THE IMPACT OF PROBLEM SITUATIONS IN CHEMISTRY TEACHING ON STUDENTS' CAUSE–EFFECT REASONING

Nagiyev K. J.
Baku State University, Baku, Azerbaijan
xalil-71@rambler.ru

This paper examines how the systematic use of problem situations in chemistry lessons influences students' cause–effect reasoning. Problem situations are designed as cognitively challenging contexts that require learners to explain chemical phenomena, justify relationships between variables, and predict outcomes based on evidence. The study focuses on how such tasks support deeper conceptual understanding, reduce rote memorization, and strengthen students' ability to build coherent explanations. The article proposes a classroom-based framework for designing problem situations and evaluating changes in students' reasoning quality through structured prompts and formative assessment criteria. Developing cause–effect reasoning is a core goal of contemporary science education, yet many chemistry classrooms still emphasize algorithmic problem solving and factual recall. As a result, students often know formulas and procedures but struggle to explain *why* a reaction occurs, *how* conditions affect equilibrium, or *what* mechanisms connect observations to theory. Problem situations address this gap by creating meaningful intellectual tension and requiring learners to link evidence, concepts, and conclusions. Therefore, investigating their impact is timely for improving conceptual learning outcomes, supporting competency-based curricula, and strengthening scientific literacy in secondary chemistry education [1].

The purpose of this study is to determine the extent to which the use of problem situations in chemistry teaching improves students' cause–effect reasoning, specifically their ability to (1) identify causal factors in chemical phenomena, (2) justify relationships between variables using chemical concepts, and (3) predict and explain outcomes based on evidence and logical argumentation. The scientific novelty of this study lies in its focused examination of problem situations as a structured didactic tool for developing cause–effect reasoning in chemistry education. Unlike traditional studies that treat problem-based learning as a general instructional approach, this research conceptualizes *problem situations* as targeted cognitive triggers designed to elicit causal explanations, justification of relationships, and predictive reasoning. The study introduces a clear framework for aligning problem situations with specific types of causal reasoning (linear, conditional, and multivariate), offering a refined perspective on how reasoning skills can be systematically cultivated within secondary chemistry lessons. The practical significance of this research is reflected in its applicability to everyday chemistry teaching practice. The proposed approach provides chemistry teachers with concrete guidelines for designing problem situations that stimulate cause–effect reasoning without requiring additional laboratory resources or technological tools. The findings can be directly used to improve lesson planning, formative assessment, and classroom discourse by shifting the focus from procedural correctness to explanatory quality. Furthermore, the results support curriculum developers and teacher educators in integrating reasoning-oriented tasks into textbooks, instructional materials, and professional development programs [2].

The study concludes that the purposeful integration of problem situations into chemistry teaching significantly enhances students' cause–effect reasoning. Students exposed to such instructional practices demonstrate improved ability to analyze chemical phenomena, justify causal relationships, and construct coherent explanations based on evidence. These outcomes suggest that problem situations serve not only as motivational elements, but also as effective cognitive instruments for deepening conceptual understanding. The findings highlight the importance of reorienting chemistry instruction toward reasoning-centered learning, thereby contributing to more meaningful and transferable scientific knowledge.

References

1. Nagiyev Khalil, K.J., Pashayeva Arzu A.A., Elyasova Jale J.E. Organization and implementation of laboratory works in chemistry for 8th grade. // Current chemical problems. VIII International (XVIII Ukrainian) scientific conference for students and young scientists. March 25–27, 2025. Vinnytsia, Ukraine. 2025. p.111

2. Nagiyev Khalil, K.J., Pashayeva Arzu A.A., Mammadova K. M. The effect of modular teaching in organic chemistry lessons on the development of students' research skills. // Proceedings of the 4 th International Scientific and Practical Conference "Modern knowledge: Research and discoveries". February 19-20, 2025. Vancouver, Canada. 2025. №236, p.131-136. https://doi.org/10.51582/interconf.19-20.02.2025