

USING PROBLEM-BASED LEARNING TECHNOLOGIES IN TEACHING CHEMISTRY

Turgunboyev Shavkatjon Shuhratjon ugli

Associate Professor (PhD) of the Department of Chemistry,

Fergana State University

Annotation: This article explores the application of problem-based learning (PBL) technologies in teaching chemistry. PBL is an innovative instructional strategy that emphasizes student-centered inquiry, critical thinking, and real-world problem-solving. The article discusses how integrating PBL into chemistry education enhances conceptual understanding, fosters engagement, and promotes lifelong learning skills. It also presents examples of PBL tasks and outlines the challenges and benefits associated with its implementation.

Key Words: Problem-based learning, chemistry education, critical thinking, student engagement, inquiry-based learning, real-world problems, active learning, teaching methods.

Modern educational approaches emphasize not only the transmission of knowledge but also the development of skills that prepare students for real-life challenges. In this context, **problem-based learning (PBL)** has emerged as an effective pedagogical strategy that supports deeper learning. In chemistry education, PBL is particularly valuable because it connects abstract chemical concepts to practical applications, encouraging students to engage in active exploration and inquiry.

Chemistry, being both theoretical and experimental in nature, provides an ideal context for implementing PBL. Unlike traditional lecture-based methods, PBL shifts the focus from teacher-led instruction to student-led investigation, where learners tackle complex, real-world problems and collaboratively seek solutions. This method supports not only subject mastery but also the development of skills such as critical thinking, teamwork, and self-directed learning.

Problem-based learning (PBL) has gained considerable attention as a transformative approach in science education, particularly in subjects like chemistry where understanding abstract concepts and applying them to real-world scenarios is essential. Unlike traditional teaching methods that often rely on passive absorption of information through lectures and textbook exercises, PBL encourages students to take an active role in their learning by engaging with complex, authentic problems that require investigation, analysis, and solution development. In the context of chemistry education, this method not only makes the subject matter more relevant and meaningful but also cultivates essential skills such as critical thinking, collaboration, and scientific reasoning. For instance, rather than simply teaching students the chemical properties of acids and bases, a teacher using PBL might present a scenario involving environmental pollution in a local water source, challenging students to analyze the problem, determine the causes of pH imbalance, and propose practical solutions based on chemical principles.

Through such immersive tasks, students are encouraged to research independently, discuss their ideas in groups, and apply theoretical knowledge in practical contexts, thereby reinforcing their understanding and retention of core concepts. This approach mirrors the investigative nature of scientific work and prepares students for future academic and professional challenges. Teachers in PBL environments act as facilitators who guide student inquiry, help refine research questions, and support collaborative learning rather than simply delivering content. One of the key advantages of PBL is its capacity to motivate students by presenting chemistry not as a set of disconnected facts, but as a dynamic and useful tool for solving real-life issues such as climate change, industrial waste management, drug development, or food safety. As a result, learners become more engaged, curious, and empowered to take ownership of their education.

Despite its numerous advantages, implementing PBL in chemistry classrooms requires thoughtful preparation and a shift in instructional design. Teachers must invest time in developing well-structured, open-ended problems and be prepared to manage diverse learning paths as students explore various hypotheses and solutions. Additionally, assessment in PBL settings can be more complex, as it must evaluate not only content mastery but also process skills such as teamwork, communication, and problem-solving strategies. Nonetheless, many educators have found that the long-term benefits—greater student engagement, improved academic performance, and enhanced scientific literacy—far outweigh the initial challenges. As educational institutions increasingly emphasize skills-based learning and interdisciplinary competence, the integration of PBL into chemistry instruction offers a promising path toward deeper, more effective science education.

Conclusion

In conclusion, the implementation of problem-based learning technologies in the teaching of chemistry marks a significant shift toward a more student-centered, inquiry-based educational paradigm. By embedding real-world problems into the learning process, PBL not only enhances the acquisition of chemical knowledge but also strengthens students' ability to think critically, collaborate effectively, and solve complex challenges. It transforms the chemistry classroom into a dynamic learning environment where theoretical concepts are applied to practical situations, thus making learning more engaging and meaningful. Furthermore, PBL aligns well with the principles of modern education that prioritize skill development, interdisciplinary thinking, and lifelong learning.

While the transition from traditional teaching to PBL may pose challenges—such as increased preparation time, the need for adaptable assessment tools, and ensuring all students are equally engaged—the benefits are substantial. Students become active participants in their own education, capable of asking relevant questions, conducting research, and justifying their conclusions. As the demands of the 21st-century workforce continue to evolve, educators must equip students not only with knowledge but with the ability to apply that knowledge creatively and responsibly. Therefore, integrating PBL into chemistry education is not just an instructional choice but a necessary step toward preparing scientifically literate, competent, and motivated learners. Future research and teacher training programs should continue to focus on developing effective PBL strategies and sharing best practices to ensure its successful adoption across diverse educational settings.

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