BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

EDUCATIONAL TECHNOLOGIES SUITABLE FOR DEVELOPING STUDENTS' SYSTEMIC THINKING IN TEACHING BIOLOGY AND THEIR PRACTICAL APPLICATION

Mustafoqulova Dildora Ismatullayevna
Teacher of Jizzakh State Pedagogical University.
https://doi.org/10.5281/zenodo.20306045

Abstract: This article analyzes modern educational technologies that contribute to the development of students' systemic thinking in the process of teaching biology. Systemic thinking is considered an important competence that helps students deeply understand the interrelationships among biological processes, phenomena, and objects. The article highlights the content and significance of innovative technologies such as interactive methods, problem-based learning, project-based learning, the use of information and communication technologies, and the STEAM approach. In addition, the ways of applying these technologies in practice, methods of integrating them into the teaching process, and their effectiveness are substantiated through examples. The research results demonstrate that the formation of systemic thinking in biology education is an important factor in improving the quality of education.

Keywords: biology education, systemic thinking, innovative technologies, interactive methods, problem-based learning, project-based learning, STEAM approach, information and communication technologies, pedagogical technology, educational effectiveness, creative thinking, integrative approach, competency-based education, didactic methods, practical application.

Systemic thinking in teaching biology is considered one of the most important tasks of the modern education system today. Systemic thinking is not only the memorization of separate facts, but also the ability to understand them in an interconnected way, identify cause-and-effect relationships, and perceive biological processes as an integrated system. Especially in complex and multi-level subjects such as biology, this type of thinking enables students to gain deep knowledge and apply it in practice. Therefore, the development of systemic thinking through the use of modern educational technologies in biology teaching is regarded as an important pedagogical taskIn traditional teaching methods, the teacher often plays the central role and knowledge is provided in a ready-made form. In such an approach, students remain only recipients of information. As a result, they cannot sufficiently develop skills such as independent thinking, analysis, and generalization. Modern educational technologies, however, ensure active student participation and place the learner at the center of the educational process. This directly influences the formation of systemic thinking.Interactive methods are among the most effective approaches widely used in biology teaching. Through these methods, students actively participate in the lesson, freely express their opinions, and solve problems collaboratively. For example, methods such as "Brainstorming," "Cluster," "Fishbone," and "INSERT" are highly useful in identifying relationships between biological concepts. These methods help students not only learn the topic but also analyze it, determine causes and effects, and develop systemic thinking.

Problem-based learning technology also plays an important role in shaping systemic thinking. In this approach, the teacher does not provide ready-made knowledge but creates a problem situation and guides students toward solving it independently. For example, questions related to

environmental issues, genetic diseases, or evolutionary processes may be presented. During the problem-solving process, students integrate various types of knowledge, identify cause-and-effect relationships, and arrive at systemic conclusions.Project-based learning technology is also highly effective in biology education. In this method, students develop and defend projects on specific topics. For instance, projects may be prepared on topics such as “Environmental Protection,” “Biological Characteristics of Plants,” or “Systems of the Human Body.” During the project process, students conduct independent research, collect information, analyze data, and generalize results. This contributes significantly to the development of their systemic thinking skills.The use of information and communication technologies also creates broad opportunities in biology education. Through multimedia tools, virtual laboratories, animations, and interactive programs, complex biological processes can be explained visually. For example, processes such as cell structure, DNA replication, or photosynthesis can be demonstrated through animations, making them more understandable and engaging for students. This helps students perceive knowledge as an integrated system.The STEAM approach (integration of science, technology, engineering, art, and mathematics) also plays a significant role in developing systemic thinking in biology teaching. Through this approach, students understand the interconnection between different disciplines. For example, biochemical processes can be studied through the integration of biology and chemistry, while biological statistical data can be analyzed using mathematics. This develops broad and systemic thinking among students.Didactic games are also effective tools widely used in biology lessons. Through games, students learn complex concepts more easily and their interest in lessons increases. For example, role-playing games can be used to demonstrate relationships among organisms within an ecosystem. In this process, students understand the role of each element within the system and realize their interdependence.

An integrative approach is also important for developing systemic thinking in biology. In this approach, different topics are taught in relation to one another. For example, when studying human body systems, not only anatomical structures but also their functional relationships are explained. This allows students to perceive knowledge not as isolated pieces of information but as a unified system.The assessment system should also be adapted to the development of systemic thinking. Instead of relying solely on test questions, it is advisable to use analytical questions, problem situations, and projects for assessment. Through this, students demonstrate not only their level of knowledge but also their thinking skills.The role of the teacher is also extremely important in this process. A modern teacher should not only be a provider of knowledge but also a guide, motivator, and facilitator. The teacher should create opportunities for students to think independently, ask questions, and conduct research. In this way, students independently construct their knowledge and develop systemic thinking.In conclusion, it is necessary to effectively use modern educational technologies in order to develop systemic thinking in biology teaching. Interactive methods, problem-based learning, project-based learning, ICT tools, and the STEAM approach are among the most effective means in this regard. Through the proper practical application of these technologies, students acquire deep biological knowledge, as well as the skills to analyze and apply it in practice. Most importantly, they gain the ability to understand complex biological processes as integrated systems, which contributes to preparing highly qualified specialists who meet the demands of modern society.

REFERENCES

1. Azizxo‘jaev N.N. – *Pedagogical Technologies and Pedagogical Skills.* Tashkent: O‘qituvchi, 2018.
2. Ishmuhamedov R.J., Yuldashev M. – *Innovative Technologies in Education.* Tashkent: Fan va Texnologiya, 2019.
3. Sayidahmedov N.S. – *New Pedagogical Technologies.* Tashkent: Moliya, 2017.
4. To‘xtaxo‘jaeva M.X. – *Pedagogy.* Tashkent: O‘zbekiston, 2020.
5. Biology – Pearson Education, 2015.