Baku State University Journal of Chemistry and Material Sciences, 2024, v. 1 (3), p.23-29

journal homepage: http://bsuj.bsu.edu.az/en
https://doi.org/10.30546/209501.201.2024.1.03.010

INTEGRATIVE APPROACHES CHARACTERIZING NEW INSTRUCTIONAL METHODS IN THE TEACHING OF CHEMISTRY

Arzu Pashayeva, Khalil Nagiyev
Baku State University, Baku, Azerbaijan

Received: 10 september 2024
Accepted: 28 october 2024
Published: 21 november 2024

This article provides an extensive analysis of the significance and application prospects of integrative approaches characterizing new instructional methods in chemistry education. It explains that in the modern education system, the implementation of innovative teaching methods, particularly integrative approaches, plays a crucial role in facilitating interdisciplinary integration and allowing students to comprehend topics in a broader and deeper context. The article explores how these approaches in chemistry teaching effectively enhance students' theoretical and practical knowledge.

The focus is on contemporary teaching methods such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), cooperative learning, the use of digital technologies, and practical laboratory work. These methods have significant potential to develop students' critical and analytical thinking skills, making learning more engaging and meaningful by confronting them with real-life problems. The ability of teachers to implement these new methods and their role in the teaching process is a central theme of the article. Additionally, the use of digital resources in the teaching process, the adaptation of teaching materials to the integrative approach, and the development of infrastructure are thoroughly discussed. The challenges encountered in applying integrative teaching approaches and ways to overcome them are also analyzed. The article also presents examples of new teaching methods successfully implemented in various parts of the world.

The article concludes that integrative approaches in chemistry education make a significant contribution to the learning process and are vital tools for improving the quality of education. The widespread application of these approaches is important for enriching students' learning experiences and fostering the development of scientific thinking.

Keywords: Integrative approach, new instructional methods, Problem-Based Learning (PBL), Project-Based Learning (PjBL), interdisciplinary integration, digital technologies, practical laboratory work, modern educational methods.

INTRODUCTION

In modern times, it is widely accepted that traditional teaching methods alone are insufficient to enhance the quality of education and provide students with deeper and broader understanding. The rapid advancement of science and technology, as well as the increase in information exchange, necessitates the implementation of new methods and approaches in the teaching process. In particular, the teaching of a complex and multifaceted science like chemistry requires more creative and flexible teaching methods to

E-mail address: pasayeva-1969@mail.ru

engage students' attention, direct their knowledge toward practical applications, and relate it to various fields.

The integrative approach is one of the most effective directions in modern education to meet this need. This approach enables students to establish connections between various sciences, solve problems in a complex manner, and understand the application of chemistry in real life. Interdisciplinary integration, modern teaching technologies, problem-based learning (PBL), and project-based learning (PjBL) increase student interest and help them engage more actively in the learning process. This article thoroughly investigates the application of new teaching methods and integrative approaches in chemistry education. The goal is to develop students' critical thinking skills, facilitate their learning by connecting different sciences, and make the educational process more interactive and effective [1-4].

Relevance and Importance of the Topic: The rapid increase in knowledge and the advancement of scientific research in modern society demand the renewal of the education system and its adaptation to contemporary requirements. Particularly, the teaching of a complex and dynamic science like chemistry should not be limited to classical methods. In fact, the application of chemistry research in various fields demonstrates how important this science is not only in academic contexts but also in our daily lives. In this context, the application of integrative approaches enriches the learning process in chemistry education, increases student interest, and develops their critical thinking skills. When discussing the role of the integrative approach in education, it ensures that learning occurs in a deeper and more complex manner by establishing connections between different scientific fields. This approach motivates students to think independently, solve problems with creative approaches, and apply interdisciplinary knowledge. Thus, the integrative approach contributes to making education more interactive and efficient, allowing students to understand how chemistry integrates with biology, physics, mathematics, and other sciences. This provides them with broader perspectives and helps them acquire scientific concepts more profoundly [5-7].

The application of modern methods in chemistry education is essential for students to be able to apply scientific knowledge in practice. Traditional lecture methods can sometimes lead to a loss of student interest, turning them into passive learners. Therefore, there is a need for new approaches such as problem-based, project-based, and cooperative learning methods. These methods allow students to develop analytical thinking, problem-solving, and teamwork skills. The application of integrative approaches in chemistry classes facilitates a deeper understanding of scientific concepts and their real-world applications, ultimately improving the quality of education [8].

Integrative teaching methods are pedagogical approaches that provide learning in a broader and deeper context by combining knowledge from different scientific fields. The main theories underlying these methods are based on principles such as cognitive psychology, constructivism, and systems thinking. Constructivism posits that learning is an active process where students assimilate new knowledge by connecting it with their prior knowledge. This approach encourages students to create links between various sciences and adapt their learning to their own contexts. Systems thinking helps to understand complex systems and allows students to integrate different aspects of a subject. For example, when studying a reaction or process in chemistry, discussions of its biological, physical, and ecological aspects are required. These approaches ensure that students can apply their knowledge in a broader framework and develop systematic thinking skills [9].

The main objective of integrative education is to make the learning process more meaningful and profound. The aims of this approach include:

- Establishing interdisciplinary connections: Providing students with the opportunity to understand the relationships between various scientific fields and apply this knowledge;
- Developing analytical and critical thinking: Enhancing students' abilities to evaluate, analyze, and solve complex problems using diverse information;
- Practical application: Learning how to apply theoretical knowledge in real life and increasing active participation among students;

- Encouraging creative approaches: Promoting independent thinking among students and encouraging them to advance new ideas and find creative solutions to problems;
- Increasing Motivation: Enhancing student interest and making learning more engaging.

Chemistry occupies a special place among the natural sciences, and its integration with other sciences offers students wide perspectives. Chemistry is closely related to fields such as physics, biology, mathematics, ecology, and engineering. For instance, in chemistry classes, the chemical composition of biological processes, the molecular explanation of physical phenomena, and the application of mathematical models are studied [10].

This integration helps students to understand chemistry in a broader context. For example, environmental chemistry studies the impact of chemical substances on the environment, while biochemistry examines the chemical reactions within biological systems. Additionally, the application of chemistry in engineering is crucial for the creation and development of materials. Thus, the application of integrative approaches in chemistry education allows students to acquire scientific concepts more broadly and profoundly, while also developing their analytical thinking and problem-solving skills. This provides a broader framework for understanding the connections between various fields of science and solving real-world problems. The application of integrative approaches offers numerous advantages across various fields of education. The specific benefits of these approaches in chemistry education include the development of students' analytical and critical thinking skills. Integrative approaches create an excellent environment for students to develop these skills. The interdisciplinary approach enables students to evaluate, analyze, and create new knowledge from diverse information and concepts. For example, in chemistry classes, students might be tasked with focusing not only on the chemical composition of a reaction or process but also on its impacts on ecology, biological systems, and the economy. This allows them to see different aspects of the problem and approach it from various perspectives. Integrative approaches facilitate the integration of information from different fields, deepening students' learning. Interdisciplinary integration allows students to connect a scientific concept with other areas. For instance, discussing issues related to biology, physics, and mathematics in chemistry classes helps students understand the broad applications of chemistry. This enables them to apply their knowledge in a wider context and see the connections between different scientific fields, making learning deeper and more meaningful [11].

Integrative approaches teach students to establish connections between various fields of science. In chemistry education, this approach offers students extensive opportunities to understand how different sciences are related to each other. For example, the connections between chemistry and biology provide an excellent foundation for exploring fields such as biochemistry, environmental chemistry, and pharmacology. These connections help students understand various aspects of a topic and apply them in real life. Establishing interdisciplinary connections enhances students' abilities to integrate their knowledge from various fields and solve more complex problems. Thus, integrative approaches enrich students' learning experiences, develop their analytical and critical thinking skills, and ensure the deeper and broader understanding of scientific concepts through strong connections between scientific fields [12-14].

EXPERIMENTAL

The main purpose of this experiment is to investigate the impact of implementing integrative approaches in the teaching of chemistry on the learning process of students. The role of innovations in education, the development of students' analytical and critical thinking skills, the establishment of interdisciplinary connections, and the deepening of learning through the integration of information from various fields will be examined. The results of the

experiment will allow for the evaluation of the effectiveness of modern teaching methods in the teaching of chemistry.
Experiment Methodology. The experiment was conducted in two stages: organization of groups and application of the learning process. The details of each stage are presented below. Stage 1: Organization of Groups
Creation of Research Groups:
Two groups were organized:

- Group taught with traditional teaching methods:
  This group primarily utilized lectures, answering questions, classical practical work, and passive use of teaching materials.

Group applying integrative approaches:
This group employed problem-based learning (PBL), project-based learning (PjBL), and interactive discussions.Each group consisted of 20 students. The age range of the students was between 15 and 16 years, and they possessed various academic abilities.
Selection of Lesson Content:
The same lesson plan was prepared for both groups. The topic selected was "Types of Chemical Reactions." This topic, as one of the fundamental concepts of chemistry, facilitates the study of various types of reactions, their characteristics, and applications.
Stage 2: Application of the Learning Process **.**Implementation of Teaching Methods.

- Traditional Group:
- Lectures: The material was presented through slides, and students passively listened to the teaching materials to attract their attention;
- Practical Work: The chemical reaction processes were conducted manually in the laboratory, but without allowing students to think independently.

Integrative Group:

- Problem-Based Learning (PBL): Students were presented with chemical problems related to reality. For example, environmental issues arising during a reaction were discussed. Each student was required to investigate this problem independently and engage in group discussions;
- Project-Based Learning (PjBL): Students were asked to prepare a project related to types of chemical reactions. This project had to cover information about the practical applications of reaction types, their ecological impacts, and potential uses;
- Intensive Interactive Discussions: Open discussion sessions were held during lessons where students shared their thoughts and gained new insights by listening to the ideas of other students.

At the end of the experiment, the knowledge of students in both groups was assessed. The assessment focused on three main areas:

1. Analytical thinking skills: Open-ended questions were asked about the types of chemical reactions.
2. Understanding interdisciplinary connections: Questions regarding the connections between chemistry and other sciences (biology, physics).
3. Application of chemistry in real life: Written assignments were presented to students about how the principles of chemistry are applied in real life.

RESULTS AND DISCUSSION

The findings from this study affirm the effectiveness of integrative teaching methods in chemistry education. The following points outline the implications of these results: Enhanced Analytical Skills, Interdisciplinary Understanding. Educators should receive training in integrative teaching methods to effectively implement these strategies in their classrooms. Additionally, developing interdisciplinary curricula that connect chemistry with fields like biology, physics, and environmental science will further enhance student learning.In conclusion, the results of this study strongly advocate for the integration of innovative teaching approaches in chemistry education. By fostering analytical skills, enhancing interdisciplinary understanding, and demonstrating real-world applications, these methods can significantly improve the educational experience and outcomes for students.The future perspectives of integrative approaches in chemistry education present the potential for further development in line with the demands of modern educational systems. Below are some key aspects of these perspectives:

In the future, it will be possible to create closer connections between fields such as biology, physics, engineering, and environmental sciences in chemistry education. For example, interactive projects in areas like biochemistry and environmental chemistry will allow students to solve problems using multidisciplinary approaches. The use of digital technologies, online resources, and simulations will increase when implementing integrative approaches. This will enable students to learn chemistry principles in a more visual and interactive manner.There is an expectation of a broader application of methods that encourage active participation from students (problem-based learning, project-based learning). These approaches will ensure that students think more independently, enhance their creative abilities, and approach real-world problems more effectively. Integrative approaches will provide opportunities for students to understand the social and ecological responsibilities of chemistry. In the future, environmental issues and their chemical aspects will be important topics for student discussions.The development of innovations in the field of education will further increase the application of integrative approaches. The use of various teaching materials, laboratory equipment, and interactive teaching programs will make chemistry education more engaging and effective.

To ensure the effective application of integrative approaches in chemistry education, the following suggestions and recommendations are proposed:

1. Professional development programs should be organized for teachers to apply integrative approaches. This will help teachers become familiar with new methods, strategies, and technologies, enabling them to incorporate this knowledge into their teaching processes.
2. The development of new programs for the joint teaching of various subjects is recommended, which can provide students with a deeper and broader learning experience by integrating scientific concepts.
3. The promotion of digital resources (simulation programs, interactive teaching materials) in chemistry classes is essential. This will ensure that students learn chemistry principles in a more visual and interactive manner.
4. Organizing practical application projects for students will be an important way to connect their learning process with the real world. These projects may relate to environmental conservation, energy efficiency, and other current issues.
5. Appropriate strategies should be implemented to encourage active participation from students during lessons. This can be achieved through discussions, group work, seminars, and other interactive activities.
6. Educational authorities should promote initiatives to create resources, financial support, and appropriate infrastructure for the implementation of integrative approaches.

The implementation of these suggestions will aid in the more efficient and effective application of integrative approaches in chemistry education. As a result, students' scientific understanding, analytical thinking skills, and knowledge regarding the application of chemistry in real life will increase, providing a crucial foundation for their future careers.

CONCLUSION

The results of both groups were collected, and each student’s performance was evaluated on a 100-point scale. The results for each area were aggregated, and overall results were derived. The collected data underwent statistical analysis. To determine the differences between the groups, the t-test method was employed. This enhances the reliability of the results and allows for a more accurate assessment of differences between the groups. In the group using integrative approaches, analytical thinking skills were rated with a success indicator of 85%. In the traditional group, this indicator was 70%**,** demonstrating that integrative approaches enhance students' analytical thinking skills. In the integrative group, 90% of the questions related to establishing interdisciplinary connections were answered correctly. In contrast, the traditional group achieved only 70%, indicating that students in the integrative group have a better understanding of the connections between different scientific disciplines. The ability to explain the application of chemistry in real life was assessed at 80% accuracy in the group utilizing integrative approaches. In the traditional group, this figure was only 55%, confirming that integrative methods increase students' understanding of the application of chemistry in their daily lives.

The results of the experiment have proven that the implementation of integrative approaches positively affects students' analytical thinking skills, their ability to establish interdisciplinary connections, and their understanding of the application of chemistry in real life. These results highlight the importance of expanding the use of integrative approaches in chemistry education. It is essential to further develop these approaches within the educational system to ensure that students grasp scientific concepts in a deeper and broader context. The findings also reveal potential opportunities for more effective application of modern methods in future chemistry classes, enhancing the dynamism of the teaching process.

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