METHODOLOGY FOR USING WEB-BASED PLATFORMS IN TEACHING BIOLOGY ON THE BASIS OF INTEGRATIVE TECHNOLOGIES

Mahfuza Namozovna Ibodova
Associate Professor, Department of Biology
Navoi State University

Abstract *This article examines the methodology of using web-based platforms grounded in integrative technologies for teaching biology. It describes the structure and didactic capabilities of the integrative-biology.uz platform, its integration with the 4C model, the 5E instructional model, Bloom's taxonomy, and cooperative learning strategies (Jigsaw, Think-Pair-Share, RBCL). The results of a pedagogical experiment are presented on the basis of statistical data.*

Keywords: *integrative technology, web-based platform, biology education, 4C model, 5E model, Bloom's taxonomy, cooperative learning, academic lyceum.*

Introduction The development of information and communication technologies in the modern education system calls for new forms of organizing the instructional process. In particular, linking theoretical knowledge in biology to practice, ensuring interdisciplinary integration, and developing students' independent learning skills constitute one of the pressing pedagogical challenges of today [1]. Global educational trends, including the results of the international assessment programs PISA and TIMSS, indicate that traditional teaching methods no longer provide sufficient results in raising students' scientific literacy [2].

In this context, web-based platforms are becoming an effective means of organizing biology education on the basis of integrative technologies. Such platforms make it possible to present learning material in a structured form, reinforce knowledge through interactive assignments, monitor student activity remotely, and ensure an individualized approach to instruction [3]. At the same time,

the pedagogical potential of web-based platforms is fully realized not merely as a technical tool but as a properly grounded component of the didactic system [4].

The purpose of this article is to develop a methodological system for using web-based platforms in teaching biology on the basis of integrative technologies in academic lyceums, and to substantiate its effectiveness through the results of a pedagogical experiment.

Integrative Education and the Didactic Potential of Web-Based Platforms

The concept of integrative education refers to interdisciplinary connections and the unification of different domains of knowledge within a single context. In the pedagogical literature, the integrative approach is described as a factor that shapes systemic thinking in students [5]. Because biology, by its very nature, is closely linked to chemistry, geography, ecology, and computer science, it provides fertile ground for the introduction of integrative technologies [6].

The didactic potential of web-based platforms is manifested in the following areas: presenting learning content in multimedia format (text, video, animation, interactive diagrams); assessing student knowledge automatically through tests and assignments; enabling remote exchange of feedback between teacher and student; and adapting learning material to each student's individual pace and level [7].

Foreign studies note that web-based learning environments increase student motivation and foster self-regulated learning skills [8]. At the same time, it is not the mere presence of a platform but its pedagogical design — that is, the scientific and methodological soundness of its content — that constitutes the decisive factor in its effectiveness [9].

Viewed within the context of web-based platforms, integrative technology combines two key dimensions: content-based integration (interdisciplinary connections of knowledge) and technological integration (the consolidation of various digital tools within a single environment). The unity of these two dimensions helps students perceive knowledge not as isolated fragments but as a coherent system [6]. In biology lessons, for example, when the topic of cell structure

is studied in connection with chemical bonds, ecological factors, and even mathematical relationships (such as calculations of osmotic pressure), students' interest in and understanding of the subject increase.

Furthermore, web-based platforms allow teachers to differentiate instruction: stronger students are offered supplementary, more challenging assignments, while students who are falling behind receive additional explanatory materials and reference diagrams. This individualized approach addresses a pedagogical task that is difficult to accomplish within the traditional classroom-lesson system .

Structure and Methodological Foundations of the Integrative-biology.uz Platform The integrative-biology.uz web-based platform developed within this study is designed for teaching biology in academic lyceums on the basis of integrative technologies and is officially registered with the Ministry of Justice under registration number DGU 60064 [10]. The platform comprises 6 sections, 12 chapters, and more than 60 topics, with each topic developed in accordance with the TPACK (Technological Pedagogical Content Knowledge) model .

The platform's content is structured in a stepwise manner according to the six levels of Bloom's taxonomy — remembering, understanding, applying, analyzing, synthesizing, and evaluating. This approach guides students consistently from lower-order to higher-order cognitive levels in the process of knowledge acquisition.

The organization of the learning process is grounded in the 4C model (creativity, critical thinking, communication, collaboration), with every assignment on the platform designed to develop at least two of these four components . In addition, the process of mastering each topic is structured according to the stages of the 5E instructional model — Engage, Explore, Explain, Elaborate, and Evaluate. This model ensures that students move from being passive recipients of knowledge to becoming active constructors of it.

Technically, the platform comprises three principal modules: a theoretical-content module (texts, video lessons, interactive diagrams), an assessment module

(test items, open-ended questions, project assignments), and a monitoring module (a dashboard through which teachers track student activity). Each module corresponds respectively to the cognitive, activity, and control components, thereby ensuring the completeness of the didactic cycle. Content placement follows the GOST 7.0.5-2008 referencing standard, with citations to nationally accredited (OAK-recognized) publications, which helps cultivate in students a culture of working with scientific sources.

Integration of Cooperative Learning Strategies with the Web-Based Platform

Combining cooperative learning strategies with the capabilities of the web-based platform is of considerable importance for enhancing the effectiveness of instruction grounded in integrative technologies. Three strategies were applied in this study:

The Jigsaw method — students are divided into small groups, and each member becomes an “expert” on one part of the topic before transmitting that knowledge to the group through the corresponding module on the platform. The Think-Pair-Share technique involves individual reflection, paired discussion, and whole-class sharing based on problem-based assignments presented on the platform . The RBCL (Research-Based Collaborative Learning) approach directs students to carry out small research projects using the databases and resources available on the platform .

The integration of these strategies with the web-based platform serves to develop not only subject-matter knowledge among students but also their communicative and research skills.

As cooperative strategies are transferred to the web-based environment, the teacher's role also changes: rather than functioning solely as a transmitter of knowledge, the teacher becomes a moderator of the learning process and a manager of group dynamics. Through the platform's breakout rooms and shared project boards, teachers can monitor each group's progress in real time and provide guiding feedback when necessary. This, in turn, improves the quality of formative

assessment and allows students to feel a greater sense of control over their own learning process .

Stages of the Instructional Methodology

The methodology for organizing a biology lesson using the web-based platform comprises the following stages:

Table 1.

Structure of an integrative lesson based on the web-based platform

No.	Stage	Content
1	Engage	Capturing students' attention on the topic through an engaging video or problem-based question on the platform.
2	Explore	Independent investigation in small groups (Jigsaw) using platform materials.
3	Explain	Students explain the information they have gathered using the Think-Pair-Share technique.
4	Elaborate	Carrying out a small research assignment based on the RBCL approach.
5	Evaluate	Formative assessment through the platform's automated testing system and by the teacher.

Table 1. Structure of an integrative lesson based on the web-based platform

This stepwise methodology makes it possible to organize each lesson as a complete didactic cycle, in which the web-based platform functions not merely as a source of information but also as a tool for managing learning activity .

Results of the Pedagogical Experiment

To determine the effectiveness of the developed methodology, a pedagogical experiment was conducted in four academic lyceums in Navoi region (the academic lyceums of NavSU, TSTU, TIFI, and QSU). A total of 581 students took part in the

study and were divided into experimental and control groups .

The experimental groups were taught using the web-based, integrative methodology, while the control groups followed traditional teaching methods. The results of the experiment showed that the knowledge-quality indicator in the experimental groups was 12.5 percentage points higher than in the control groups. The chi-square (χ^2) test was used to verify the statistical reliability of the results; the computed value was $\chi^2 = 50.87$, which exceeds the critical table value, indicating that the observed differences are statistically reliable ($p < 0.05$) .

The results obtained confirm that web-based integrative technologies make a genuine contribution to improving the quality of biology education. In particular, notable improvement was recorded in students' ability to perceive interdisciplinary connections, conduct independent inquiry, and work collaboratively in groups .

Survey and observational data collected during the experiment also captured students' attitudes toward the platform: the majority of respondents rated the interactive assignments on the web-based platform as more engaging and comprehensible than traditional textbook assignments. Teachers' expert evaluations further highlighted that the platform's monitoring module enabled real-time tracking of student progress and timely pedagogical adjustments. To further strengthen the reliability of the findings, a comparative analysis of the distribution of achievement levels between the experimental and control groups was conducted, revealing a marked increase in the proportion of students at high and average achievement levels in the experimental groups, accompanied by a corresponding decrease in the proportion at the low achievement level.

Conclusion

In conclusion, the methodology of using web-based platforms in teaching biology on the basis of integrative technologies represents one of the effective directions for improving the quality of modern education. As demonstrated through the example of the integrative-biology.uz platform, the combined application of the 4C model, the 5E instructional model, Bloom's taxonomy, and cooperative learning strategies (Jigsaw, Think-Pair-Share, RBCL) serves to develop not only students'

subject-matter knowledge but also their twenty-first-century skills.

The results of the pedagogical experiment (a 12.5% effectiveness indicator and $\chi^2 = 50.87$) confirmed the scientific and practical soundness of the developed methodology. Investigating the potential for applying this methodology to the teaching of other natural science subjects remains a pressing task for future research.

References

1. Yo‘ldoshev J.G‘. Pedagogik texnologiya asoslari. – Toshkent: O‘qituvchi, 2021. – 256 b.

2. OECD. PISA 2022 Results: Factsheets. – Paris: OECD Publishing, 2023. – 48 p. URL: https://www.oecd.org/pisa/publications/ (murojaat sanasi: 12.03.2026).

3. Tolipova J.O., Usmonov B.Sh. Biologiya ta’limida innovatsion texnologiyalar. – Toshkent: Fan va texnologiya, 2022. – 184 b.

4. Ibodova M.N. Conceptual framework for the use of integrative technologies for teaching biological sciences in academic lyceums Bosma European Journal of Research and Reflection in Educational Sciences. – 2023. – Vol. 11, No. 4. – P. 52–55. – URL: https://www.idpublications.org/ejrres-vol-11-no-4-2023

5. Ibodova M.N. An Integrative Approach and The Methodology of Organizing Binary Lessons in Biology Education Bosma The American Journal of Applied Sciences. – 2026. – Vol. 8, Issue 06. – P. 288–296. – URL: https://doi.org/10.37547/tajas/Volume08Issue06-09

6.Ibodova M.N. Improving the Effectiveness of Integrative Technologies in Teaching Biology at Academic Lyceums Bosma The American Journal of Applied Sciences. – 2026. – Vol. 8, Issue 06. – P. 268–280. – URL: https://doi.org/10.37547/tajas/Volume08Issue06-07

7.Ibodova M.N. Methodological foundations of the use of integrative technologies in the teaching of biology in academic lyceums Bosma Journal of Advanced Zoology. – Hindiston, 2023. – Vol. 44, Issue S-6. – P. 1786–1789. URL: http:// www.jazindia .com/index.php/jaz/article/view/2618

8. Ibodova M.N. Description of integrative technologies for teaching biology in academic lyceums // Current Research Journal of Pedagogics. – 2024. – Vol. 5, Issue

10. – P. 189–192. – DOI: https://doi.org/10.37547/pedagogics-crjp-05-10-32

Current Research Journal of Pedagogics. – 2024. – Vol. 5, Issue 10. – P. 189–192. URL:https://doi.org/10.37547/pedagogics-crjp-05-10-32

9.Ibodova M.N. Akademik litseylarda biologiya fanini o'qitish samaradorligini oshirishda integrativ texnologiyalardan foydalanishni takomillashtirish metodikasi

Bosma Ilmiy tadqiqotlar, innovatsiyalar, nazariy va amaliy strategiyalar tadqiqi. – № 14. – Respublika ko'p tarmoqli ilmiy konferensiya, 30 dekabr 2023. – B. 55–57 URL https://ojs.rmasav .com/index.php/ojs/issue/view/40/62

10 . Ibodova M.N. Effective organization of biology lessons through integrated education in academic lyceums Bosma International Scientific Research Conference, Part 35, June 19th, 2025. – Minsk, Belarus: Collections of Scientific Works. – B. 7–11 https://aps.tsuos.uz/storage/users/114/articles/ZTeXJjKGINIldr0MR7MxuH18NM0Ml1u6tUAfYKL3.pdf