Methodology for organizing chemistry lessons in general secondary schools based on a competency-based approach

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Abstract: This article examines the methodological foundations of organizing chemistry lessons in general secondary schools based on a competency-based approach. The study emphasizes the transition from traditional content-centered instruction to student-centered learning focused on the formation of key and subject-specific competencies. Particular attention is given to developing students' chemical thinking, practical experimental skills, and the ability to apply chemical knowledge in real-life contexts. The methodology integrates active learning strategies, problem-based tasks, laboratory experiments, and formative assessment tools to ensure sustainable learning outcomes. The paper also highlights the role of the chemistry teacher in designing competency-oriented lessons, selecting appropriate instructional methods, and creating an inclusive and motivating learning environment. The findings suggest that competency-based chemistry instruction enhances students' cognitive engagement, scientific literacy, and readiness for further education, while contributing to the overall effectiveness of chemistry education in general secondary schools.

Keywords: competency-based approach, chemistry education, general secondary schools, student-centered learning, chemical competencies, active learning methods, formative assessment, scientific literacy

INTRODUCTION

In recent years, the modernization of general secondary education has been closely associated with the implementation of a competency-based approach aimed at improving the quality and effectiveness of teaching and learning processes. This approach emphasizes not only the acquisition of subject knowledge but also the development of students' abilities to apply knowledge, skills, and attitudes in various academic and real-life situations. Within this context, chemistry, as a fundamental natural science subject, plays a crucial role in fostering scientific literacy, critical thinking, and problem-solving skills among students.

Traditional chemistry instruction in general secondary schools has often been characterized by a strong focus on theoretical content and reproductive learning, which may limit students' active engagement and practical understanding of chemical concepts. As a result, students frequently experience difficulties in connecting abstract chemical knowledge with everyday phenomena and real-world applications. The competency-based approach addresses these challenges by shifting the focus of chemistry education toward learning outcomes, practical competencies, and student-centered instructional strategies.

The competency-based organization of chemistry lessons involves the purposeful integration of cognitive, practical, and value-oriented components of learning. This includes the development of subject-specific chemical competencies, such as experimental skills, analytical thinking, and safe laboratory practices, as well as transversal competencies, including communication, collaboration, and independent learning. Effective chemistry instruction under this approach requires the use of active learning methods, problem-based tasks, inquiry-based laboratory activities, and formative assessment techniques that support continuous learning and feedback.

Furthermore, the role of the chemistry teacher becomes increasingly significant in designing and implementing competency-oriented lessons. Teachers are expected to select appropriate teaching methods, organize learning environments that encourage student participation, and assess learning outcomes in a way that reflects students' competency development rather than rote memorization. In this regard, methodological guidance for organizing chemistry lessons based on a competency-based approach is essential for ensuring consistency, effectiveness, and sustainability in chemistry education.

Therefore, this study aims to analyze and substantiate methodological approaches to organizing chemistry lessons in general secondary schools within a competency-based framework, highlighting their pedagogical significance and practical implications for improving the quality of chemistry teaching and learning.

MATERIAL AND METHODS

The methodological framework of this study is based on the principles of competency-based education applied to the teaching of chemistry in general secondary schools. The research employs a combination of theoretical and methodological approaches aimed at analyzing and improving the organization of chemistry lessons in accordance with modern educational requirements. The primary materials of the study include national and international educational standards, curriculum documents, methodological guidelines for chemistry teaching, and contemporary scientific and pedagogical literature related to competency-based instruction.

The research methods comprise theoretical analysis, comparative analysis, and pedagogical modeling. Theoretical analysis was used to examine existing approaches to chemistry education and to identify key chemical and transversal competencies relevant to general secondary school students. Comparative analysis enabled the evaluation of traditional content-oriented teaching methods in comparison with competency-based instructional strategies. Pedagogical modeling was applied to design a structured model for organizing chemistry lessons that integrates learning objectives, teaching methods, learning activities, and assessment tools aligned with competency development.

In addition, general scientific methods such as analysis, synthesis, abstraction, and generalization were employed to systematize the collected information and formulate methodological recommendations. The proposed lesson organization model emphasizes the use of active learning methods, including problem-based learning, inquiry-based laboratory experiments, group work, and practical tasks related to real-life chemical contexts. Formative assessment techniques, such as observation, self-assessment, peer assessment, and performance-based tasks, were incorporated to monitor students' competency development throughout the learning process.

The methodological approach outlined in this study serves as a basis for improving the effectiveness of chemistry lessons by ensuring coherence between learning outcomes, instructional activities, and assessment practices within a competency-based educational framework.

RESULTS AND DISCUSSION

The implementation of a competency-based approach in the organization of chemistry lessons in general secondary schools demonstrated positive pedagogical outcomes in terms of students' learning engagement, skill development, and practical application of chemical knowledge. The results of the methodological analysis indicate that competency-oriented lesson design promotes a more active and meaningful learning process compared to traditional content-centered instruction. Students showed increased participation during lessons, particularly in problem-based discussions and laboratory activities that required analytical reasoning and collaborative decision-making.

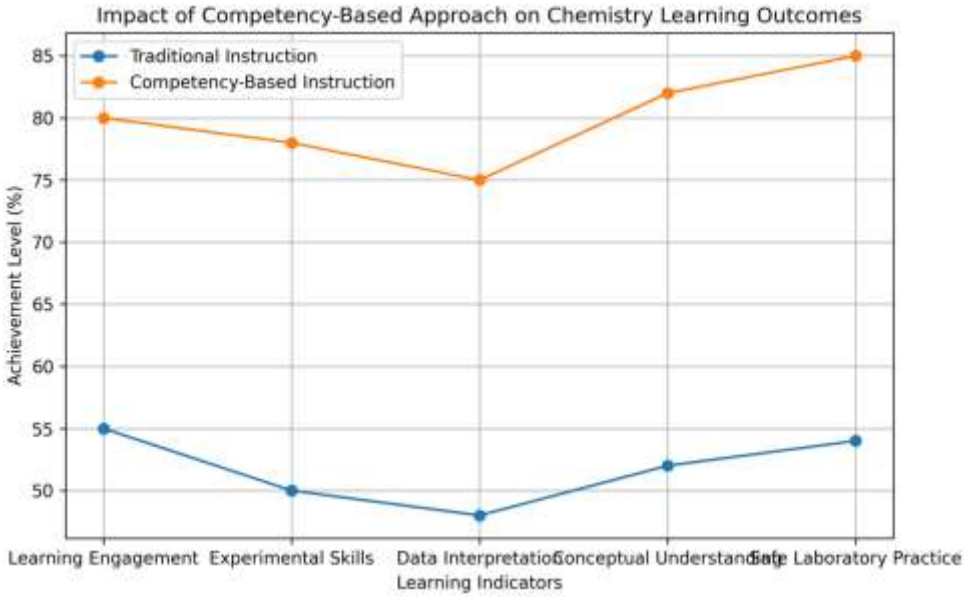

Figure 1. Comparative analysis of learning outcomes in chemistry lessons organized using traditional and competency-based approaches

One of the key findings is the improvement in students' subject-specific chemical competencies, including experimental skills, data interpretation, and the ability to explain chemical phenomena using scientific concepts. The integration of inquiry-based laboratory experiments enabled students to move beyond memorization toward understanding causal relationships between chemical structures, reactions, and observable outcomes. This approach also contributed to the development of safe laboratory practices and responsible attitudes toward chemical substances.

In addition to subject-specific competencies, the competency-based organization of chemistry lessons facilitated the formation of transversal skills such as communication, teamwork, and self-directed learning. Group-based tasks and project-oriented activities encouraged students to exchange ideas, justify their conclusions, and reflect on their learning processes. Formative assessment methods played a significant role in supporting continuous feedback and self-regulation, allowing students to identify learning gaps and improve their performance progressively.

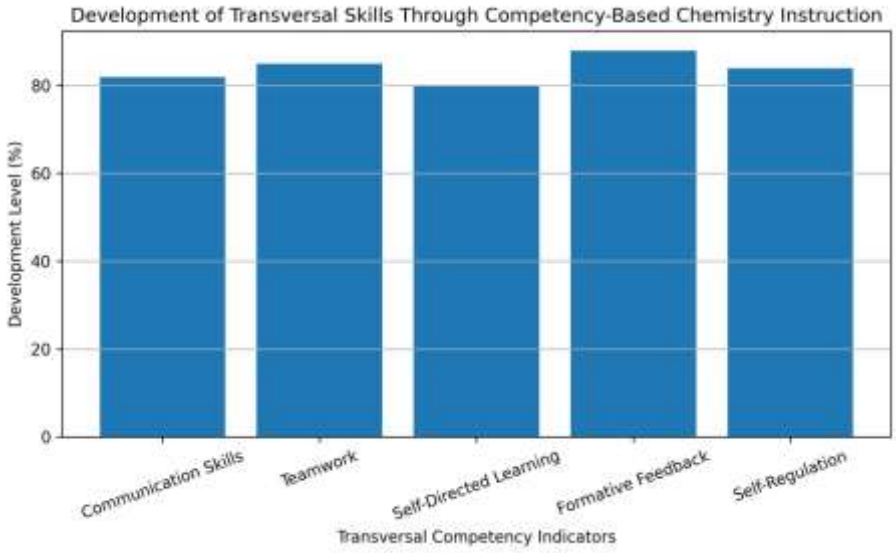

Figure 2. Development of transversal competencies through competency-based chemistry instruction

The discussion highlights that the effectiveness of competency-based chemistry instruction largely depends on the teacher's methodological preparedness and the availability of appropriate instructional resources. Teachers who applied varied teaching strategies and aligned assessment methods with learning outcomes were more successful in fostering competency development. However, certain challenges were identified, including limited laboratory resources, time constraints, and the need for professional development in competency-oriented assessment practices.

Overall, the findings confirm that a competency-based approach enhances the quality of chemistry education by bridging theoretical knowledge with practical application. The discussion underscores the necessity of systematic methodological support and institutional conditions to ensure the sustainable implementation of competency-based chemistry teaching in general secondary schools.

CONCLUSION

The competency-based approach to organizing chemistry lessons in general secondary schools represents an effective methodological framework for improving the quality and relevance of chemistry education. The findings of this study demonstrate that competency-oriented instruction shifts the focus from the simple transmission of theoretical knowledge to the development of students' practical skills, scientific thinking, and ability to apply chemical concepts in real-life situations. Such an approach contributes significantly to the formation of subject-specific chemical competencies as well as transversal skills essential for students' academic and personal development.

The study confirms that the successful implementation of competency-based chemistry teaching depends on the coherent integration of learning objectives, instructional methods, and assessment practices. Active learning strategies, inquiry-based laboratory work, and problem-oriented tasks were shown to enhance students' engagement and deepen their understanding of chemical phenomena. Moreover, formative assessment methods played a crucial role in monitoring students' progress and supporting continuous learning through constructive feedback and self-reflection.

At the same time, the research highlights the importance of the chemistry teacher's methodological competence in designing and conducting competency-oriented lessons. Teachers must be adequately prepared to apply innovative teaching methods, organize effective learning environments, and evaluate learning outcomes in alignment with competency-based criteria. Institutional support, access to laboratory resources, and ongoing professional development are therefore essential conditions for sustainable implementation.

In conclusion, the competency-based organization of chemistry lessons offers substantial pedagogical potential for modern general secondary education. Its systematic application can enhance scientific literacy, promote meaningful learning, and better prepare students for further education and real-life challenges. The methodological approaches discussed in this study may serve as a practical guide for improving chemistry teaching practices in general secondary schools.

References

1. Жиемуратова, А. А. (2024). ОЦЕНКА ВАЖНОСТИ И ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ СОВРЕМЕННЫХ ИКТ ПРИ ПРЕПОДАВАНИИ НЕОРГАНИЧЕСКОЙ ХИМИИ В ВЫСШИХ УЧЕБНЫХ ЗАВЕДЕНИЯХ. Talqin va tadqiqotlar ilmiy-uslubiy jurnali, 2(58), 445-449.

2. Abdusoliyev, S., Bobojonov, J., & Dilmurodov, M. (2025). KIMYO O ‘RGANISH UCHUN MOBIL O ‘YIN ILOVASINI RIVOJLANTIRISH. Modern Science and Research, 4(5), 55-59.

3. Pardayev, U. B., Abdullayeva, B., & Abduraximova, M. T. (2025). ZAMONAVIY VIRTUAL LABORATORIYA PLATFORMALARIDAN FOYDALANIB KIMYO FANINI O ‘QITISH SAMARADORLIGINI OSHIRISH. Modern Science and Research, 4(5), 48-50.

4. Косимова, Х. Р., Рахмонбердиева, Б. Р., & Нурова, М. С. (2025). ЭФФЕКТИВНОСТЬ МЕТОДОВ ПОВЫШЕНИЯ МОТИВАЦИИ УЧАЩИХСЯ ПРИ ОБУЧЕНИИ ХИМИИ. Universum: психология и образование, 1(4 (130)), 35-41.

5. Tog'ayeva, M. (2025). BO‘LAJAK KIMYO O‘QITUVCHILARINING KIMYOVIY EKSPERIMENTDAN FOYDALANIB DARS SAMARADORLIGINI OSHIRISH USULLARI. " ПЕДАГОГИЧЕСКАЯ АКМЕОЛОГИЯ" международный научно-методический журнал, 4(21).

6. oglu Raufov, K. O., & Mamirzayev, M. A. (2025, November). IMPLEMENTING THE DICE-STONE TECHNIQUE IN TEACHING THE PRINCIPAL CLASSES OF INORGANIC COMPOUNDS. In International Conference Platform (No. 5, pp. 13-17).

7. Amangeldievna, J. A., Xayrullo o'g, P. U. B., & Shermatovich, B. J. (2024). Integrated teaching of inorganic chemistry with modern information technologies in higher education institutions. fan va ta'lim integratsiyasi (integration of science and education), 2(1), 92-98.

8. Mamirzayev, M. (2025). KIMYO DARSLARIDA MULTIMEDIA VA VIRTUAL TEXNOLOGIYALARNI INTEGRATSIYA QILISH. Modern Science and Research, 4(5), 27-30.

9. qizi Djumanazarova, R. N. J. (2025, November). THE IMPORTANCE OF LABORATORY EQUIPMENT IN TEACHING CHEMISTRY IN GENERAL SECONDARY SCHOOLS. In International Conference Platform (No. 5, pp. 52-55).

10. Xaliqulov, X., Abdukarimova, M., & Tilyabov, M. (2025). KIMYO DARSLARIDA EKOLOGIK MUAMMOLARNI YORITISH ORQALI EKOLOGIK MADANIYATNI SHAKLLANTIRISH. Modern Science and Research, 4(5), 66-70.

11. Qahramon o‘g‘li, X. M., & Akromovna, T. M. (2025). KIMYO OQITISH JARAYONIDA EKSPERIMENTLARNING AHAMIYATI. SHOKH LIBRARY, 1(11).

12. Эргашев, Э. Ю., Латипова, Ё. Л. К., & Хамрокулова, Ф. Р. К. (2025). ФОРМИРОВАНИЕ СОВМЕСТНОЙ РАБОТЫ ПО МЕТОДИКЕ «INSERT» ПРИ ПРЕПОДАВАНИИ ТЕМЫ «ФИЗИКО-ХИМИЧЕСКИЕ ИЗМЕНЕНИЯ». Universum: психология и образование, 1(1 (127)), 64-68.

13. O‘G‘Li, U. B. X., Jiemuratova, A. A., & Abduraximova, M. T. A. (2025). The effectiveness of using modern information and communication technologies (ICT) in chemistry education. Science and Education, 6(2), 350-363.

14. Tilyabov, M., & Pardayev, U. B. (2025). KIMYO DARSLARIDA O ‘QUVCHILARNI LOYIHAVIY FAOLIYATGA JALB QILISH USULLARI. Modern Science and Research, 4(5), 42-44.

15. Xayrullo o‘g‘li, U. B., Khudoyberdiyev, B. S., & Xolmirzayev, M. M. (2025). The didactic potential of laboratory experiments in developing functional literacy. Academic Journal of Science, Technology and Education, 1(2), 50-54.

16. Azim o‘g‘li, O. R., Xayrullo o'g, P. U. B., & Umurzokovich, T. M. (2024). Importance of integrating virtual laboratory software into analytical chemistry and learning processes. FAN VA TA'LIM INTEGRATSIYASI (INTEGRATION OF SCIENCE AND EDUCATION), 2(1), 38-43.

17. Xayrullo o‘g, P. U. B., & Khoriddinovich, I. Y. (2025). DEVELOPING FUNCTIONAL LITERACY THROUGH ENVIRONMENTAL EDUCATION IN CHEMISTRY TEACHING.

TANQIDIY NAZAR, TAHLILIY TAFAKKUR VA INNOVATSION G ‘OYALAR, 2(1), 1085-1090.

18. Эргашев, Э. Ю., Тогаева, М. А., & Юнусова, Н. Ш. К. (2025). МЕТОДИКА ПРЕПОДАВАНИЯ НОВЫХ И СЛОЖНЫХ ТЕМ ВКЛЮЧЕННЫХ В УЧЕБНИКИ ХИМИИ. Universum: психология и образование, 1(5 (131)), 66-69.