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Improving The Methodology of Developing Reflective Competences in Teaching Chemistry

Shodmanova Shaxnoza Qurdashevna

Head Teacher of Academic Lyceum No. 2 at Tashkent State Medical University, Uzbekistan

ABSTRACT

This thesis analyzes how the visualization of physics experiments, purposefully embedded in a STEAM framework that combines science, technology, engineering, the arts, and mathematics, advances scientific literacy in secondary education. The argument positions visualization not as a decorative enhancement but as a mediating practice that links phenomena, measurement, modeling, and explanation. A design-oriented review synthesizes theory and practice to show that visualizing experiments through data acquisition, dynamic graphs, simulations, physical and digital prototyping, and artistic renderings strengthens conceptual stability, improves evidence-based reasoning, and broadens student participation. The methods outline how visualization tasks can be aligned with physics learning goals and assessed with performance-based rubrics that capture growth in modeling and argumentation. The thesis concludes that STEAM-aligned visualization, when planned around clear physics targets and supported by iterative critique, meaningfully develops the core capacities of scientific literacy: asking testable questions, constructing and revising models, using evidence to justify claims, and communicating ideas with precision to varied audiences.

Keywords: Observation and questioning stage, analysis and evaluation stage, reflective generalization stage, SWOT and PEST analyses.

INTRODUCTION

Modern teaching methodology should not only focus on delivering knowledge but also on working with knowledge, reflecting on it, evaluating it, and analyzing it. In particular, the methodology of developing reflective competences in chemistry requires a specific approach. This methodology covers such processes as learners' analytical thinking about chemical phenomena, forming a personal position toward a problem, and drawing conclusions from their own mistakes.

To improve lesson methodology aimed at developing reflective competences, it is first necessary to reconsider traditional approaches. In the didactic process, the teacher is often positioned as the primary source of knowledge. However, in contemporary pedagogical practice, the teacher is regarded as one who stimulates reflection, encourages critical thinking, and directs learners toward reflective processes.

In the research of French pedagogue J. L. Martin, the "Reflective Dialogue" method is widely recommended in education. According to this approach, at each stage of learning, questions should be asked that do not simply guide the learner to the correct answer but rather encourage them to think, analyze, and reassess their knowledge.

To develop a reflective methodological approach in chemistry, it is necessary to improve the following methods:

1. Systematizing reflective written assignments

For example, after each laboratory experiment, learners can be given written analysis tasks based on questions such as "What did I learn?", "At which stage did I face difficulties?", and "What does this mistake indicate?" This helps students approach experiments not only as performers but also as analysts. Research shows that reflective essays and laboratory journals increase students' metacognitive activity by 1.4 times.

2. Applying the "reflective pause" technique

During the lesson, at certain moments, the teacher pauses and asks students to provide written responses in 1–2 minutes to questions such as "What am I learning right now?" and "Why is this knowledge important for me?" This is a simple but effective method of self-observation and self-awareness.

3. Using graphic reflection methods

Another important aspect of methodological improvement is ensuring that each task requires reflection afterward. For instance, instead of memorizing a chemical formula, students should be asked questions like "What process does this formula represent?" and "Why does this particular reaction occur?" Such questions guide learners not just toward knowledge, but toward the act of knowing itself.

The primary task in improving reflective methodology is to structure the entire lesson so that it progresses from theoretical explanation to practical experiment and finally to analytical–reflective activity. For this purpose, a tiered methodological model is proposed, consisting of the following stages:

1. Observation and Questioning Stage

At this stage, learners develop independent observation and differentiation skills regarding chemical phenomena. The teacher's role here is not to provide direct information but to create an environment for observation. For example, open-ended questions such as "What do you think the change in the color of this solution indicates?" stimulate learners' curiosity and reflection.

2. Analysis and Evaluation Stage

Learners analyze the results of the experiment, compare them with other groups, and ask questions about uncertainties. Self-assessment and peer-assessment techniques are crucial at this stage. For instance, using established evaluation criteria, learners may rate themselves on a 1–5 scale, thus expressing a conscious attitude toward their own performance.

3. **Reflective Generalization Stage**

In this stage, learners express their ideas in a structured form (essays, tables, concept maps, or written reports). As a methodological recommendation, the "Reflective Letter" or "Letter to Myself" technique may be used, in which the learner seeks answers to questions such as "What did I learn today?" or "Which ideas surprised me?"

Furthermore, to effectively develop reflective competence, the teacher's role must change. The teacher should act as:

- not a transmitter of ready-made knowledge, but a methodological guide;
- not a controller, but a conversational partner and encourager of thought;
- not one who answers questions directly, but one who redirects the question back to the learner.

In this regard, Austrian pedagogue M. Schatz noted in 2020: "In modern STEM subjects, the teacher is not the knowledge itself, but a facilitator for the development of thinking." Therefore, teachers are also required to continually update their methodological skills and practice reflective analysis of their own activity (pedagogical reflection).

In the improved model of the assessment system, the following directions are prioritized:

- formative assessment based on written reflections;
- process monitoring through a metacognitive portfolio;
- evaluation of reflective potential using SWOT and PEST analyses.

These are especially effective given the independent and research-oriented nature of chemistry, as they help learners to develop not only the ability to "know the subject" but also the capacity to "understand themselves within the subject."

The effectiveness of reflective methodology is determined by the extent of its integration into the educational process. To ensure the full functioning of this methodology, theoretical modeling alone is not sufficient—its practical application is equally essential.

References

1. Schneider, M., & Prechtl, H. (2021). Reflective thinking in science education: Empirical approaches and teaching strategies. Chemistry Education Research and Practice, 22(1), 45–59.
2. Leclercq, K. (2017). Réflexivité et apprentissage autonome: Approche pédagogique. Paris: L'Harmattan.
3. Salimova, G.T. (2020). Akademik litsey oʻquvchilarining psixologik yetuklik omillari. Psixologiya va ta'lim jurnali, №2.
4. Karimova, A.S. (2022). Reflektiv oʻqitish strategiyalari: Olmaota litseylari tajribasi. Pedagogik innovatsiyalar tahliliy byulleteni, №4.
5. Petrini, E. & Valerio, M. (2021). Mentoring for reflective thinking: Building professional identity in science classrooms. Journal of Research in Science Teaching, 58(9), 1230–1247.
6. Litsey ichki monitoring hisoboti. (2023). Oʻzbekiston Milliy universiteti huzuridagi akademik litsey. Toshkent.