

MODERN METHODS OF TEACHING CHEMISTRY

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In the modern education system, the methodology of teaching chemistry has been fundamentally updated, transitioning from traditional teaching methods to active, interactive, and student-centered approaches. Since chemistry is based not only on theoretical knowledge but also on experimental activity, the use of modern pedagogical technologies is essential for effective teaching. In recent years, STEM education, digital technologies, distance learning, problem-based learning, project-based learning, and research-based learning methods have been widely introduced. These methods contribute to the development of students' independent thinking, problem-solving skills, and scientific reasoning. Research shows that student-centered active methods such as flipped classroom, gamification, problem-based learning, and inquiry-based learning significantly increase students' level of knowledge, motivation, and academic achievement. The main goal of modern methods is to transform students from passive recipients of knowledge into active creators of knowledge. This makes it possible to achieve high efficiency in teaching chemistry. Furthermore, through modern methods, students learn to connect theoretical knowledge with real-life situations, which increases their scientific literacy. The use of innovative technologies in teaching chemistry makes the learning process more effective, interactive, and engaging. One of the widely used modern methods in chemistry education is the flipped classroom method. In this approach, students study new topics independently using videos, electronic resources, or interactive materials, while classroom time is devoted to discussions, practical activities, and problem-solving. This method strengthens interaction between teachers and students and increases the depth of students' understanding. According to research, the flipped classroom method is effective in improving students' academic performance, reducing failure rates, and increasing motivation. In addition, problem-based learning is one of the modern methods that develops students' critical thinking and problem-solving abilities.

Research shows that this method significantly improves students' analytical, evaluative, and independent conclusion-drawing skills. Inquiry-based learning

methods are also very important in teaching chemistry. Through this method, students gain knowledge by conducting scientific experiments, making observations, and analyzing results. Research indicates that inquiry-based learning improves students' scientific thinking, independent reasoning, and interest in science. Therefore, these methods are considered one of the main directions of modern chemistry education. Digital technologies also play an important role in modern chemistry education. The Internet, virtual laboratories, interactive simulations, multimedia materials, and distance learning platforms improve the effectiveness of chemistry teaching. For example, organizing discussions through web platforms helps strengthen students' knowledge and improves their understanding of complex chemical concepts. Research shows that digital technologies and online active methods increase student participation and help retain knowledge for a longer period.

Context-based teaching methods are also widely used in chemistry education. In this method, chemical knowledge is connected with real-life examples such as ecology, industry, medicine, and everyday life. Research shows that green chemistry and real-life-based teaching methods significantly improve students' scientific literacy. Gamification, or the use of game elements, is also an effective method in chemistry education. This approach increases students' interest in lessons, encourages active participation, and makes learning easier. Thus, modern methods in chemistry education not only provide knowledge but also develop students' scientific thinking. In conclusion, modern methods of teaching chemistry play an important role in organizing the educational process effectively. These methods deepen students' knowledge, develop independent thinking, form scientific reasoning, and teach them to work with modern technologies.

Methods such as flipped classroom, problem-based learning, inquiry-based learning, gamification, digital technologies, and context-based teaching play an important role in effective chemistry education. Through these methods, students acquire not only theoretical knowledge but also practical skills. The main goal of modern chemistry education is to develop individuals who can think independently, solve problems, and apply scientific knowledge in practice. In the future, the use of new technologies such as artificial intelligence, virtual reality, and interactive simulations is expected to make chemistry education even more effective. Therefore, the use of modern teaching methods is one of the most important conditions for improving the effectiveness of chemistry education.

Table-1.

Modern methods of teaching chemistry and their educational significance

No.	Teaching Method	Description	Educational Advantages	Application in Chemistry
1	Flipped Classroom	Students study theoretical material independently before class using videos and digital resources	Improves active participation and deep understanding	Used for studying chemical theories, reaction mechanisms, and conceptual discussions
2	Problem-Based Learning (PBL)	Students solve real-life problems through analysis and discussion	Develops critical thinking and problem-solving skills	Applied in solving chemical calculations, environmental chemistry problems
3	Inquiry-Based Learning	Students learn through experiments, observation, and scientific investigation	Enhances scientific thinking and research skills	Used in laboratory experiments and chemical investigations
4	Gamification	Integration of game elements such as quizzes, points, and competitions	Increases motivation and engagement	Used in quizzes, chemical formula learning, and interactive assessments
5	Digital Technologies	Use of virtual labs, simulations, multimedia, and online platforms	Improves visualization and accessibility of learning	Helps visualize molecular structures and chemical processes
6	Context-Based Learning	Connecting chemistry concepts with real-life applications	Improves understanding and scientific literacy	Applied in green chemistry, medicine, and industrial chemistry

Conclusion

In conclusion, modern methods of teaching chemistry play an important role in improving the effectiveness of the educational process. While traditional teaching methods are mainly teacher-centered, modern approaches place students at the center of the learning process and ensure their active participation. Through the use of methods such as flipped classroom, problem-based learning, inquiry-based learning, gamification, and digital technologies, students are able to gain deeper understanding of knowledge, develop independent thinking, and improve their problem-solving skills. These methods not only strengthen students' theoretical knowledge but also help form their practical skills. In particular, the use of virtual laboratories, interactive simulations, and multimedia tools helps students better understand chemical processes and increases their interest in the subject.

Furthermore, modern methods play a significant role in developing students' scientific thinking, creative approach, and ability to apply knowledge in real-life situations. Context-based teaching reveals the connection between chemistry and fields such as ecology, industry, medicine, and everyday life, which enhances students' scientific literacy. With the help of modern technologies and innovative methods, the educational process becomes more interactive, effective, and engaging. In the future, the wider implementation of artificial intelligence, virtual reality, and digital learning platforms is expected to further improve the quality of chemistry education. Thus, the use of modern teaching methods is an important factor in achieving high educational outcomes and preparing competitive specialists with strong scientific thinking.

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