Venn diagram resulting from a comparison of three objects, focusing on the similarities and differences between these objects.

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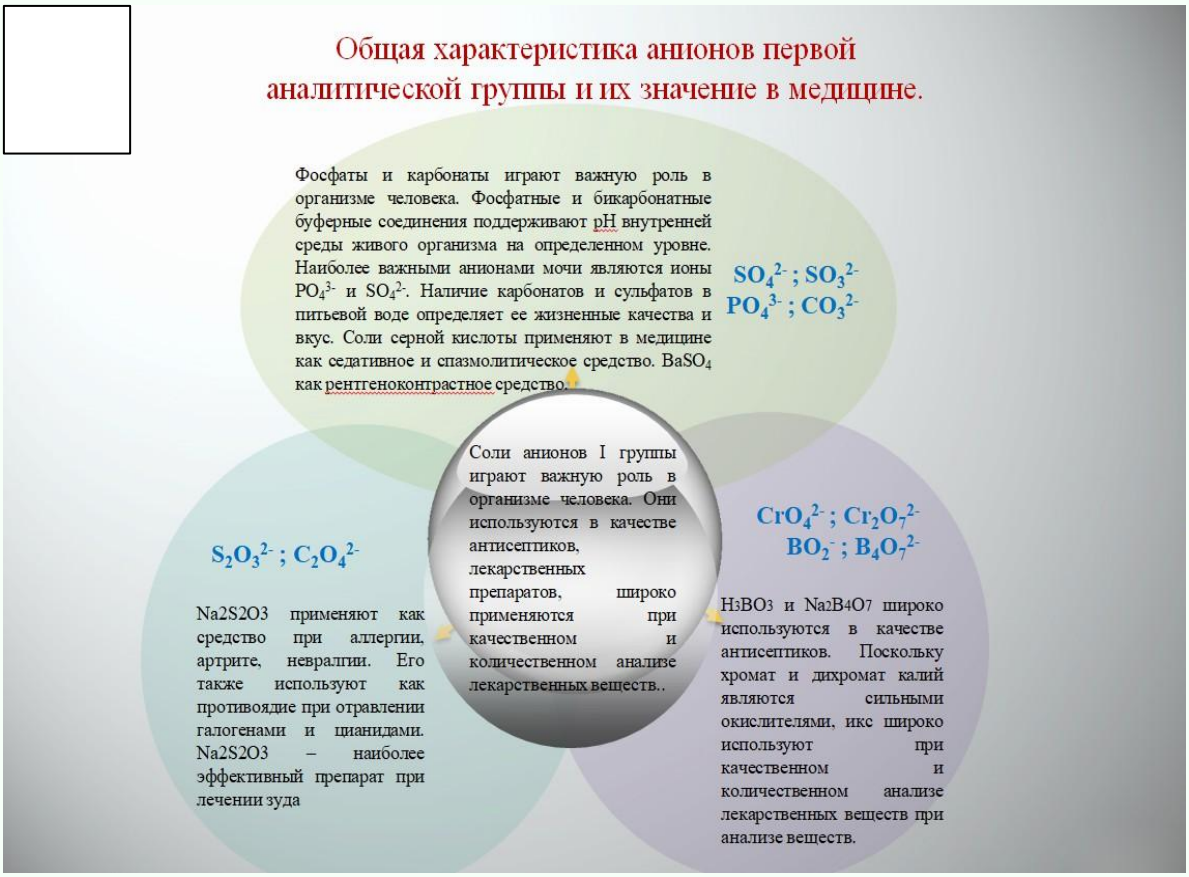

Figure 1. General characteristics of anions of the first analytical group

A Venn diagram is used to compare and contrast two or three aspects, as well as to identify commonalities. This develops students' skills in systems thinking, comparison, analysis, and contrast. Steps to use:
Students are divided into two, three, four and five groups;

A poster with a diagram image is posted on the board;
A point value is predetermined for each correct statement. Each student writes correct or incorrect ideas in the corresponding sections of the diagram using two different colored markers. One student in the group writes down the names of their classmates and the statements they made. After completing the statements, the teacher and students jointly identify the correct and incorrect answers. If a correct answer is worth three points, three points are subtracted from the group's total for each incorrect answer. The group with the most points wins and receives a reward. During group work, incorrect answers are erased, and students are awarded differentiated points based on their results.

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The Venn diagram method works well for analyzing, comparing, contrasting, and reinforcing knowledge on interrelated topics across different groups. For example, it is effective in generalizing methods aboutksimetry.

Fig. 2. General description of oximetry methods

Below are examples of using Venn diagrams in analytical chemistry lessons on the topic "Analysis of a Mixture of Group V Cations." Iron plays a vital role in the human body. It is a component of hemoglobin in the blood and is essential for the body. Fe(II) and Fe(III) compounds are used to treat anemia associated with iron deficiency. Reduced iron, iron(II) sulfate FeSO4*7H2O, iron(III) glycerophosphate, iron(II) lactate, and iron(II) ascorbate are used for this purpose. Iron supplements are taken in powder, tablet, and pill form. Iron salts are also used to authenticate medications.

Manganese compounds, such as potassium permanganate KMnO4, are a powerful antiseptic and are used to disinfect wounds and treat various skin conditions. In cases of poisoning, a KMnO4 solution is also used for gastric lavage, as well as for drug authentication and quantitative analysis.

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Magnesium is essential for the functioning of the central nervous system and for certain biochemical reactions in the body. Magnesium compounds such as magnesium oxide, magnesium carbonate, and magnesium sulfate are widely used in medicine.

Bismuth compounds, such as bismuth dihydroxynitrate Bi(OH)2NO3, are used in medicine as anti-inflammatory and, in some cases, as antiseptics for the treatment of diseases of the stomach and intestines.

Information about group V cations can also be used to form Venn diagrams.

After completing qualitative reactions for Group V cations, using the "Venn diagram" method to summarize and reinforce knowledge on the topic "Analysis of a mixture of Group V cations" will significantly increase the effectiveness of the lesson.

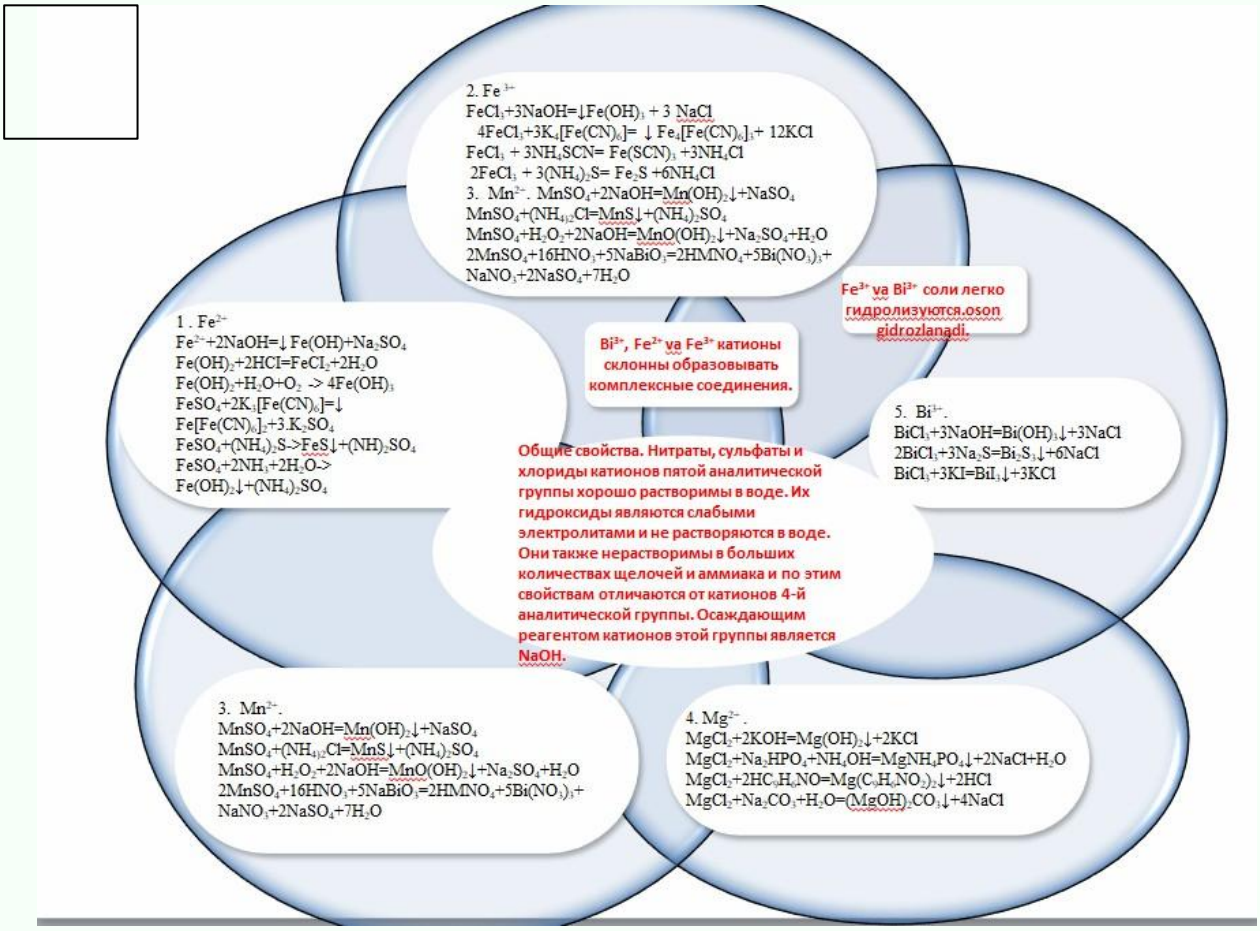

Fig. 3. Analysis of a mixture of group V cations

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Practical experience in modern education shows that the use of pre-prepared active methods in lessons helps teachers and students make classes more interesting and achieve positive results, which, in turn, increases the effectiveness of the lesson.

Conclusion

Using the aforementioned interactive methods, a course in analytical chemistry was conducted for university students. Second-year students participated in the experiment, and the following results were obtained. Two groups participated in the experimental work. The potential of students in both groups was equal. The first group of students represented the experimental group, and the second, the control group. In the experimental group, classes were conducted using the aforementioned interactive methods. In the control group, classes were conducted using traditional methods (lectures). To analyze the knowledge gained, both groups were given the same assignments, the results of which were analyzed. Based on the data obtained, the following conclusion was drawn. The aim of the study was to develop a methodology for teaching an analytical chemistry course at higher education institutions using interactive methods. During the experiment, several working materials on analytical chemistry were developed using interactive methods to develop students' scientific literacy. Algorithms for the development and application of innovative teaching technologies for the "Analytical Chemistry" course were improved.

A methodology for teaching analytical chemistry using interactive methods was developed for university students. Various interactive methods, such as correct interpretation, task completion, scientific interpretation of tasks, and others, were explored during the course of the course. The study results showed that the use of interactive methods in teaching chemistry at universities is recommended for improving the effectiveness of the learning process.

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