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“INTEGRATIVE AND COLLABORATIVE TEACHING APPROACHES IN BIOLOGY EDUCATION

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Abstract: *The article analyzes the theoretical and methodological foundations of the integrative approach and binary lessons in biology education, their didactic potential, as well as the mechanisms for their implementation in the educational process. It is scientifically substantiated that integrated education contributes to improving learning effectiveness by ensuring close interconnection between biology and other academic disciplines. In addition, the results of experimental research conducted in academic lyceums aimed at determining the effectiveness of applying the integrative approach and binary lessons in biology teaching are analyzed.*

Keywords: *integrative approach, binary lessons, biology education, interdisciplinary integration, competency-based approach.*

INTRODUCTION

In the modern education system, teaching subjects separately often leads to the fragmentation of students' knowledge. Therefore, ensuring interdisciplinary integration and forming knowledge as a holistic system is considered one of the key tasks of contemporary education [1].

In particular, revealing the interconnections among natural sciences in biology education plays an important role in developing students' scientific worldview [2]. An integrative approach and binary lessons enable the combination of theory and practice in teaching biology and contribute to the development of students' competencies [3].

For this reason, this section provides a scientific justification of the methodology for organizing integrative approaches and binary lessons in biology education.

Theoretical Foundations of the Integrative Approach in Biology Education The integrative approach is aimed at organizing educational content based on interdisciplinary connections, ensuring the systematic and logical acquisition of knowledge [1]. In biology education, integration makes it possible to explain biological processes in harmony with chemical, physical, and geographical laws. According to V.V. Kraevsky and I.Ya. Lerner, integrated educational content forms not only theoretical knowledge but also practical and analytical skills in students [2].

The integrative approach in biology education is based on the following didactic principles:

- scientific validity and systematicity;
- continuity and consistency;
- practice-oriented learning;
- competency-based approach [4].

The integrative approach facilitates the comprehension of complex concepts in biology education, increases students' interest in sciences, and contributes to the formation of ecological culture [6]. The Concept of Binary Lessons and Their Pedagogical Significance A binary lesson is an integrated form of instruction jointly organized by two or more subject teachers [3]. In biology education, binary lessons are commonly conducted through the integration of biology with chemistry, physics, geography, and informatics. According to Yu.K. Babansky, binary lessons contribute to optimizing the educational process and increasing students' cognitive activity [3]. Through such lessons, students gain a deeper understanding of biological processes and develop skills for applying knowledge in practice [7].

Methodology for Organizing Binary Lessons in Biology Education

To effectively organize binary lessons, appropriate topics for integration must first be selected. For example, topics such as "Chemical Foundations of Photosynthesis" or "Physical Mechanisms of Nerve Impulses" can be studied through the integration of biology with other sciences [6].

During the planning stage of binary lessons:

- a common didactic goal is determined;
- interdisciplinary content is identified;
- responsibilities are distributed among teachers [5].

Implementation of Binary Lessons

When conducting binary lessons, it is recommended to use problem-based learning, project-based methods, interactive teaching techniques, and digital technologies [4]. During the lesson, teachers present biological processes from the perspectives of different disciplines, which contributes to the development of students' analytical thinking [8]. Assessment of Learning Outcomes In the assessment process, attention is paid to students' ability to apply interdisciplinary knowledge, solve problem situations, and demonstrate creative approaches [9]. Rating systems, portfolios, and project work are considered effective assessment tools [5].

The Impact of Integrative Approaches and Binary Lessons on Educational Effectiveness Research shows that binary lessons organized based on an integrative approach increase students' level of knowledge acquisition and develop independent thinking and research competencies [6; 10]. Moreover, such lessons help reveal the practical and real-life significance of biology as a subject. Results of Experimental Studies on the Effectiveness of Integrative Approaches and Binary Lessons To determine the effectiveness of integrative approaches and binary lessons in biology education, experimental studies were conducted in several academic lyceums during the 2020–2025 academic years. The experiments focused on introducing integrated lessons, organizing binary classes, and identifying their impact on educational outcomes [6].

Experimental Sites and Participants A total of 580 students from academic lyceums affiliated with Navoi State University, Tashkent State Pediatric Medical Institute, Tashkent Pharmaceutical Institute, and Kokand State Pedagogical Institute participated in the study. Among them, 282 were first-year students and 298 were second-year students. The

selection of participants from academic lyceums in different regions contributed to the reliability of the research results [1]. Organization of the Experimental Study During the experimental process, students were divided into experimental and control groups. In the experimental groups, biology instruction widely applied:

- integrative approaches;
- binary lessons based on biology–chemistry and biology–physics integration;
- problem-based learning and project methods [3; 4].
- In the control groups, traditional biology teaching methods were maintained.

Analysis of Experimental Results At the end of the experiment, students' levels of biological knowledge acquisition, ability to apply interdisciplinary concepts, analytical and logical thinking skills were assessed through special diagnostic tasks [5].

The analysis showed that in the experimental groups:

- academic performance in biology significantly increased;
- students demonstrated a higher level of understanding interdisciplinary connections;
- independent and creative thinking skills were formed [6].

In particular, binary lessons conducted at the academic lyceum of Tashkent Pharmaceutical Institute were notable for significantly improving students' understanding of biological processes from a chemical perspective.

Pedagogical Significance of the Experimental Results The obtained results confirmed that the application of integrative approaches and binary lessons in biology education:

- enhances educational effectiveness;
- develops students' competencies;
- reveals the practical and real-life significance of biology as a subject [7; 10].

This indicates that the implementation of this methodology in biology education practice is scientifically and pedagogically justified.

Conclusion In conclusion, the methodology for organizing integrative approaches and binary lessons in biology education is one of the important directions in modernizing the educational process. This approach enhances educational effectiveness by integrating biology with other disciplines and contributes to the formation of students' scientific worldview and competencies. The widespread implementation of this methodology in educational practice will serve to improve the quality of biology education.

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