UTILIZATION OF CONTEXTUALIZED TASKS IN EXPERIMENTAL ORIENTED INDEPENDENT LEARNING

Shoira Bobonazarovna Farmanova,

PhD, Associate Professor, Department of Chemistry and Methodology of Its Teaching, Nizami Tashkent State Pedagogical University

Abstract:
This article elucidates the significance of employing experimental contextualized tasks within independent learning, and offers methodological recommendations for solving such tasks through an experimental approach. This pedagogical strategy facilitates the development of students' capacity for autonomous critical thinking and the acquisition of practical competencies during the educational process.

Keywords:
independent learning; experimental task; sulfur; physicochemical properties; contextualized tasks; competencies; research; practical outcomes; analysis.

1. Introduction

Independent learning is a pivotal pedagogical approach aimed not only at furnishing students with theoretical knowledge but also at cultivating their practical skills. Among such innovative methods are experimental contextualized tasks, which integrate theoretical concepts with real-world problem-solving exercises, thereby enhancing the overall efficacy of the learning process. Through these tasks, students bridge abstract chemical theories and their applications, leading to deeper understanding and skill development.

2. Experimental Contextualized Task I: The Dead Sea

Topic: Formation and properties of sulfuric acid
Context:
Despite its ominous name, the Dead Sea—located on the border between Israel and Jordan—possesses numerous unique characteristics. Its water, primarily supplied by the Jordan River, contains an exceptionally high concentration of dissolved salts. Industrial and agricultural utilization of Jordan River water has reduced the inflow,

resulting in hypersaline conditions unsuitable for aquatic life, hence the appellation "Dead Sea." Recent research has also revealed the presence of sulfuric acid–rich springs on the seabed, which contribute to the lake's geochemical dynamics.

Task:
How might sulfuric acid form on the Dead Sea floor?

Expected Answer:
Chemosynthetic bacteria oxidize hydrogen sulfide to sulfuric acid.

Objective of the Experiment:

- To instruct students in the laboratory preparation of sulfuric acid from hydrogen sulfide.
- To develop competencies in writing and analyzing chemical reaction equations.
- To foster independent experimental work and conclusion-drawing skills.

2.1 Theoretical Basis

In laboratory conditions, elemental sulfur or hydrogen sulfide can be oxidized to sulfur dioxide, which, under the influence of molecular oxygen in the presence of a catalyst, converts to sulfur trioxide; subsequent reaction with water yields sulfuric acid. The sequence of reactions is as follows:

$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$$

$$2SO_2 + O_2 \rightarrow 2SO_3$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

2.2 Experimental Procedure

1. **Reagents and Apparatus:**
   - Source of H_2S gas (generated via the reaction of FeS with HCl)
   - Catalysts: Cr_2O_3 or V_2O_5
   - Distilled water, litmus paper, test tubes, gas-delivery tubing
2. **Steps:**
   1. $FeS + 2HCl \rightarrow FeCl_2 + H_2S$
   2. Oxidize the evolved H_2S in the presence of oxygen to yield SO_2.
   3. Catalytically oxidize SO_2 to SO_3 using the chosen catalyst.
   4. Absorb SO_3 into distilled water to form H_2SO_4.
   5. Confirm acidity of the resulting solution using litmus paper.

Through independent execution of this experiment, students consolidate both theoretical and practical knowledge, while enhancing problem-solving and logical reasoning skills. The use of experimental contexts renders the study of chemistry more engaging and comprehensible.

3. Experimental Contextualized Task II: Solution Density at the Dead Sea

Topic: Density of solutions
Context:
The Dead Sea, situated on the Arabian Peninsula, ranks second worldwide—after Lake Assal in Africa—in terms of salinity. Whereas average ocean water contains 35 g of salt per liter, Dead Sea water approaches 275 g L^{-1}. This extreme salinity increases buoyancy, allowing even non-swimmers to float effortlessly. Moreover, the mineral-rich water offers therapeutic benefits for conditions such as osteoarthritis, arthritis, and gout, and its minerals are utilized in cosmetic production. However, ingestion of Dead Sea water can lead to poisoning or renal failure. Its water also turns inky black at dusk. Alarmingly, the water level is receding annually;

scientists predict that without intervention, the Dead Sea may vanish within fifty years.

3.1 Theoretical Basis

The phenomenon of human buoyancy in the Dead Sea relates to fundamental physicochemical principles, including solution density and Archimedes' principle. A simple experiment can effectively demonstrate these concepts, deepening students' understanding of fluid properties and reinforcing their scientific reasoning.

3.2 Experimental Procedure

1. **Reagents and Apparatus:**
   - Table salt (NaCl)
   - Distilled water
   - Two transparent cylinders or beakers
   - Two raw eggs
2. **Steps:**
   1. Fill the first vessel with distilled water.
   2. Prepare a saturated salt solution in the second vessel by dissolving salt until no more can dissolve.
   3. Gently place one egg in each vessel and observe their behavior.

3.3 Results and Discussion

- **Observation:** In distilled water, the egg sinks; in the saturated salt solution, the egg remains buoyant.
- **Explanation:** The density of pure water is lower than that of the egg, causing the egg to sink. The saturated salt solution's density exceeds that of the egg, resulting in flotation.

- **Dead Sea Implication:** The Dead Sea's extremely high salt concentration elevates water density above that of the human body, preventing submersion.

3.4 Control Questions and Tasks

1. **Knowledge Check:**
   - Which factors determine the density of solutions?
   - How does increasing salt concentration affect the egg's behavior in water?
   - Why is the density of Dead Sea water greater than that of ordinary seawater?
2. **Analytical Thinking:**
   - What formulas can be used to calculate solution density?
   - Which other solutes might increase solution density if added?
3. **Practical Assignment:**
   - Given 500 mL of water and a target solution density of 1.20 g mL^{-1}, calculate the requisite mass of salt.
4. **Creative Task:**
   - Repeat the experiment using different solutions (e.g., sugar water, vinegar solution, oil–water emulsion) and compare results.

4. Competency Development and Assessment

- **Subject-Matter Competency:** Grasp of solution density and the physicochemical properties of fluids.

- **Practical Competency:** Ability to conduct independent experiments and analyze results.
- **Analytical Thinking:** Drawing evidence-based conclusions from experimental data.
- **Creative Competency:** Designing new experimental tasks and testing hypotheses.

5. Conclusion

Incorporating experimental contextualized tasks into the curriculum significantly contributes to the development of students' scientific and practical competencies. By exploring topics such as sulfur production, its physicochemical properties, and applications, learners not only acquire robust theoretical knowledge but also hone independent research skills, result analysis, and critical conclusion-drawing abilities. Consequently, students evolve into professionals capable of integrating scientific inquiry with real-world problem solving, thus embodying autonomy and analytical proficiency.

References

1. Torayev, Sh. F. (2024). *Methodology for improving independent learning via innovative technologies within a credit-module system*: Doctoral dissertation abstract [PhD thesis]. Bukhara.
2. Shmarion, Yu. V. (2003). *Designing Educational Systems (System–Contextual Approach)*. Belgorod: BelSU.
3. Usmonova, D. T. (2025). Competence-Based Approach in Teaching Environmental Chemistry. *Modern Scientific Research International Scientific Journal*, 3(1), 114–120.
4. Shomurotova, S. Kh., Farmonova, S. B., Kamolova, N. I., & Movlonova, S. A. (2020). Improving the Methodology of Teaching the Role of Metals in Biochemical Processes Using Pedagogical Technologies. *Engineering and Management Journal*, 83