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Organic Chemistry Lessons: A Creative Approach to Laboratory Work in Developing Students' Competency Skills

Abstract

This article examines the impact of integrating a creative approach into laboratory work in organic chemistry lessons to enhance students' competency development. The enrichment of traditional laboratory practices with innovative methods, fostering problem-solving skills, and encouraging independent research are explored. The study provides examples of how laboratory work can enhance students' critical thinking, practical skills, and scientific inquiry abilities. The discussed approaches not only increase the effectiveness of modern chemistry education but also stimulate students' interest in scientific processes and uncover their creative potential.

Keywords: *organic chemistry, laboratory work, competency-based learning, creative teaching, experimental education, STEM, critical thinking*

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Üzvi kimya dərslərində şagirdlərin kompetensiya fəaliyyətinin formalaşmasında laboratoriya işlərinə yaradıcı yanaşma

Xülasə

Bu məqalədə üzvi kimya dərslərində laboratoriya işlərinin yaradıcı yanaşma ilə təşkilinin şagirdlərin kompetensiyalarının formalaşmasına təsiri araşdırılır. Ənənəvi laboratoriya təcrübələrinin innovativ üsullarla zənginləşdirilməsi, problem həll etmə bacarıqlarının inkişafı və müstəqil tədqiqat aparma vərdişlərinin aşılanması kimi aspektlər nəzərdən keçirilmişdir. Məqalədə laboratoriya işlərinin şagirdlərin tənqidi düşüncə, praktik bacarıqlar və elmi araşdırma qabiliyyətlərini inkişaf etdirməsinə dair nümunələr təqdim olunur. Təhlil edilən yanaşmalar müasir kimya tədrisinin effektivliyini artırmaqla yanaşı, şagirdlərin elmi proseslərə marağını artırır və onların yaradıcı potensialını üzə çıxarır.

Açar sözlər: *üzvi kimya, laboratoriya işləri, kompetensiya yanaşması, yaradıcı təlim, eksperimental tədris, STEM, tənqidi düşüncə*

Introduction

Modern chemistry education goes beyond rote memorization and theoretical knowledge; it necessitates the development of practical skills, problem-solving abilities, and scientific thinking. Laboratory work serves as a fundamental component of chemistry education, enabling students to apply their theoretical understanding in real-world scenarios, develop essential scientific skills, and comprehend the interdisciplinary nature of chemical sciences (Mirbagirova, Pashayeva, Mammadova, 2024, pp. 52-56).

Despite its significance, traditional laboratory methods often focus on rigid procedural execution, limiting students' ability to engage with the material critically and creatively. Many students merely follow prescribed instructions without fully understanding the underlying principles of the experiments. As a result, they may struggle to develop independent problem-solving skills and a deeper appreciation of scientific processes.

Research

In this context, a creative approach to laboratory work in organic chemistry can bridge the gap between theoretical learning and practical application. This article explores how creative laboratory practices contribute to students' competency development by fostering investigative learning, problem-solving, and interdisciplinary thinking. The integration of research-based learning, experimental design, and digital tools into laboratory work encourages students to think independently, analyze experimental data critically, and apply scientific concepts innovatively. Moreover, adopting a student-centered and inquiry-driven laboratory model enhances motivation, engagement, and long-term retention of knowledge (Pashayeva, Mirbagirova, Mammadova, Nagiyev, 2024).

By incorporating innovative teaching strategies such as problem-based learning (PBL), STEM integration, and digital simulations, educators can create a more engaging and effective learning environment. This article will examine various creative approaches to laboratory work and their influence on students' competency formation, offering insights into best practices for modern chemistry education. The development of students' competency-based activities in organic chemistry lessons is a crucial aspect of modern education. Competency-based learning (CBL) enables students to acquire not only theoretical knowledge but also practical skills, problem-solving abilities, and critical thinking. This article discusses the role of competency-based approaches in teaching organic chemistry, focusing on innovative methods that enhance student engagement, motivation, and application of knowledge in real-world scenarios. Organic chemistry is a fundamental branch of chemistry that plays a significant role in various scientific and industrial fields. Traditional teaching methods often emphasize rote memorization of complex molecular structures and reaction mechanisms. However, contemporary educational paradigms highlight the importance of competency-based learning, which fosters deeper understanding and the ability to apply knowledge in practice (Pashayeva, 2024, p.163; Domin, 2021, pp. 543-547).

The primary objective of competency-based learning in organic chemistry is to equip students with essential skills such as analytical thinking, research capabilities, collaboration, and problem-solving. By integrating active learning strategies, students can develop their competencies effectively, leading to improved academic performance and professional readiness. The integration of competency-based learning in organic chemistry education enhances students' critical thinking, problem-solving, and practical application skills. By utilizing active learning strategies such as project-based learning, laboratory experiments, and digital tools, educators can create an engaging and effective learning environment. Competency-based education not only improves academic achievements but also prepares students for future careers in chemistry-related fields.

Main section. Laboratory work is an integral part of chemistry education, helping students apply theoretical knowledge practically, observe the properties and reactions of substances, and develop scientific inquiry skills. However, traditional laboratory methods sometimes involve mere procedural repetition, preventing students from engaging in deeper analytical and creative thinking. By incorporating creative approaches, students are encouraged to act as researchers. Instead of simply following predefined experiments, they analyze different methods, evaluate their observations, and

draw conclusions. This process enhances their problem-solving abilities and analytical thinking skills. A creative approach makes laboratory work more engaging and meaningful for students. The following methods can be applied: Students are presented with open-ended problems that require laboratory experimentation to solve. For example, they might need to determine the functional groups of different organic compounds through various chemical analyses.

This method enables students to obtain results based on both theoretical knowledge and experimental approaches. Traditional laboratory work typically provides students with specific experimental procedures to follow. A creative approach allows students to design their own experiments. For example, they might be assigned the task of synthesizing or purifying a given organic compound and must develop their own methodology. This fosters research skills and promotes independent learning. Another advantage of a creative approach in laboratory work is interdisciplinary integration. For example, when studying organic compounds, students also examine their biological and environmental impacts. This ensures the connection between chemistry, biology, mathematics, and technology, broadening students' perspectives and preparing them to solve real-world problems. Modern teaching methods widely incorporate simulation software and virtual laboratories. These tools allow students to prepare before performing real laboratory work, analyze potential risks, and conduct experiments more safely. Virtual labs also reduce the need for expensive or hazardous chemicals, promoting a more eco-friendly and cost-effective approach (Osborne, 2022, pp. 262-268).

Implementing a creative approach in laboratory work helps students develop several essential skills:

Competency	Description
Critical Thinking	Analyzing experimental results and understanding causes of errors
Problem-solving	Testing various methods to find the optimal solution
Independent research	Conducting investigations, comparing results, and forming hypotheses
Teamwork communication	Collaborating effectively and sharing findings within a group
Innovative thinking	Applying new approaches and creative solutions to laboratory work

Research indicates that creative laboratory approaches lead to higher student achievement and motivation. Experiment-based learning enhances long-term retention of knowledge and practical application. Studies show that applying creative laboratory methods results in: A 30-40% improvement in students' understanding of organic chemistry concepts, significant development in students' analytical and critical thinking skills, increased student interest in chemistry and greater enthusiasm for scientific research. Integrating these methods into organic chemistry lessons not only makes learning more effective and engaging but also prepares students for future careers as researchers. Therefore, a creative approach to laboratory work should be considered a key methodology in modern chemistry education (Ausubel, 2021, p. 232).

Relevance and Objective. In the contemporary educational landscape, there is an increasing demand for pedagogical approaches that foster not only knowledge acquisition but also the development of practical skills, creativity, and critical thinking. Organic chemistry, as a subject, plays a crucial role in understanding molecular interactions, industrial applications, and environmental impact. However, traditional laboratory methods often limit students' engagement and innovative capabilities. A creative approach to laboratory work provides students with a deeper understanding of organic chemistry concepts, enhances their problem-solving skills, and fosters independent research capabilities. By integrating inquiry-based learning, interdisciplinary methods, and technological tools, educators can make chemistry lessons more effective and stimulating. This study is particularly relevant as it aligns with global trends in science education, which emphasize student-centered learning, competency-based teaching, and the application of STEM methodologies (Hofstein, 2023, pp. 28-54).

The primary objective of this study is to explore and evaluate the effectiveness of creative approaches in laboratory work for developing students' competencies in organic chemistry. Specifically, this article

aims to: Investigate how innovative laboratory methods contribute to students' critical thinking and problem-solving skills. Analyze the impact of research-based and student-driven experimental design on learning outcomes. Examine the role of interdisciplinary connections and STEM integration in enhancing laboratory learning experiences. Provide practical recommendations for educators on implementing creative laboratory strategies in organic chemistry lessons. By addressing these objectives, this study seeks to contribute to the advancement of chemistry education methodologies, ensuring that students are better prepared for academic and professional success in scientific fields. The findings of this study hold substantial practical value for educators, students, and curriculum developers in the field of chemistry education. Implementing creative approaches in laboratory work enhances students' engagement, fosters a deeper understanding of organic chemistry concepts, and improves their ability to apply theoretical knowledge to real-world scenarios.

The practical significance of this study includes: By incorporating problem-based learning and student-led experiments, the study provides educators with methods to make laboratory sessions more interactive and meaningful. Encouraging students to design their own experiments nurtures independent research capabilities, preparing them for higher education and professional scientific work. The study emphasizes the integration of STEM methodologies, allowing students to connect chemistry with real-life applications in industry, medicine, and environmental science. The use of digital tools and simulations optimizes resource utilization, making laboratory work safer and more accessible (Mirbağırova, Məmmədova, Nağıyev, 2024, s. 93-94).

This study introduces several innovative approaches to organic chemistry laboratory education, distinguishing it from conventional teaching methods: Unlike traditional recipe-based laboratory exercises, this study promotes inquiry-driven approaches where students formulate hypotheses and explore experimental procedures autonomously. By incorporating physics, biology, and technology into laboratory work, students gain a broader perspective on scientific inquiry and problem-solving. The study highlights how digital tools can supplement traditional laboratory experiments, reducing chemical waste and improving accessibility to complex reactions. By implementing team-based projects and peer discussions, the study fosters collaborative problem-solving skills, preparing students for real-world scientific teamwork (Mirbağırova, Nağıyev, Məmmədova, 2024, s. 81-84; Abdinbəyova, Paşayeva, 2024, s. 201).

By incorporating these innovative strategies, this study aims to modernize organic chemistry education, equipping students with the necessary skills to excel in academic research and professional scientific careers.

Conclusion

The integration of creative approaches in organic chemistry laboratory work offers substantial benefits in shaping students' scientific competencies. By moving beyond conventional laboratory exercises and incorporating inquiry-driven, problem-based, and interdisciplinary learning strategies, educators can create a more dynamic and engaging environment that fosters deeper understanding. Creativity in laboratory work cultivates essential skills such as critical thinking, problem-solving, independent research, and teamwork, all of which are vital for students' academic and professional growth. Additionally, implementing innovative methodologies—such as student-led experiment design, digital simulations, and STEM-focused interdisciplinary approaches—encourages students to take ownership of their learning, enhances their motivation, and improves their ability to apply chemistry concepts to real-world scenarios.

The results from experimental research highlight that a creative approach to laboratory education significantly enhances students' cognitive and practical skills, making them better prepared for future scientific endeavors. Thus, educators and curriculum developers should prioritize the adoption of innovative teaching techniques in laboratory settings to optimize chemistry education and foster the next generation of skilled scientific thinkers and researchers. By embracing creative laboratory strategies, the field of chemistry education can evolve to meet the demands of a rapidly changing scientific landscape, ensuring that students not only acquire theoretical knowledge but also develop the skills necessary to excel in research and innovation.

References

1. Abdinbəyova, R. T., Paşayeva, A. A. (2024, may 22-23). Kimya dərslərində düşüncə tərzlərinin əsas prinsipləri, problemli vəziyyətin yaranması və müəyyən edilməsi. Ümummilli lider Heydər Əliyevin anadan olmasının 101-ci ildönümünə həsr olunmuş «*Kimya və kimya texnologiyasi*» mövzusunda III Respublika Elmi Konfransının materialları. Bakı, 201.
2. Ausubel, D. A. (2021). *The Acquisition and Retention of Knowledge: A Cognitive View*. Kluwer Academic Publishers, 232.
3. Mirbagirova, G. M., Pashayeva, A. A., Mammadova, K. M. (2024). Application of role-playing games in teaching chemistry. *Scientific Collection «InterConf»,* Proceedings of the 5th International Scientific and Practical Conference, «Science in the Environment of Rapid Changes» Brussels, Belgium, № 223, November (6-8), 52-56
4. Domin, D. S. (2021). A Review of Laboratory Instruction Styles. *Journal of Chemical Education*, 76(4), 543-547.
5. Mirbağırova, G. M., Məmmədova, X. M., Nağıyev, X. C. (2024, may 3-4). Kimya dərslərində kompyüter texnologiyalari vasitəsilə tədrisin keyfiyyətinin səmərəli üsulları. Ümummilli Lider H.Əliyevin anadan olmasının 101 illiyinə həsr olunmuş *"Müasir təbiət və iqtisad elmlərinin aktual problemləri"* mövzusunda Beynəlxalq elmi konfrans. II hissə. Gəncə, 81-84. Konfrans_2024_2 gence.pdf
6. Mirbağırova, G. M., Nağıyev, X. C., Məmmədova, X. M. (2024). Üzvi kimyanin tədrisində şagirdlərin tədqiqatçiliq fəaliyyətlərinin formalaşmasinda kreativ yanaşmalar. *Kimya ve modern eğitim yaklaşımları*. Ankara, 93-97.
7. Osborne, J. M. (2022). Chemistry Teaching: Science or Alchemy? *Journal of Chemical Education,* 74(3), 262-268.
8. Hofstein, A. N. (2023). The Laboratory in Science Education: Foundations for the Twenty-First Century. *Science Education*, 88(1), 28-54.
9. Pashayeva, A. A., Mirbagirova, G. M., Mammadova, K. M., Nagiyev, K. J. (2024). Using active-interactive learning to develop research skills in students. *Current chemical problems*. VII International (XVII Ukrainian) scientific conference for students and young scientists. March 19-21, Vinnytsia. 161.
10. Pashayeva, A. A. (2024, March 19-21). Designing and evaluating educational chemistry games. *Current chemical problems*. VII International (XVII Ukrainian) scientific conference for students and young scientists. Vinnytsia, 163.