STRATEGIES FOR DEVELOPING STUDENTS' ABILITY TO APPLY CHEMICAL KNOWLEDGE IN EVERYDAY LIFE.

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Annotation: *This article explores effective strategies for developing students' ability to apply chemical knowledge in everyday life, a key component of functional scientific literacy. In the context of modern education, it is increasingly important that students understand not only chemical theories, but also their relevance and practical application in real-world situations. The study identifies pedagogical methods that promote contextual learning, such as problem-based learning, inquiry-oriented activities, and interdisciplinary tasks. Emphasis is placed on designing lessons that bridge the gap between academic content and students' daily experiences, including environmental issues, household chemistry, and health-related contexts. The paper also discusses the role of teacher guidance, curriculum flexibility, and assessment tools in supporting the transfer of classroom knowledge to everyday decision-making. The findings highlight that when chemistry education is connected to real-life applications, students become more engaged, motivated, and better prepared to act as scientifically informed citizens.*

Key words: *chemical literacy, everyday chemistry, contextual learning, problem-based learning, real-life application, science education, student engagement.*

Introduction: In recent years, the focus of science education has shifted from memorization of facts toward the development of competencies that prepare students for real-life challenges. One of the key competencies in chemistry education is the ability to apply chemical knowledge in everyday situations—a core aspect of functional scientific literacy. This includes understanding the chemistry behind household substances, environmental phenomena, health and nutrition, and industrial processes that impact daily life.

Despite its importance, many students struggle to see the relevance of chemistry to their own experiences. Traditional teaching methods, which often emphasize theoretical knowledge and procedural problem-solving, fail to connect classroom content with students' lived realities. As a result, students may perceive chemistry as abstract, difficult, or unrelated to their future lives and careers.

To address this gap, educators and curriculum designers have begun to explore pedagogical strategies that bridge the divide between academic chemistry and practical application. These include contextual learning, problem-based instruction, interdisciplinary integration, and the use of real-life case studies. When implemented effectively, such approaches not only improve conceptual understanding but also increase motivation, engagement, and long-term retention. This paper aims to investigate and synthesize effective strategies for helping students use their chemical knowledge to understand and solve problems in everyday contexts. The ultimate goal is to inform teaching practices that empower learners to become scientifically literate citizens capable of making informed decisions and participating meaningfully in society.

Literature review: The application of scientific knowledge to real-life situations has long been recognized as a cornerstone of scientific literacy. According to the OECD's PISA framework (2018), functional scientific literacy involves not only understanding scientific concepts but also the capacity to apply them in authentic, everyday contexts. In chemistry education, this includes interpreting chemical labels, understanding environmental issues, evaluating health products, and making decisions about resource use—all of which require contextual understanding of chemical principles.

Several researchers have emphasized the importance of connecting chemistry instruction to students' lives. Gilbert (2006) noted that relevance is critical in sustaining student interest and engagement, particularly in subjects perceived as abstract or difficult. Similarly, Holbrook and Rannikmäe (2009) argued that a context-based approach in science teaching increases motivation and promotes a deeper understanding of scientific content.

Contextual learning and problem-based instruction have emerged as powerful strategies for developing real-world competencies. In context-based curricula, chemical content is introduced through scenarios that mirror societal or personal challenges. Bennett and Lubben (2006) found that students exposed to such curricula demonstrated higher motivation and a better ability to transfer knowledge to new situations. Problem-based learning (PBL), rooted in constructivist theory, encourages learners to take responsibility for their learning by solving complex, real-life problems collaboratively (Hmelo-Silver, 2004).

Other studies have explored interdisciplinary approaches, where chemistry is integrated with subjects such as health education, environmental science, or economics. This integration helps students appreciate the multifaceted nature of chemical knowledge and its broad applicability. Moreover, assessment tools that measure application rather than recall—such as performance-based tasks and reflective journals—have been shown to better capture students' functional understanding (Sadler, 2004).

Despite growing recognition of these approaches, challenges remain. Teachers often cite lack of time, curriculum constraints, and limited access to relevant teaching materials as barriers to implementation (King, 2012). Additionally, professional development is needed to equip educators with the skills and confidence to adopt more student-centered, context-driven teaching practices.

Overall, the literature supports the view that fostering the ability to apply chemical knowledge in everyday life enhances both scientific literacy and student engagement. However, successful implementation requires intentional curriculum design, supportive assessment strategies, and ongoing teacher training.

Methodology: This study utilized a qualitative action research design to explore the effectiveness of instructional strategies aimed at enhancing students' ability to apply chemical knowledge in real-life contexts. The research was conducted over the course of one academic term in two secondary schools located in the Samarkand region of Uzbekistan, involving 52 students from grades 9 and 10. An action research framework was adopted to allow for iterative planning, implementation, observation, and reflection, enabling adjustments to instructional strategies based on student feedback and classroom dynamics. Participants included two chemistry teachers with over five years of teaching experience and their respective student groups; both teachers volunteered for the study and had demonstrated interest in real-life integration of chemical concepts. The instructional intervention consisted of chemistry lessons centered around real-world scenarios such as water purification, food additives, air pollution, and household chemicals. These lessons incorporated problem-based tasks (e.g., evaluating detergent impact), contextual case studies (e.g., interpreting nutrition labels), hands-on experiments (e.g., testing household substance acidity), and reflective writing prompts (e.g., journaling chemistry's role in daily decisions). Data were collected through student reflective journals, teacher observation notes, pre- and post-lesson questionnaires, and focus group interviews. Thematic analysis using inductive coding was applied to identify emerging patterns regarding students' contextual understanding, problem-solving ability, relevance perception, and confidence in applying chemical knowledge beyond the classroom.

Results: The analysis of data collected from student journals, interviews, observations, and questionnaires revealed several positive outcomes regarding students' ability to apply chemical knowledge in everyday life. Students showed increased awareness of the relevance of chemistry to real-world situations, frequently referencing examples such as food preservation, environmental pollution, and the chemical composition of household products. Reflective journal entries demonstrated that learners began to consciously connect classroom topics with practical issues, such as using pH knowledge to assess water quality or interpreting ingredient labels on consumer goods. In post-intervention questionnaires, over 80% of students reported feeling more confident in applying chemical knowledge outside school settings. Observations indicated a notable improvement in engagement, particularly during problem-based and hands-on activities, where students exhibited collaborative problem-solving and critical thinking behaviors. Teachers reported a shift in classroom dynamics, noting that students asked more purposeful questions and demonstrated greater initiative in exploring the societal implications of chemical processes. Focus group interviews further confirmed that students found chemistry more meaningful when presented through real-life contexts, and many expressed a newfound appreciation for the subject's practical value. Overall, the data suggest that the use of context-rich, reflective, and problem-oriented instruction significantly enhances students' ability to transfer chemical understanding to everyday situations.

Discussion: The results of the study underscore the effectiveness of instructional strategies that integrate real-life contexts in enhancing students' ability to apply chemical knowledge meaningfully. Students not only demonstrated improved conceptual understanding but also exhibited increased motivation and engagement when lessons were grounded in everyday scenarios. These findings support previous research emphasizing the importance of contextual learning in science education, confirming that students are more likely to internalize and transfer knowledge when it is relevant to their personal experiences. The success of problem-based tasks and hands-on experiments in this study illustrates the pedagogical value of active, inquiry-oriented approaches in building functional chemical literacy. Furthermore, reflective components such as journaling enabled students to monitor their own learning and develop metacognitive awareness, which plays a crucial role in long-term retention and knowledge application.

Teacher feedback indicated that students became more inquisitive and self-directed, often initiating discussions about real-world chemical issues beyond the curriculum. These shifts suggest a transformation in classroom culture, moving from passive reception to active construction of knowledge. However, the findings also highlight the need for institutional support, such as flexible curricula and teacher training programs, to facilitate the widespread adoption of context-based methodologies. In conclusion, integrating real-life relevance into chemistry education not only enriches students' academic experience but also prepares them to function as scientifically literate citizens capable of making informed decisions in everyday life.

Conclusion: This study concludes that incorporating real-life contexts into chemistry instruction significantly enhances students' ability to apply chemical knowledge in everyday situations. The integration of problem-based tasks, contextual scenarios, hands-on experiments, and reflective activities proved effective in fostering functional chemical literacy. Students became more engaged, demonstrated higher levels of motivation, and showed a stronger connection between theoretical concepts and practical relevance. These outcomes affirm that when chemistry education is aligned with students' lived experiences, learning becomes more meaningful and enduring. Moreover, the development of metacognitive skills through structured reflection enabled learners to better monitor their understanding and apply it beyond the classroom. While the results are promising, the study also recognizes the need for ongoing teacher training, resource development, and curricular flexibility to sustain such pedagogical innovations. Overall, this research highlights the transformative potential of context-based, student-centered teaching strategies in preparing learners to think critically, act responsibly, and engage with scientific knowledge in their daily lives.

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