

THE USE OF MODERN PEDAGOGICAL TECHNOLOGIES IN INORGANIC CHEMISTRY CLASSES

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Abstract

This article examines the didactic potential, role in improving educational effectiveness, and methodological characteristics of modern pedagogical technologies used to organize inorganic chemistry lessons. It analyzes opportunities for integrating problem-based learning, project-based learning, the STEAM approach, interactive teaching methods, and digital educational tools. The article also presents methodological recommendations for explaining chemical concepts to learners, simulating experiments, developing independent thinking, and connecting theoretical knowledge with practical applications.

Keywords: Inorganic chemistry, modern pedagogical technologies, interactive methods, STEAM, problem-based learning, project-based learning, digital technologies, virtual laboratory, chemical experiment, competency-based approach.

Introduction

Ongoing reforms in education require not only improving learners' theoretical knowledge but also developing their abilities to think independently, solve problems, analyze information, and apply what they have learned in everyday life. From this perspective, the use of modern pedagogical technologies in teaching the natural sciences, particularly inorganic chemistry, is of considerable importance.

Inorganic chemistry is the branch of chemistry concerned with chemical elements, simple substances and compounds, their structures, physical and chemical properties, methods of preparation, and practical significance. Many topics in this discipline involve abstract concepts, chemical formulas and equations, and processes occurring at the microscopic level. Consequently, learners may encounter difficulties in mastering certain theoretical concepts.

Whereas traditional instruction often places substantial emphasis on the teacher's presentation of ready-made information, modern pedagogical technologies are designed to make learners active participants in the educational process. Learners acquire knowledge by observing phenomena, conducting experiments, seeking answers to questions, working in groups, developing projects, and substantiating their conclusions.

The aim of this article is to examine opportunities for using modern pedagogical technologies in inorganic chemistry lessons and to develop methodological recommendations for their effective integration into teaching practice.

The significance of modern pedagogical technologies in inorganic chemistry education.

Modern pedagogical technologies constitute a systematic approach to the educational process in which teaching content, methods, resources, and assessment procedures are coordinated to achieve specified learning objectives.

When selecting a pedagogical technology, it is necessary to consider the content of the topic, learners' age and prior preparation, available laboratory equipment, and the objectives of the lesson. No interactive method guarantees high achievement on its own. Its effectiveness depends on careful planning, active learner participation, and objective assessment of outcomes.

Modern pedagogical technologies used in inorganic chemistry lessons

1. Problem-based learning. Problem-based learning is an instructional approach in which learners are presented with a specific question or challenging situation and are encouraged to propose hypotheses based on their existing knowledge and find a solution using evidence.

For example, when studying "Chemical Properties of Metals," the teacher may pose the following problem: Why do some metals react rapidly with water, whereas others show little or no reaction under ordinary conditions?

Learners analyze the metal reactivity series, atomic structure, and reaction conditions to support their hypotheses. The teacher, in turn, clarifies the necessary concepts, poses guiding questions, and helps learners arrive at scientifically sound conclusions.

Problem-based learning can be organized in the following sequence:

1. Creating a problem situation.
2. Identifying the problem and formulating questions.
3. Proposing hypotheses.
4. Testing the hypotheses through experiments, observation, or theoretical analysis.
5. Discussing the results and drawing conclusions.

This approach helps learners understand cause-and-effect relationships, develop scientific reasoning, and recognize chemical patterns and principles.

2. The STEAM approach. STEAM integrates science, technology, engineering, art, and mathematics. In inorganic chemistry lessons, this approach provides opportunities to connect theoretical knowledge with the solution of practical problems.

For example, in a lesson on “Water Purification Methods,” learners may examine impurities in water, filtration, adsorption, and ion-exchange processes, and then design a simplified model of a water purification system.

Within such a project:

- Science: studying impurities present in water and their properties;
- Technology: collecting information about water purification methods;
- Engineering: designing a model or prototype;
- Art: presenting the model in a clear and visually appealing way;
- Mathematics: taking measurements, recording results in tables, and comparing data.

It should be explicitly explained that ordinary filtration does not completely remove dissolved heavy-metal ions. For classroom experiments, safe, artificially prepared model systems should be used instead of genuinely contaminated water or hazardous chemical solutions.

The STEAM approach promotes learners’ understanding of interdisciplinary connections and develops their design, problem-solving, and presentation skills.

3. Project-based learning. Project-based learning involves learners independently or collaboratively investigating a defined problem, collecting information, developing a practical solution, and presenting their results.

The following projects may be used in inorganic chemistry lessons:

1. “The Influence of Chemical Factors on Drinking Water Quality”;
2. “The Environmental Impact of Heavy Metals and Methods for Reducing It”;
3. “The Importance of Mineral Fertilizers in Agriculture”;
4. “Metal Corrosion and Methods of Corrosion Protection”;
5. “Sorting Household Waste and the Proper Disposal of Batteries.”

Project work may include selecting a problem, establishing aims and objectives, collecting information, carrying out a practical or theoretical investigation, analyzing the results, and presenting the findings.

Assessment of project outcomes should take into account not only the final product but also the learner’s inquiry process, use of scientific evidence, contribution to teamwork, and the soundness of the conclusions.

4. The use of interactive methods. Interactive methods facilitate active communication, collaboration, and the exchange of ideas among learners. Depending on the objectives of the lesson, these methods can be applied separately or in complementary combinations.

Brainstorming. Questions such as “How can metal corrosion be reduced?” encourage learners to suggest different ideas, which are subsequently examined from a scientific perspective.

Concept mapping (clustering). Information concerning the composition, classification, chemical properties, preparation, and applications of acids is organized around the central concept of “Acids.”

The KWL method (Know–Want to Know–Learned). Learners use a table to record what they already know about a topic, what they would like to know, and what they have learned by the end of the lesson.



The INSERT method. While reading a text, learners mark information that is familiar, new, unclear, or in need of further verification.

Group work. Each group is assigned a task involving the properties of oxides, acids, bases, or salts, the writing of chemical equations, and the presentation of findings.

Alongside increasing learners' participation, these methods help them organize knowledge and provide justification for their views.

A methodology for organizing lessons using modern pedagogical technologies

A lesson on "The Main Classes of Inorganic Compounds" can be organized through the following stages.

Lesson objective: to develop learners' knowledge of oxides, bases, acids, and salts, their ability to distinguish these substances by composition and properties, and their skills in working with chemical formulas.

Teaching materials: a periodic table, cards bearing chemical formulas, an electronic presentation, safe experimental materials, or a virtual laboratory.

Organizational and motivational stage. The teacher presents examples of substances encountered in everyday life and asks learners questions about their chemical composition and properties.

Inquiry stage. Learners are divided into groups. Each group analyzes chemical formulas, assigns the substances to the appropriate classes, and identifies the criteria used for classification.

Development of new knowledge. The teacher synthesizes learners' responses, explains the composition and classification of the substances, and demonstrates the necessary chemical equations.

Consolidation stage. Learners classify cards displaying chemical formulas, write the corresponding reaction equations, and justify their answers.

Assessment stage. Learners' knowledge is assessed through theoretical questions, practical tasks, group presentations, and self-assessment.

In such a lesson, the teacher acts not only as a source of knowledge but also as an organizer of inquiry, a facilitator, and an evaluator of learning outcomes.

To determine the actual effectiveness of modern technologies, it is necessary to compare pre- and post-assessment results, observe learners' performance on practical tasks, and analyze the collected data systematically. In the absence of empirical testing, reporting the effectiveness of a technology in precise percentages is not scientifically justified.

CONCLUSION

The use of modern pedagogical technologies in inorganic chemistry lessons makes it possible to organize instruction in a learner-centered, active, and practically oriented manner. Problem-based learning, the STEAM approach, project-based learning, interactive methods, and digital tools can help learners understand chemical concepts more deeply, apply theoretical knowledge in practical situations, and develop independent thinking skills.

Effective use of these technologies requires clearly defined learning objectives, selection of methods appropriate to the topic, consideration of learners' individual characteristics, and

advance development of assessment criteria. Moreover, integrating digital tools and virtual laboratories with real chemical experiments can enhance both the content and practical value of instruction.

Thus, the purposeful and systematic integration of modern pedagogical technologies into inorganic chemistry education is an important factor in developing chemical literacy, fostering a scientific worldview, and preparing learners to understand chemical and environmental problems encountered in everyday life on a scientific basis.

REFERENCES

1. Law of the Republic of Uzbekistan “On Education.” September 23, 2020, No. O‘RQ-637.
2. Bybee, R. W. The BSCS 5E Instructional Model: Creating Teachable Moments. Arlington, VA: NSTA Press, 2015.
3. Freeman, S., Eddy, S. L., McDonough, M., et al. Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences. 2014. Vol. 111, No. 23. pp. 8410–8415.
4. Hake, R. R. Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics. 1998. Vol. 66, No. 1. pp. 64–74.
5. Prince, M. Does Active Learning Work? A Review of the Research. Journal of Engineering Education. 2004. Vol. 93, No. 3. pp. 223–231.
6. UNESCO. UNESCO ICT Competency Framework for Teachers. Version 3. Paris: UNESCO, 2018.
7. PhET Interactive Simulations. University of Colorado Boulder. <https://phet.colorado.edu/>
8. ChemCollective. Virtual Labs and Learning Activities. <https://chemcollective.org/>

