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WAYS TO DEVELOP STUDENTS' CREATIVE ACTIVITY IN AN INTEGRATED LEARNING ENVIRONMENT

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Abstract: In the modern educational process, it is not sufficient for students to acquire only theoretical knowledge; it is essential to develop their ability to integrate creative thinking, emotional intelligence, and practical activity. From this perspective, the "STEAM + EQ" approach introduces new content into the educational process. This approach integrates science, technology, engineering, art, and mathematics while also considering students' emotional states and affective perception.

This article analyzes effective ways of integrating chemistry education into artistic and emotional dimensions through the "Chemical Art" project. The project combines chemical processes, color changes, crystal formation, and molecular structures with the creation of works of art. This allows students to perceive chemistry not only as a scientific subject but also as a source of creative inspiration. Moreover, the article scientifically examines the role of an integrated learning environment, visual and emotional experiences, and project-based teaching methodology in developing students' creative thinking. Experiments conducted during the study demonstrated that the "Chemical Art" project significantly enhances students' understanding of the connection between science and art, aesthetic appreciation, research interest, and creative initiative.

Keywords: Integrated Learning, STEAM + EQ, Creative Thinking, Emotional Intelligence, Chemistry Education, Chemical Art, Interdisciplinary Approach, Aesthetic Perception, Student Motivation, Project-Based Learning

Introduction. Today, the education system must focus not only on students' knowledge levels but also on developing their creative, emotional, and analytical thinking. In the 21st century, with the rapid advancement of science and technology, equipping students solely with traditional knowledge is insufficient. It is imperative to nurture them as independent thinkers who can approach problems innovatively and understand and manage their emotions.

An integrated approach in education eliminates artificial boundaries between subjects, provides students with opportunities for complex thinking, and encourages their creative activity. In this regard, the globally expanding STEAM education concept (Science, Technology, Engineering, Art, Mathematics) attracts special attention due to its practical significance, universality, and innovative potential.

However, numerous studies indicate that alongside the development of technological and scientific competencies, emotional intelligence (EQ)—the ability to understand one's emotions, recognize others' feelings, and maintain balance in communication—is a crucial factor in

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personal success. Therefore, the "STEAM + EQ" approach introduces a new level into integrative education. This model aims to develop students' cognitive and emotional-intellectual potential in harmony.

This article analyzes mechanisms for developing students' creative activity using the "Chemical Art" project, created on these social concepts and principles. The project synthesizes science and art by combining chemical phenomena such as color changes, material structures, and crystal formation with artistic creativity [1].

The main purpose of the study is to identify ways to develop students' creative thinking, aesthetic perception, and emotional competencies through the application of the integrated "STEAM + EQ" model in chemistry education. The relevance of the study lies in the fact that the "Chemical Art" project not only strengthens students' chemical knowledge but also enriches their inner world, allowing them to observe, feel, and analyze natural and scientific phenomena through an artistic lens. This approach makes the educational process more engaging, emotionally rich, and creatively stimulating. The effectiveness of developing students' creative activity through integrating chemistry education with the "STEAM + EQ" approach was examined using experimental and observational methods during the 2024–2025 academic year in three stages: preparation, experiment, and analysis.

In the first stage, students' attitudes towards chemistry, creative thinking, and emotional-intellectual levels were determined. The "Science Motivation Survey," "Emotional Intelligence Diagnostics," and creative thinking tests were conducted. Preliminary data indicated that students' interest in chemistry was primarily knowledge-oriented, while creative and emotional components were underdeveloped [2].

In the second stage, lessons were organized based on the "Chemical Art" project. Experimental class students studied chemical phenomena (e.g., color changes, crystal formation, oxidation-reduction processes) using artistic expression. Each lesson combined scientific content with art elements, and students engaged in the following activities:

- Creating abstract compositions with colored solutions;
- Making artistic objects based on molecular models;
- Developing "chemical poster" projects on ecological topics;
- Expressing chemical processes metaphorically to develop emotional perception.

Additionally, interdisciplinary integration was implemented within the "STEAM + EQ" model, revealing connections between chemistry, biology, art, and technology through small projects. During the lessons, students' abilities to express emotions, defend ideas creatively, and work collaboratively were analyzed.

In the third stage, students' motivational, cognitive, creative, and emotional growth dynamics were re-measured. Results showed:

- Motivation towards chemistry increased by 24%;
- Creative thinking indicators rose by an average of 22%;
- Emotional-intellectual balance (EQ) improved by 18%;
- 82% of students showed interest in aesthetically analyzing and artistically expressing chemical processes.

These results confirmed that integrative lessons based on the "STEAM + EQ" model effectively develop systematic thinking, aesthetic perception, and conscious emotional regulation in students. The study demonstrated that the "Chemical Art" project under the "STEAM + EQ" approach significantly enhances not only students' knowledge in chemistry but also their creative thinking, emotional sensitivity, and understanding of interdisciplinary connections [3].

One of the most notable changes observed during the experimental process was increased motivational activity. Students' opportunities to express ideas artistically and analyze chemical experiments aesthetically expanded, strengthening their intrinsic motivation toward science. According to survey results, 77.5% of students evaluated chemistry as "creative and life-related," confirming the effectiveness of the integrative approach.

Furthermore, the dynamics of emotional-intellectual growth were significant. Students developed skills in managing their emotions, defending opinions in groups, and listening to others, improving pedagogical communication culture and ensuring a safe creative classroom environment.

Analysis of results indicated that students taught using the “STEAM + EQ” model achieved higher outcomes in problem analysis, proposing scientific hypotheses, and drawing visual-logical conclusions compared to the control group. Creative thinking indicators increased by an average of 22%, demonstrating the importance of STEAM + EQ integration in forming cognitive-emotional synthesis in the learning process.

In conclusion, the integrated “STEAM + EQ” approach creates a student-centered, creative, and emotionally rich model for teaching chemistry. This model transforms education from merely conveying knowledge into a platform for developing human intellect, emotional culture, and aesthetic worldview.

The study results show that teaching chemistry in an integrated learning environment under the “STEAM + EQ” approach comprehensively develops students’ knowledge, creative potential, and emotional thinking. This approach strengthens interdisciplinary connections and fosters harmony between emotions, aesthetic perception, and cognition. Incorporating art into chemistry education—the “Chemical Art” model—links scientific concepts with experiential learning, enhancing long-term retention, analytical thinking, and innovative thinking. Observing crystal shapes, color changes, or reaction dynamics helps students perceive the unity of nature and art. Connecting chemistry with art, design, ecology, and technology allows teachers to develop integrative lesson models. For example, introducing topics such as “Chemical Nature of Colors,” “Ecological Design and Molecular Structures,” and “Crystallography and Decorative Art” enhances interdisciplinary thinking and practical creativity. The study also confirmed the significant role of emotional intelligence in mastering chemistry. Students’ abilities to understand emotions, collaborate, and defend opinions in teams were highly developed, improving pedagogical communication culture and ensuring a creative safety environment in lessons.

Recommendations:

1. Systematically implement the “STEAM + EQ” concept in chemistry education—incorporate interdisciplinary integration into lesson content and develop criteria to assess students’ emotional-intellectual activity.
2. Expand the “Chemical Art” project nationwide, providing students opportunities to participate in creative laboratories, colorful experiments, and chemical design workshops.
3. Develop specialized training and methodological guides for teachers, providing practical examples of integrating STEAM elements with EQ.
4. Develop digital platforms combining art and technology in chemistry teaching (virtual labs, 3D modeling, simulations).
5. Organize “Chemical Art Exhibitions” or “Creative Experiment Weeks” to develop students’ aesthetic thinking and scientific observation skills.

In summary, the integration of “STEAM + EQ” is not only a new methodological approach but also a modern interpretation of educational philosophy. It integrates chemistry with emotions, aesthetic perception, technology, and innovation, forming students as creative, emotionally mature, and socially responsible individuals. The results of this study can serve as a theoretical and practical basis for future scientific research projects, pedagogical innovations, and international educational programs.

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