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The Importance of Interdisciplinarity in the Study of Chemistry

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Abstract

This article discusses the importance of utilizing interdisciplinary connections in teaching chemistry to introduce and integrate various contemporary topics and materials into the learning process. The article highlights the significance of incorporating interdisciplinary relationships in the process of identifying and understanding them and provides insights into the methods necessary for learning these connections.

Keywords: Interdisciplinary connections, Integration, Science and technology, Learning materials, Challenging tasks, Creative tasks, Conferences, Seminars, Extracurricular activities.

Introduction

The issue of the quality of education has become one of the top priorities in the present time. In general, along with the development of methods for optimizing the learning process, understanding the results of this process is of paramount importance. These results should be based on fundamental skills.

This means that the modern school's task at graduation is to develop the ability to create new knowledge and new methods independently, to shape the ability to perform various tasks in different fields of science. Learning chemistry allows students to understand the essence of the chemical processes around us. To foster curiosity on the subject, students should not be passive recipients of knowledge during lessons but active partners in the learning process.

Cognitive activity is the quality of an individual's social significance, and it is formed in the learning activity organized and regulated by the teacher. In the process of acquiring knowledge, the ability to develop cognitive skills, intellectual development, and independent actions are described as necessary stages.

Main Part

Teaching chemistry can benefit from various modern approaches and the integration of interdisciplinary and intra-disciplinary connections in presenting the learning material. Interdisciplinary and intra-disciplinary integration helps to enrich the information flow of the content, expand the heuristic and practical areas of using acquired knowledge and skills in the learning process. Identifying interdisciplinary connections is one of the most challenging tasks. To achieve this, one must not only have an understanding of the content of other subjects and textbooks but also have a broad perspective and creativity.

Working in this direction allows teachers to transfer knowledge from one subject to another, teach students to apply their knowledge in new conditions, and, moreover, develop a very important skill – shaping the perception of the world around us. To enhance interdisciplinary connections, it is essential to:

- Interdisciplinary tasks;

- Challenging and creative tasks;
- Conducting integrated lessons;
- Organizing conferences;
- Hosting seminars;
- Extracurricular activities;
- Research home assignments and others.

Utilizing interdisciplinary tasks can significantly enhance the quality of education. Interdisciplinary tasks are cognitive tasks that contribute to solving problems in an independent manner and mastering integral methods of combining various solution methods. The development and application of interdisciplinary tasks are based on scientific, integration, and creativity approaches.

The methodological foundations of creating and utilizing interdisciplinary tasks in the content of various subjects are competence-based and integrative approaches. They should be aimed at comparative analysis, synthesis, and generalization of students' knowledge and actions, as well as the formation of their fundamental competencies. Thus, the use of interdisciplinary tasks in the content of chemistry and mathematics provides assistance in developing students' comparative analysis, establishing cause-and-effect relationships, synthesizing and generalizing knowledge, modeling tasks, making forecasts during the problem-solving activity, and solving problems using various methods; it also aids in monitoring task performance and using chemistry and mathematics correctly.

Solving Chemistry Problems:

In resolving chemistry problems, students need to simplify mathematical concepts and perform accurate calculations, including rounding numbers. They should also be able to calculate the mass and volume of components in mixtures, express ratios, linear equations, systems of equations, inequalities, and solve and interpret them. The organization and generalization of knowledge and skills in the process of learning and mastering subject matter and concepts suggest the following tasks:

Task 1:

Determine the volume of a solution with a mass concentration of 40.00% (p=1430g/l) of sodium hydroxide required to mix with 200 ml of a solution containing 6.02% sodium hydroxide (p=1065 g/l) in order to obtain a solution containing more than 20% but less than 30% sodium hydroxide.

(Answer: More than 104 ml but less than 357 ml.)

Task 2:

Two solutions containing p1% and p2% magnesium sulfate are taken. The mixture of these solutions resulted in a solution with a composition of p%. Calculate the mass of the first solution, given that m grams of the mixture were obtained.

(Answer: (p1m - pm) / (p - p2) g.)

In creating and solving subject-specific tasks involving both chemistry and mathematics, it is important to establish objective connections, concepts, and ideas. Consider the following:

Topics and content of chemistry and mathematics lessons that may accommodate these interdisciplinary tasks.

The content of chemical and mathematical problems.

Types of interdisciplinary tasks.

Stages of the lesson where these tasks are essential.

The complexity level of interdisciplinary tasks.

Interdisciplinary tasks in chemistry and mathematics promote students' cognitive activity, develop logical thinking, and stimulate their interest in natural and mathematical sciences. These tasks help students form the necessary mental representations for studying natural sciences, particularly mathematics. Developing logical reasoning and enhancing students' cognitive independence is vital in stimulating their interest in the natural sciences.

Challenging and Creative Tasks:

Utilizing challenging and creative tasks not only nurtures individual craftsmanship in shaping the field of chemistry but also enhances knowledge in various subjects, including biology, geography, physics, literature, history, and other disciplines. Examples include:

1. Why does a bent stem occur?

(Plant stems bend downwards when there is a lack of nitrogen fertilization, similar to a drooping leaf. This typically occurs towards the end of the summer when the soil's nitrogen supply, necessary for plant growth, is significantly reduced).

Task: Write the formulas for salts commonly referred to as mineral nitrogen fertilizers.

Creative task: Create an illustrated mini-guide about the biological role of nitrogen in plant life.

2. Why does cabbage turn yellow when cooked for a long time?

(The reason for this phenomenon is the presence of numerous iron ions in cabbage. Prolonged exposure to heat results in the release of hydrogen sulfide gas, causing a portion of the iron ions to oxidize. The insignificant amount of hydrogen sulfide leads to the formation of gray-black iron sulfide deposits).

Task: Write the formulas and names of two amino acids.

Creative task: Select a series of experiments involving cabbage leaves.

3. Why do you shiver in winter?

(Winter air is colder, containing less oxygen necessary for bodily functions. Blood thickens, circulation slows down, burdening the heart and blood vessels. Therefore, cold, vasoconstriction results in headaches and shivering).

Select a series of experiments involving the use of cabbage leaves.

Task: Create a "composition of air" diagram.

Creative task: Prepare a report on the topic "oxygen production in industry."

Integrated Lessons: Integration (from Latin "integratio" - joining, combining) is a process based on the interconnection of individually specialized elements within a system that leads to unity, completeness, and differentiation. The integration of natural sciences promotes structured thinking, addresses a range of global problems, and contributes to understanding humanity's place in the modern world. Conducting integrated lessons is possible. The role of demonstrating the interconnectedness of two study subjects, shaping their single and holistic perception of the surrounding world, plays an essential role in achieving this goal – this is the purpose of integrated lessons.

Integrated Lesson Topics:

- Integrated Chemistry and Geography Lesson: Study Object - Oil;
- Biology and Social Sciences Integration through Chemistry: Study Object - Ethyl Alcohol. "The Impact of Alcoholic Beverages on the Human Body and Its Consequences";
- "Physical Phenomena in Chemistry" (Grade 8, Chemistry, Physics);
- "Factors Affecting Chemical Reaction Rates" (Grade 9, Chemistry, Biology);

- "Acids, Their Structure, Properties, and Biological Functions" (Grade 10, Chemistry, Biology);
- "Chemistry of Gases" (Grade 10, Chemistry, English);
- "Solving Problems in Calculating Hydrocarbon Formulas Using the Equation System" (Grade 10, Chemistry, Algebra, Informatics);
- "Formation of Water in Chemical Terms" (Grade 11, Chemistry, Biology);
- "A.P. Borodin - The Great Conductor and Chemist" (Grade 11, Chemistry, Music).

Conducting Conferences, Seminars, Extracurricular Activities:

Conferences and seminars can be organized both as part of the curriculum and as extracurricular activities. Examples include:

- "Chemistry and the Environment";
- "Chemistry and Medicine";
- "Chemistry and Nutrition";
- "Collecting Wild Plants";
- "Chemical Composition of Cosmetics and Hygiene Products. Natural Cosmetics";
- "Acids: Benefits and Hazards";
- "Yogurts: Benefits and Hazards";
- "Fast Food. Convenient, but Healthy?";
- "Vitamins. Synthetic Vitamins" and others.

These activities provide significant didactic opportunities for developing chemical reasoning, logic, and intellectual skills (generalization, classification, systematization, establishing cause-and-effect relationships, and more). Chemical literacy is essential in modern society, especially in the fields of daily life, healthcare, maintaining a healthy lifestyle, safe nutrition, and ensuring safety. Conferences and seminars can address various topics, such as:

- The impact of chemistry on the environment;
- The role of chemistry in medicine;
- Chemistry and nutrition;
- Collecting and using medicinal herbs;
- The chemical composition of cosmetics and personal hygiene products, with a focus on natural cosmetics;
- The benefits and risks of acids;
- The benefits and risks of yogurt consumption;
- Fast food: convenient or healthy?;
- Vitamins and synthetic alternatives.

These activities aim to foster a deeper understanding of the role of chemistry in everyday life and promote informed decision-making.

How are accumulations classified as Bioorganic, and why are they named so?

- Which group of vitamins and which substances are unique to our region's population?
- Methods of protecting the human body from excessive nitrates in the diet from vegetables.
- Protecting the human body from heavy metals, radiation, and chemical exposure.

- What foods should be consumed to lose weight?
- Risks of collecting mushrooms, berries, and fruits near highways.

What is sewage?

What are freons, and how do they pose risks to the environment?

Not only in regular classes but also in seminars, students should engage in group and team activities. Group work offers several advantages compared to traditional individual assignments. Collaborative work in the classroom and an atmosphere of mutual assistance contribute to the development of curiosity for knowledge. Working together, following the rules, and individual performance of each student lead to higher outcomes than when each student completes the task individually.

Research assignments and project activities:

Practical work demonstrates that research assignments enable students to independently seek knowledge, develop experimental, research, and investigative skills.

Examples:

1. Through the action of invertase, sucrose is converted into monosaccharides. Create the relevant chemical reaction equation. How can the efficiency of invertase be experimentally proven? Test it at different temperatures (+5°C, +35°C, +65°C).

Invertase is highly effective.

2. The sympathetic nervous system. Use the following solutions for selection: milk, lemon juice, apple juice, concentrated sugar solution, onion juice, and a cotton swab soaked in paste made from flour and water. Write your observations. Explain what happens when using a cotton swab. Identify the receptors. Students gain a high level of activity and a sense of independence when they have a significant arsenal of knowledge, skills, and abilities that enable them to demonstrate high activity and a certain level of independence in the process of learning new material. When each student is involved in active creative work, believes in themselves, and feels free, they undoubtedly achieve success. In this way, cognitive curiosity and personal motivation contribute to better assimilating knowledge.

Research tasks and project activities allow students to: Develop various methods of integrating information. Formulate their ideas based on various experiences, observations, and conclusions. Construct logical chains of conclusions and evidence. Express their ideas clearly, confidently, and accurately to others. Conclusions and practical recommendations.

1. Integrating the content of chemistry with other subjects such as biology, physics, mathematics, history, and others to foster interdisciplinary connections.
2. It is recommended to conduct integrated lessons.
3. Utilize various teaching methods in chemistry classes, prepare interdisciplinary, challenging-creative, and research assignments.
4. Organize project activities.
5. Conduct seminars and conferences.

During the process of establishing interdisciplinary connections, students will gain a deeper understanding of the ongoing processes in the surrounding world, connect various subjects with each other, and develop an interest in learning them.

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