INTEGRATION OF CASE STUDY TECHNIQUES IN CHEMISTRY INSTRUCTION

Boboqulova O. J.
Urgut Branch of Samarkand State University named after Sh. Rashidov.
Ziyadullayeva Z. J.
Urgut Branch of Samarkand State University named after Sh. Rashidov.
Ruziev I.Kh.
Institute of Biochemistry, Samarkand State University named after Sh. Rashidov
Kenjayeva I.A
Institute of Biochemistry, Samarkand State University named after Sh. Rashidov
E-mail: ilyosruziyev867@gmail.com

Abstract. It is known that the main goal of the modern pedagogy in its development is to train specialists, those who have information and communication technologies that allow the application of fundamental knowledge, fundamentals of project activities in solving specific professional problems, suggestions as a method of progressive pedagogical technology. The article describes the activity training during the practical training of the "Organic Chemistry" course for students in the directions of the pedagogical experience described in the article. The use of the case method activates students' cognitive activity, develops motivation for learning, and ensures the correctness of the saying that practice without theory, and theory without practice, is meaningless.

Key words: work method, higher engineering education system, state method, state, state technologies, application methodology, case method, organic chemistry, synthesis gas, ethanol, insecticide, pesticide, anesthetic, rules, orientation in the benzene ring.

Аннотация. Известно, что основной целью современной педагогики в её развитии является подготовка специалистов, владеющих информационно-коммуникационными технологиями, позволяющими применять фундаментальные знания, основы проектной деятельности при решении конкретных профессиональных задач, а также внушения как метод прогрессивной педагогической технологии. В статье описывается деятельностное обучение в ходе практического обучения по курсу «Органическая химия» для студентов по направлениям педагогической практики, описанным в статье. Использование кейс-метода активизирует познавательную деятельность студентов, развивает мотивацию к обучению и подтверждает справедливость высказывания о том, что практика без теории, как и теория без практики, бессмысленны.

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Ключевые слова: рабочий метод, система высшего инженерного образования, государственный метод, государство, государственные технологии, прикладная методология, кейс-метод, органическая химия, синтез-газ, этанол, инсектицид, пестицид, анестетик, правила, ориентация в бензольном кольце.

Annotatsiya. Ma'lumki, zamonaviy pedagogikaning rivojlanishidagi asosiy maqsadi axborot-kommunikatsiya texnologiyalari sohasida malakali mutaxassislarni tayyorlash, ularga fundamental bilimlar va loyihaga asoslangan faoliyat tamoyillarini muayyan professional muammolarni hal qilish uchun qo'llash imkonini berish, shuningdek, ilg'or pedagogik texnologiya usuli sifatida taklif qilishdir. Ushbu maqolada maqolada tasvirlangan pedagogik amaliyot sohalari bo'yicha talabalar uchun "Organik kimyo" kursida amaliy mashg'ulotlar davomida faoliyatga asoslangan o'rganish tasvirlangan. Keys usulidan foydalanish talabalarning kognitiv faolligini faollashtiradi, o'rganishga motivatsiyani rivojlantiradi va nazariyasiz amaliyot, amaliyotsiz nazariya kabi ma'nosiz degan gapning to'g'riligini tasdiqlaydi.

Kalit so'zlar: ish usuli, oliy muhandislik ta'limi tizimi, holat usuli, holat, holat texnologiyalari, qo'llaniladigan metodologiya, keys usuli, organik kimyo, sintez gazi, etanol, insektitsid, pestitsid, anestetik, qoidalar, benzol halqasida yo'nalish.

Introduction.

Modern chemistry education in schools and universities is focused on developing students not only fundamental knowledge but also practical skills necessary for solving real-life professional and life problems. With the transition to a competency-based learning model, there is a growing need for pedagogical techniques that actively engage students in the learning process, develop critical thinking, analytical skills, and independent decision-making. One of the most effective techniques that meets these requirements is the case study method.

The case study method is an interactive approach based on the analysis of specific problem situations simulating real-life chemical, environmental, or industrial processes. The use of case studies allows students to combine theoretical knowledge with practical aspects of chemistry, stimulating research, discussion, and collaborative search for solutions. This approach promotes the development of cognitive, communication, and analytical skills, as well as the professional competencies of future teachers and chemical specialists.

The introduction of case studies into chemistry teaching offers significant opportunities for enhancing student motivation, improving learning, and developing a holistic understanding of the relationship between chemistry and other sciences and fields of study. Despite the widespread adoption of this method, the methodology for developing and using case studies, the specifics of their

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application at different stages of chemistry education, and the evaluation of their effectiveness require further scientific and methodological substantiation. This article examines the theoretical foundations and practical aspects of applying the case study method in chemistry teaching, as well as analyzes its pedagogical potential and advantages.

The purpose of this work is to theoretically substantiate and experimentally identify the effectiveness of using the case method in teaching chemistry, as well as to determine the pedagogical conditions that contribute to its successful application to improve the quality of education and the development of cognitive and professional competencies of students.

Analysis of literary data. A competency-based approach is widely used in the modern higher education system, according to which the outcome of student training is a developed set of knowledge, abilities, skills, personal characteristics, and experience in independent work [1]. This approach is reflected in the requirements for learning outcomes enshrined in the Federal State Educational Standard (FSES). In particular, future teachers must possess professional competencies such as the ability to create an educational environment and effectively use their own resources to implement educational policy objectives, as well as the ability to design the teaching and learning process based on modern technologies [1, 2]. This ensures the development of professionally mature teachers prepared to work in a modern school environment.

To achieve these goals, teachers use a variety of teaching tools that encourage student active participation in the study of methodological disciplines [3, p. 248; 4]. One such effective tool is situational tasks. Their advantages stem from the fact that they combine theoretical and practical components of methodological training, enhance its applied focus, develop methodological competence and thinking, and foster skills in searching for necessary information, analyzing it, and justifying decisions [5]. Completing situational tasks helps students develop skills in designing the educational process, creating didactic materials, and creating teaching aids. The use of such tasks in the educational process improves students' cognitive, communicative, and analytical abilities, which helps them more successfully adapt to the requirements of modern school chemistry education.

It requires the search for teaching methods and forms of organization of the educational process that allow the introduction of a competency-based approach in educational practice. It is appropriate for the student to get the necessary information not in a ready form, but in the process of research and creative understanding. The search for solutions to this problem has led to an expansion of understanding of the possibilities of case technology in higher education.

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The CASE method (Computer-Assisted Structure Elucidation) is an innovative approach to teaching organic chemistry, which allows automatic determination of the structure of unknown molecules using computer technology [6, 8]. This method is currently of great importance because it can significantly speed up the process of identifying new compounds.

In the modern world, the pharmaceutical and biotechnology industry is developing rapidly, and new materials and polymers are emerging. All these fields require precise determination of the structure of molecules, which makes the CASE method particularly relevant.

In addition, the use of the CASE method in the teaching of organic chemistry allows to improve the quality of training of specialists in this field. Learning with CASE allows students to gain a deeper understanding of molecular structures and patterns, accelerate the learning process, and improve educational efficiency.

Thus, the CASE method is of great importance nowadays and can be useful for many fields related to organic chemistry and for improving the quality of teaching students in chemistry.

CASE (Cognitive Acceleration through Science Education) is a teaching method developed in the UK in the 1980s. It is based on the idea that the use of special tasks increases the level of intellectual development of students and helps them to better understand complex scientific concepts. The CASE method is successfully used in teaching many scientific subjects, including organic chemistry [7].

Organic chemistry studies chemical compounds that contain carbon. This is a very important area of chemistry because most biologically active molecules such as proteins, carbohydrates, and lipids are composed of carbon. Organic chemistry is also widely used in medicine, pharmacology, food and petrochemical industries.

The CASE method involves the use of special tasks that help students improve their thinking ability [6, 11]. In the case of organic chemistry, these tasks can be aimed at developing the following skills in students:

1. Abstract thinking: students should be able to analyze complex chemical concepts and relate them to real life examples.

2. Critical thinking: Students should be able to evaluate the given information and draw conclusions based on their analysis.

3. Logical Thinking: Students should be able to apply logical principles to a variety of chemical concepts and solve complex problems.

An example of tasks that can be used in the teaching of organic chemistry in the CASE method is to determine the structure of organic compounds. In this assignment, students are given a set of data such as mass spectrum, infrared spectrum, and nuclear magnetic resonance (NMR), and based on this data, they

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need to determine the structure of the compound. This task requires students to apply their knowledge of chemistry and mathematics to determine the structure of a compound and to use the information obtained logically [9].

Research Materials and Methods. The study was conducted as part of a pedagogical experiment aimed at identifying the effectiveness of integrating case study methods (such as problematic situations and chemistry case studies) into chemistry teaching.

Research Materials

The following materials were used:

1. Chemistry curricula and work plans
2. Developed chemistry case studies, including: environmental, everyday, and technological situational problems; problematic production situations; and interdisciplinary cases linking chemistry with biology, ecology, and physics.
3. Methodological recommendations for teachers**, including a lesson plan using the case study method.
4. Diagnostic materials.

Results and discussion. Using the CASE method in teaching organic chemistry can improve understanding of complex concepts and help develop thinking skills that can be useful not only in chemistry, but also in other scientific disciplines. This method can be especially useful for students who have difficulty understanding chemistry concepts or who have limited experience in the subject.

Instead of traditional chemistry labs, you can use practical situations, and then instead of simply pouring substances into test tubes, students are well-prepared to strengthen their knowledge, skills, and decision-making in this situation. Practical cases should be as specific and detailed as possible, and this can best be reflected in practical work. I think that it is possible to use practical cases in the study of the topic "Chemical industry". For example, when studying ethanol production in the 11th grade.

Role playing method.

A letter to the project institute: "The owner of our factory gave instructions to organize ethanol production, we have never produced it and we do not know how to do it. Help to obtain ethanol in an industrial way!".

Job 1. The task for logisticians: what raw materials are needed for the production of ethanol, how to use the final product. (Internet resources can be used).

Case 2. Task for Economists: Analyzing the Costs of Ethanol Production.

Information material

1) Industrially, ethyl alcohol is obtained by anaerobic fermentation of vegetable carbohydrates with the participation of yeast and ethylene hydration. There are

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ways to obtain ethyl alcohol: direct synthesis from CO and H2 or through methyl alcohol. ($CO + 2H_2$): $CO + 2H_2 \rightarrow CH_3OH$. 50 kg of alcohol is obtained from 20 m^3 of hydrogen.

2) Alkaline hydrolysis of halogen derivatives of alkanes:

$C_2H_5Cl + NaOH \rightarrow C_2H_5OH + NaCl$. 40 kg of ethanol is obtained from 100 kg of chloroethane

3) Oxidation of methane in the presence of catalysts: $C_2H_6+O_2 \rightarrow C_2H_5OH$. 200 kg of ethanol can be obtained from 100 kg of methane

Note: The efficiency of the reaction is estimated by the mass fraction of the product yield.

Substance name	Unit of measure	Price, in soums (2022)
Methane	1 l	1500
Oxygen	10 m^3	30000
Synthesis gas	1 l	1200
Ethyl chloride	1 l (ρ=0,903 g/l)	13000
Sodium hydroxide	1 kg	65000

Another example of case study

1. Physical properties of alkanes and alkenes.

When the author studies the physical properties of alkanes in organic chemistry, he focuses on explaining that the boiling point of alkanes depends mainly on intermolecular forces, which include van der Waals forces and hydrogen bonding, and van der Waals forces are related to molecular bonds. liq. mass and molecular polarization. The melting point of a substance is related not only to molecular interactions, but also to molecular symmetry: the better the symmetry and the closer the molecules are in the crystal lattice, the higher the melting point. When discussing the physical properties of olefins in chapter 3, the author does not explain the factors affecting the boiling point and melting point of substances, but the following cases are presented directly: Butene-2 exists in two isomers , in their molecules, the bonding sequence of the atoms and the position of the double bond are exactly the same, but the spatial arrangement of the atoms is different.



Since cis-butene-2 and trans-butene-2 are different substances (isomers), they have different properties. The melting point of cis-butene-2 is -138,9 °C, and that of trans-butene-2 is above 33 °C (-105.5 °C).

Question: Why does the cis structure have a high boiling point and a low melting point?

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Give the whole class 3 minutes to reflect and discuss, then ask students to respond. According to the basic knowledge they are learning (about 5 minutes) and finally the teacher summarizes the thoughts of all students: cis-2-butene and trans-2-butene are isomerides, the boiling points of the substances depend on the molecular polarities: cis -2-butene is more polar than trans-2-butene, so the boiling point of cis-2-butene is higher than that of trans-2-butene; Although the melting point is related not only to molecular interatomic forces, but also to molecular symmetry, the symmetry of trans-2-butene is high, so its melting point is also high.

In this way, students will better understand the factors affecting the boiling point. and melting points will also learn how to solve real-world problems using the underlying knowledge they have learned.

Using the case method in teaching chemistry can be very useful for students because it helps them to better understand how to apply knowledge in real life. Cases can be problem situations or tasks that require a solution based on the knowledge and skills acquired in the study of chemistry.

An example of this can be a review of technologies for the production and use of different types of fuels. As part of such work, students can get acquainted with the processes of obtaining gas from biodiesel, methanol, coal and other fuels and problems related to their use.

Conclusions. The study confirms the high pedagogical effectiveness of the case study method in teaching chemistry. An analysis of theoretical approaches and practical experience using case study techniques demonstrate that incorporating problematic situations into the learning process promotes students' cognitive activity, fosters a strong motivation to study chemistry, and develops skills in analysis, comparison, evaluation, and decision-making.

The use of case studies integrates theoretical knowledge with practical aspects of chemistry, allowing students to simulate real-life professional and professional situations. This contributes to the development of key competencies: communication, analytical, research, and design. Furthermore, the case study method helps develop students' teamwork and reasoned discussion skills, which are particularly important in today's educational environment.

The study results indicate that the effectiveness of the case study method directly depends on the quality of the development of situational assignments, the level of problematic nature of the materials presented, and adherence to the pedagogical conditions for their implementation. Well-structured case studies, focused on interdisciplinary connections and practical relevance, have a significant impact on the quality of chemical knowledge acquisition and the development of professional competencies.

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Thus, the case study method can be considered a promising and effective technology for teaching chemistry, improving the quality of education and developing students' independence and critical thinking. Its systematic use in the educational process creates the conditions for developing competent, active, and motivated students capable of effectively applying chemical knowledge in a variety of situations.

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