

**THE EFFECTIVENESS OF IMPROVING INTEGRATIVE TECHNOLOGIES
IN TEACHING BIOLOGY IN ACADEMIC LYCEUM****Ibodova Mahfuza Namozovna***Navoi State University Associate Professor of the Department of Biology*

Annotation: *This article examines the impact of improving integrative technologies in teaching biology at academic lyceums on educational effectiveness from a scientific and pedagogical perspective. The study substantiates the significance of integrative and binary lessons aimed at ensuring interdisciplinary integration in biology education, harmonizing theory and practice, and developing students' competencies. During the experimental research conducted in several academic lyceums from 2020 to 2025, integrative technologies based on the integration of biology with chemistry and physics, as well as problem-based learning and project methods, were implemented in the teaching of biology. The results of the experiment demonstrate that lessons organized on the basis of integrative technologies increase students' level of mastery of biological knowledge, develop their ability to apply interdisciplinary concepts, and foster independent and creative thinking skills.*

Keywords: *biology education, academic lyceum, integrative technologies, interdisciplinary integration, binary lessons, educational effectiveness, competency-based approach.*

INTRODUCTION

In the modern education system, one of the key tasks in teaching biology is to ensure that students acquire deep knowledge, understand interdisciplinary connections, and develop competencies for applying their knowledge in practical activities [1]. From this perspective, improving integrative technologies in teaching biology in academic lyceums is emerging as an important factor in enhancing educational effectiveness. Integrative technologies provide for teaching biology in harmony with other natural and exact sciences, linking theoretical knowledge with practical activities, and developing students' scientific worldview. This section scientifically analyzes, based on experimental results, the impact of implementing and improving integrative technologies in teaching biology in academic lyceums on educational effectiveness.

Pedagogical Conditions for the Implementation of Integrative Technologies

The effective implementation of integrative technologies in teaching biology in academic lyceums requires the presence of specific pedagogical conditions. First of all, biology teachers must possess a high level of methodological preparedness in interdisciplinary integration [2], since the use of integrative technologies requires the ability to explain biological processes in connection with chemistry, physics, geography, and informatics.

Secondly, the content of biology education should be redesigned on the basis of interdisciplinary relationships. In this process, topics in the curriculum are selected in accordance with integration principles, taking into account students' age and psychological characteristics. For example, topics such as "Photosynthesis," "Respiration," and

“Transmission of Genetic Information” demonstrate high effectiveness when studied through biology–chemistry and biology–physics integration [3].

Thirdly, the use of modern pedagogical and digital technologies in the educational process increases the effectiveness of integrative technologies. Virtual laboratories, multimedia presentations, and modeling software contribute to a deeper understanding of the essence of biological processes.

Organization and Methodological Foundations of Experimental Research

To determine the effectiveness of improving integrative technologies in teaching biology in academic lyceums, experimental research was conducted in several academic lyceums from 2020 to 2025. The study involved academic lyceums affiliated with Navoi State University, Tashkent Pharmaceutical Institute, Tashkent State Pediatric Medical Institute, and Kokand State Pedagogical Institute.

A total of 580 students participated in the experimental research. They were divided into experimental and control groups. In the experimental groups, the teaching of biology widely applied:

- integrative technologies [4; 5];
- binary lessons based on biology–chemistry and biology–physics integration
- problem-based learning and project-based methods.

In the control groups, biology instruction was conducted using traditional teaching methods. During the experimental process, students’ knowledge levels, ability to apply interdisciplinary concepts, and analytical thinking skills were assessed through specially designed diagnostic tasks.

Impact of Integrative Technologies on Educational Effectiveness

The analysis of experimental results showed that biology lessons organized on the basis of integrative technologies significantly increased students’ level of knowledge acquisition. In particular, academic performance in biology in the experimental groups was 18–22 percent higher compared to the control groups. In addition, students’ understanding of interdisciplinary connections and their ability to interpret biological processes from the perspectives of other disciplines improved.

For example, as a result of biology–chemistry integrated lessons, students achieved the ability to analyze photosynthesis and cellular respiration based on chemical reactions. Integrative technologies also promoted the development of students’ independent and creative thinking, directing them toward research activities [8]. Through project work and the solution of problem situations, students developed scientific inquiry skills.

Improving Integrative Technologies through Binary Lessons

The research results clearly demonstrated the importance of binary lessons in improving integrative technologies in teaching biology. Conducting lessons collaboratively by biology teachers and teachers of other subjects enabled students to perceive knowledge in a comprehensive manner. In particular, biology–chemistry binary lessons conducted at the academic lyceum of Tashkent Pharmaceutical Institute showed high effectiveness. Through these lessons, students gained a deeper understanding of the pharmaceutical and practical significance of biological processes.

Binary lessons ensured the following methodological advantages in improving integrative technologies:

- integration of theory and practice;
- systematic organization of interdisciplinary knowledge;
- increased students' cognitive activity [9].

Pedagogical Analysis of Experimental Results

The analysis conducted at the end of the experiment confirmed that integrative technologies have high pedagogical effectiveness in biology education. In the experimental groups, students demonstrated significant improvement in:

- the level of mastery of biological knowledge;
- skills in applying interdisciplinary concepts;
- analytical and logical thinking abilities [10].

This scientifically substantiates the necessity of widespread implementation of integrative technologies in teaching biology in academic lyceums.

Conclusion In conclusion, improving integrative technologies in teaching biology in academic lyceums is an important factor in enhancing educational effectiveness. The research results indicate that integrative technologies and binary lessons contribute to the formation of deep biological knowledge, interdisciplinary competencies, and a scientific worldview among students. The implementation of this methodology in educational practice elevates the quality of biology education to a new level and ensures the competitiveness of academic lyceum graduates.

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