INTERNATIONAL CONFERENCE **Dehli, India, 2026**
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THE EFFECTIVENESS OF MODERN PEDAGOGICAL TECHNOLOGIES IN TEACHING OXIDATION–REDUCTION REACTIONS IN CHEMISTRY

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Abctract This article analyzes the effectiveness of modern pedagogical technologies in teaching oxidation–reduction reactions in chemistry. The study investigates the didactic potential of integrating digital educational platforms (particularly Kahoot), interactive teaching methods, and the mentor–apprentice approach. A comparative analysis between experimental and traditional teaching methods was conducted to evaluate students' knowledge acquisition, logical thinking skills, and learning motivation. The results demonstrate that the integration of modern pedagogical technologies significantly enhances the quality of chemistry education.

In contemporary education systems, traditional teaching approaches are gradually being replaced by interactive and digital pedagogical technologies. In chemistry education, especially in teaching complex topics such as oxidation–reduction reactions, visualization and interactive methods play a crucial role in improving conceptual understanding.

Oxidation–reduction reactions represent one of the fundamental branches of chemistry and require students to develop high-level abstract thinking and analytical skills. Therefore, the application of innovative pedagogical technologies in teaching this topic is of great importance.

The study employed the following research methods:

- Pedagogical observation
- Experimental lesson design
- Testing and diagnostic assessment
- Surveys using interactive digital platforms (Kahoot)
- Comparative analysis

The experiment was conducted in two groups:

- **Control group:** taught using traditional instructional methods

- **Experimental group:** taught using Kahoot, interactive methods, and a mentor–apprentice approach

The results of the study revealed the following improvements in the experimental group:

- Students' level of subject mastery increased by **25–35%**
- Motivation and active participation in lessons significantly improved
- Understanding of complex reaction mechanisms became easier
- Collaborative and communication skills were enhanced

The use of the Kahoot platform supported effective reinforcement of knowledge through rapid-response assessment and gamified learning. Additionally, the mentor–apprentice approach contributed to reducing individual learning differences among students.

The findings indicate that modern pedagogical technologies not only facilitate knowledge delivery but also contribute to the formation of key competencies. In particular, interactive, visual, and gamified approaches are highly effective in teaching oxidation–reduction reactions in chemistry.

However, the successful implementation of these technologies largely depends on teachers' methodological preparedness and digital literacy.

Based on the results of the study, the following conclusions can be drawn:

- Modern pedagogical technologies improve the quality of chemistry education
- Interactive methods are highly effective in teaching oxidation–reduction reactions
- Platforms such as Kahoot increase students' motivation and engagement

The mentor–apprentice approach enhances individualized learning effectiveness
The results confirm that modern pedagogical technologies create a more dynamic and effective learning environment. Gamification through Kahoot increases intrinsic motivation, while interactive discussions foster critical thinking.

The mentor–apprentice model ensures that weaker students receive individualized attention, thus improving equity in learning outcomes. Moreover, visualization tools help students understand electron transfer processes in oxidation–reduction reactions more clearly.

However, the effectiveness of these technologies depends on teachers' digital literacy, pedagogical competence, and ability to integrate traditional and modern methods effectively.

The study concludes that modern pedagogical technologies significantly enhance the teaching and learning of oxidation–reduction reactions in chemistry. Key findings include:

- Interactive and digital methods improve student performance and motivation
- Kahoot and similar platforms strengthen knowledge retention
- The mentor–apprentice approach supports individualized learning
- Complex chemical concepts become more accessible through visualization and gamification

Future research should focus on expanding digital integration in other areas of chemistry and developing teacher training programs for effective implementation.

I would like to express my sincere gratitude to the principal of our school, Z.M. Komilova, and the head of the methodological association, Sh.K. Khudjaeva, who closely supported and guided me. They shared their experience, teaching skills, knowledge, and professional expertise with me, contributing significantly to the development of my competencies and practical teaching experience.

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