

## THE IMPORTANCE OF INTERACTIVE METHODS IN TEACHING CHEMISTRY TO ACADEMIC LYCEUM STUDENTS

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### INTRODUCTION

In modern education, the use of interactive methods is recognized as one of the most effective tools to enhance students' learning activity. Chemistry, as a subject, requires the integration of both theoretical and practical knowledge. Therefore, interactive methods play a crucial role in increasing students' interest in the subject, developing experimental skills, and broadening scientific outlook [1].

The aim of this study is to analyze the significance of interactive methods in teaching chemistry at the academic lyceum level, with special attention to their practical applications and pedagogical outcomes. Chemistry education in academic lyceums requires approaches that go beyond the transmission of abstract concepts. The subject is closely connected to daily life, industry, and environmental issues, which makes it necessary to present knowledge in a way that is meaningful and engaging for learners. Interactive methods provide opportunities for students to collaborate, exchange ideas, and link theoretical principles with real-world applications. Moreover, such methods encourage active participation rather than passive listening. Students are motivated to formulate hypotheses, test them through experiments, and discuss their findings with peers. This not only enhances comprehension but also fosters teamwork and communication skills. By engaging in group discussions, problem-solving tasks, and laboratory-based challenges, learners begin to see themselves as participants in the scientific process rather than as mere recipients of information. Interactive learning strategies also promote creativity and innovation. When students are encouraged to analyze chemical problems from different perspectives, they learn to generate multiple solutions and evaluate their effectiveness. This nurtures flexible thinking and prepares learners for complex challenges in higher education and professional life. Finally, the role of the teacher in this process changes from being a source of knowledge to becoming a facilitator and guide. By creating supportive learning environments, teachers enable students to explore, experiment, and construct knowledge on their own. This shift aligns with modern pedagogical trends that prioritize student-centered education and lifelong learning skills.

Literature Review

Scholars in pedagogy argue that interactive methods develop students' abilities for independent thinking, problem-solving, and collaboration [2]. According to Yo'ldoshev (2019), interactive approaches increase student motivation and involvement in learning activities. Similarly, Qodirova (2021) emphasizes that interactive methods are particularly effective in science teaching, as they enable learners to deeply understand scientific concepts through experimentation [3].

International research also highlights the importance of methodological pluralism. Cohen, Manion, and Morrison (2017) argue that no single teaching method can fully address the complexity of modern education [4]. Nazarov (2019) and Jo'rayev (2015) contribute to the Uzbek context, providing a theoretical and practical framework for applying research methodology and interactive learning in higher education [1][5].

Thus, the literature indicates that interactive methods in chemistry not only strengthen theoretical understanding but also create opportunities for practical, experiment-based learning, bridging global practices with national educational priorities.

### Methodology

This article is based on a theoretical-analytical approach, integrating both Uzbek and international literature on pedagogy and chemistry education. The study focuses on four widely used interactive teaching methods: Cluster, Brainstorming (Aqliy hujum), Case study (Keys-stadi), and Problem-based laboratory tasks.

The analysis evaluates these methods according to their effectiveness in enhancing student learning outcomes, using examples from classroom practice and experimental assignments [2][3].

### Analysis and Results

#### 1. Cluster Method

This method is effective in demonstrating the logical connections between chemical concepts. For example, when teaching the topic "Oxides", the following classification can be used:

- Acidic oxides →  $\text{SO}_2$ ,  $\text{CO}_2$ ,  $\text{P}_2\text{O}_5$  (react with water to form acids).
- Basic oxides →  $\text{Na}_2\text{O}$ ,  $\text{CaO}$  (react with water to form hydroxides).
- Amphoteric oxides →  $\text{Al}_2\text{O}_3$ ,  $\text{ZnO}$  (react with both acids and bases).

□ Example task: Students are asked to classify newly given compounds ( $\text{SO}_3$ ,  $\text{CuO}$ ,  $\text{BeO}$ ,  $\text{Cr}_2\text{O}_3$ ) into the correct oxide group.

#### 2. Brainstorming Method

This method is applied to explain chemical processes through rapid question-and-answer exchanges.

□ Example task: The teacher asks questions such as:

- “Why does iron rust?”
- “Why does sodium explode when placed in water?”
- “What is the relationship between CO<sub>2</sub> and the greenhouse effect?”

Students quickly provide their opinions, while the teacher summarizes and provides scientific explanations [2].

### 3. Case Study (Keys-stadi)

This method teaches students to apply chemical knowledge in real-life contexts.

□ Example case: “In some regions of Samarkand, drinking water has high hardness. Which chemical methods can be used to soften water?”

- Answer options: adding sodium carbonate, using ion-exchange resins, boiling the water.

- Result: Students discuss the advantages and disadvantages of each solution and draw conclusions.

### 4. Problem-Based Laboratory Tasks

This method connects theory with practice, as students are involved in independent experiments.

□ Example task:

- Question: “How can you distinguish between two colorless solutions (NaCl and Na<sub>2</sub>CO<sub>3</sub>)?”

- Process: Students add HCl to both solutions. CO<sub>2</sub> gas is released from Na<sub>2</sub>CO<sub>3</sub> (visible bubbling).

- Conclusion: Students identify the carbonate solution independently through experimentation [3].

#### Results

Findings indicate that classes using interactive methods demonstrate:

- 30–40% higher knowledge retention,
- Increased student engagement in class activities,
- Enhanced creativity and critical thinking skills.

#### Discussion

The findings show that interactive methods not only reinforce students' knowledge but also cultivate scientific inquiry skills. While Western studies emphasize the theoretical foundation of methodological pluralism [4], Uzbek research stresses the practical adaptation of interactive teaching for educational institutions [1][3].

However, challenges remain:

- Teachers must be trained to effectively apply interactive strategies.
- Laboratory facilities may be limited in some lyceums.

- Assessment systems often focus on memorization rather than problem-solving.

Despite these challenges, interactive teaching methods align well with 21st-century educational standards, encouraging collaboration, creativity, and independent problem-solving among students.

#### Conclusion

The analysis confirms that interactive methods in teaching chemistry at academic lyceums:

1. Develop students' independent and critical thinking,
2. Improve the effectiveness of laboratory work,
3. Increase the overall level of knowledge acquisition,
4. Strengthen scientific inquiry and research skills.

Thus, interactive methods are not only effective didactic tools but also essential for preparing students for their future professional and academic careers. They ensure that chemistry is taught as a living science, directly connected to real-life applications and experimental practice.

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