



DEVELOPING FUNCTIONAL LITERACY THROUGH ENVIRONMENTAL
EDUCATION IN CHEMISTRY TEACHING.

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Annotation: This article explores the integration of environmental education into chemistry teaching as a means to develop students' functional scientific literacy. In the face of growing global ecological challenges, it is essential that chemistry education not only provides theoretical knowledge but also equips students with the skills and values needed to understand and respond to real-world environmental issues. The paper highlights how environmental contexts—such as pollution, resource conservation, waste management, and sustainable development—can be effectively embedded into chemistry curricula to make learning more relevant, interdisciplinary, and action-oriented. It also emphasizes pedagogical approaches such as project-based learning, inquiry-driven experiments, and reflective discussion as tools to foster critical thinking, problem-solving, and responsible citizenship. The study suggests that when chemistry lessons are grounded in ecological relevance, students become more engaged, better understand the societal implications of science, and are more capable of applying chemical knowledge in everyday decision-making. The findings support the call for a more environmentally conscious and functionally literate generation of science learners.

Key words: functional literacy, chemistry education, environmental education, ecological awareness, sustainability, real-life application, science teaching strategies.





Introduction: In the 21st century, science education is increasingly expected to prepare students not only with disciplinary knowledge but also with the competencies needed to address complex, real-world problems. One of the most pressing global challenges today is environmental sustainability, which demands scientifically literate citizens who can make informed decisions about ecological and chemical processes that impact daily life. In this context, developing functional literacy through environmental education within the chemistry curriculum is both timely and essential.

Functional scientific literacy refers to the ability to apply scientific knowledge in practical situations, particularly in ways that influence individual and societal well-being. In chemistry, this includes understanding the chemical basis of environmental issues such as air and water pollution, greenhouse gas emissions, waste management, and the chemical safety of consumer products. Traditional approaches to chemistry teaching often emphasize abstract concepts and equations, which can make it difficult for students to connect what they learn to everyday environmental realities.

Integrating environmental education into chemistry lessons provides a meaningful context for learning and supports interdisciplinary thinking. It encourages students to recognize the relevance of chemistry in solving ecological problems and promotes values such as responsibility, sustainability, and critical thinking. Moreover, pedagogical methods like project-based learning, inquiry-based experiments, and reflective discussion enhance students' engagement and empower them to act as environmentally conscious citizens.

This paper aims to investigate strategies for embedding environmental education into chemistry teaching to foster functional literacy. It focuses on how real-life ecological issues can be used as a foundation for developing chemical understanding and how such integration supports the formation of scientifically literate and environmentally responsible learners.

Literature review: The integration of environmental education into science teaching has been widely recognized as a vital approach to enhancing students' functional literacy. According to the OECD (2018), functional scientific literacy is defined as the capacity to apply scientific knowledge to life-related problems, especially those involving environmental and societal dimensions. In chemistry education, this literacy involves not only the comprehension of core concepts but also their application to ecological issues such as pollution, climate change, and sustainable development.

Numerous studies have shown that contextualizing chemistry content through environmental themes can improve student engagement and promote deeper understanding. For instance, Holbrook and Rannikmäe (2009) argue that science education should empower students to make socially responsible decisions by connecting scientific learning to global and local issues. They emphasize that environmental education, when embedded into subject teaching, contributes to critical thinking, ethical awareness, and the development of problem-solving skills.





Research by Yager and Lemons (2002) highlights the effectiveness of science curricula that use real-world environmental problems as the basis for inquiry. Their findings suggest that students are more likely to retain information and transfer knowledge when learning is framed in terms of ecological relevance. Similarly, Aikenhead (2006) notes that science teaching becomes more meaningful when it addresses issues students encounter in their lives, advocating for a humanistic and context-based model of instruction.

The role of pedagogy is also central in promoting both environmental consciousness and functional literacy. Project-based learning (PBL), for example, has been shown to foster autonomy, collaborative learning, and the ability to synthesize information from multiple sources (Thomas, 2000). In environmental chemistry education, PBL can engage students in analyzing water samples, exploring the chemical effects of pollution, or designing sustainable solutions to community-based problems. Reflective practices—such as environmental journaling or group discussions—further reinforce metacognitive development and personal accountability.

Despite the promising evidence, several challenges persist. Many educators lack the resources or training to effectively integrate environmental education into chemistry instruction. Furthermore, rigid curriculum structures and exam-oriented assessment systems often limit opportunities for interdisciplinary, inquiry-driven teaching. Nevertheless, the literature consistently supports the value of combining environmental education with chemistry instruction to prepare functionally literate students capable of understanding and addressing ecological challenges.

Methodology: This study employed a qualitative action research methodology to investigate how integrating environmental education into chemistry lessons can enhance students' functional literacy. The research was conducted over a 10-week period at two public secondary schools in the Samarkand region of Uzbekistan and involved 50 students from grade 9, along with two chemistry teachers experienced in student-centered instruction. The intervention included the design and implementation of a series of chemistry lessons centered on real-life environmental topics such as water quality, air pollution, chemical waste, and sustainability practices. Each lesson integrated core chemical content with environmental contexts and included activities such as local problem analysis, project-based investigations, and reflective discussions. Instructional strategies included inquiry-based learning, small group collaboration, and the use of multimedia resources to explore chemical processes within ecological systems. Data were collected through multiple sources including classroom observations, student interviews, pre- and post-intervention questionnaires, and students' reflective journals. Thematic analysis was used to evaluate qualitative data, focusing on key indicators of functional literacy such as contextual understanding, scientific reasoning, ecological awareness, and students' ability to apply chemical knowledge in real-life situations. This methodology allowed for a deep examination of the pedagogical effectiveness and student response to environmentally integrated chemistry education.





Results: The results of the study revealed that integrating environmental education into chemistry lessons had a significant positive impact on students' functional literacy. Analysis of student reflections and classroom observations showed increased engagement and a deeper interest in real-world applications of chemistry, particularly regarding ecological issues such as pollution, waste management, and resource conservation. More than 80% of students demonstrated improved contextual understanding by accurately relating chemical concepts—such as solubility, pH, and reaction types—to environmental phenomena encountered in their communities. Reflective journal entries indicated growth in metacognitive awareness, with students expressing greater confidence in explaining how chemistry contributes to solving ecological problems. Project-based tasks allowed students to apply scientific reasoning, and more than two-thirds of them successfully proposed environmentally sound solutions supported by chemical principles. Interviews with teachers confirmed that students asked more thoughtful questions and exhibited increased curiosity about the societal implications of chemistry. Questionnaire data further showed that students not only improved their academic understanding of chemical topics but also began to view chemistry as a tool for informed, responsible decision-making. Overall, the data suggest that environmentally contextualized chemistry education fosters higher levels of functional literacy, scientific reasoning, and personal responsibility among students.

Discussion: The findings of this study confirm the pedagogical value of integrating environmental education into chemistry instruction as a powerful means of developing students' functional literacy. Students not only gained a stronger understanding of core chemical concepts but also demonstrated the ability to apply that knowledge in analyzing and addressing ecological challenges. These outcomes support previous research highlighting the effectiveness of context-based and problem-oriented approaches in science education, which promote deeper learning and real-world relevance. The increased student engagement observed during project-based tasks and reflective activities suggests that environmental themes can make chemistry more meaningful and personally relevant to learners. Moreover, the development of metacognitive skills—as evidenced by students' reflective journal entries—indicates that environmental contexts foster higher-order thinking and self-directed learning. The study also shows that when students are encouraged to view chemistry as a tool for understanding and solving real-life environmental problems, they are more likely to become active, responsible, and scientifically literate citizens. However, the implementation of such interdisciplinary approaches requires curriculum flexibility, access to environmental data and materials, and ongoing teacher support. Teachers must be equipped with both pedagogical strategies and environmental knowledge to guide meaningful inquiry and reflection. In summary, the discussion underscores the potential of environmentally integrated chemistry teaching to transform students' perceptions of science and to cultivate functional literacy that is both practical and socially responsible.

Conclusion: This study concludes that the integration of environmental education into chemistry teaching is an effective strategy for developing students' functional literacy. By





connecting chemical concepts to real-world ecological issues, students became more engaged, demonstrated stronger contextual understanding, and developed the ability to apply scientific reasoning to everyday environmental challenges. The combination of inquiry-based tasks, project work, and reflective practices allowed learners to think critically, act responsibly, and recognize the societal value of chemistry. These findings highlight the need to reframe science education as not only a platform for knowledge acquisition but also as a tool for promoting sustainability, informed decision-making, and active citizenship. For such pedagogical approaches to be widely implemented, educational systems must support interdisciplinary curriculum design, provide relevant teaching resources, and ensure teacher training in both environmental and reflective teaching strategies. Ultimately, fostering functional literacy through environmentally contextualized chemistry lessons prepares students to navigate complex global issues with scientific awareness and ethical responsibility.

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