

## TECHNOLOGIES FOR IMPROVING THE METHODOLOGICAL TRAINING OF BIOLOGY TEACHERS IN THE PROCESS OF CONTINUOUS PROFESSIONAL DEVELOPMENT.

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**Annotation:** This article addresses the issue of improving the methodological training of students in the process of teaching biological sciences. The study focuses on harmonizing the theoretical and practical foundations of biology teaching methodology. The richness of current biology curricula does not always allow the inclusion of tasks aimed at developing students' methodological skills. It is well known that the development of methodological knowledge and skills in biology students occurs alongside the assimilation of biological content. Therefore, there is a need to develop a methodological mechanism that ensures the holistic and systematic integration of biological and methodological components.

**Keywords:** methodological training, matter, generalization, interactive methods, innovative approach, cluster.

To determine the commonality of scientific and methodological components, it is appropriate to take a holistic view of the process of teaching biology and identify the distinctive features that differentiate it from other scientific disciplines. This approach helps define the place of biology as a subject within the system of methodological training for biology teachers and makes it possible to identify its contribution to this process. The holistic approach to constructing a model of biology as a science serves as a leading methodological approach that contributes to the generalization of methodological training based on biological knowledge. This is a general philosophical approach that requires clarification at different methodological levels when applied in practice.

The content of the biology course has a complex structure, incorporating morphological, physiological, ecological, systematic, paleontological, zoogeographical, and phylogenetic concepts. The concepts studied in biology — such as “the cell as the structural unit of life,” “the organism as an integrated whole,” “the unity of structure and function of organs,” “metabolism,” and “the evolution of the

organic world” — make it possible to develop general biological concepts systematically.

The biology course is closely related to human practical activity. The integrative nature of biology education content is, firstly, that it shows what the development of biological life as a form of matter movement culminates in, and secondly, what the origins of the biological form of matter movement are, and which biological regularities caused its emergence. Accordingly, the requirement for methodological training in the study of biology lies in teaching learners how to use biological content to generalize their knowledge in biology. In this context, generalization becomes a strategic direction in constructing the biology course. This method allows solving several psychological, pedagogical, and methodological tasks, including:

Generalization determines the structure of the content of biology as a science, moving from the general to the specific.

Identifying the essential and significant aspects within the broad biochemical content enables teachers to determine the scope of knowledge and skills that students should acquire at school.

The degree of specification of generalized knowledge depends on the students' level of preparation and age characteristics, as well as the methods, forms, and tools used in the educational process, class specialization, and other conditions.

Designing the content of the discipline in accordance with the principle of meaningful generalization defines the structure of learners' educational activities related to mastering this content. The main operations involved in generalization are abstraction (identifying the essential and significant), modeling (constructing an object model based on the understanding of its significant features), and specification (explaining particular cases based on the knowledge of general laws).

Meaningful generalization determines the system of teaching tools — models that record the main and essential characteristics of a biological object and make it possible to study their expression under various conditions.

Generalization develops learners' systematic theoretical thinking and serves as one of the technologies of developmental teaching at school.

It is also an important method for establishing interdisciplinary connections in the curriculum, as it requires the involvement of methodological concepts common to several disciplines. Thus, generalization helps develop a holistic view of the world in learners' consciousness.

Generalization serves as the basis for integrating ecological components into the content of the biology course since biological knowledge is inherently generalizing in nature. On this basis lies the understanding of the universal interconnectedness and mutual influence of all processes in the world. Therefore, when introducing content into the system of biological concepts of an individual, it should be elevated to the necessary maximum level of generalization.

In developing the system of methodological training during the study of biology, it is necessary to consider the specific features of methodological preparation itself.

Although this quality plays a significant role in the evolution of social systems, it does not determine the evolutionary process itself. For social evolution, it is essential that the next generation develops morally and intellectually beyond the previous one, allowing social progress to occur. Therefore, teachers play a key role in fostering the moral, aesthetic, and creative development of the younger generation and in transmitting cultural experience.

Incorporating evolutionary relationships into the construction of biology course content helps teachers develop an understanding of the teacher's social role in modern society, as well as personal responsibility for professional choice and the quality of professional training.

Currently, the following are considered interactive learning technologies: interactive methods ("Case study," "Blitz survey," "Modeling," "Creative work," "Dialogue," "Plan," "Discussion," "Competition"), strategies ("Brainstorming," "Boomerang," "Gallery," "Zigzag," "Step-by-step," "Carousel," "Rotation," "T-chart"), and graphic organizers ("Fishbone," "K-W-L," "Concept table," "Venn diagram," "Lotus flower," "Insert," "Cluster," "Why?", "How?"); among others

In teaching biology, it is important to develop learners' competencies using modern pedagogical technologies, active and interactive methods, and to enhance their knowledge, skills, and abilities to apply these methods in practice. Improving the ability to organize biology lessons according to modern requirements holds a special place in methodological training.

Currently, there are various perspectives on the classification of educational technologies applied in the educational process. To successfully implement innovative and modern pedagogical technologies in the teaching and upbringing process, biology teachers must possess special methodological knowledge, skills, and competencies necessary for pedagogical practice. A teacher must first determine whether a particular technology or method is suitable for the topic being studied.

In solving problems and exercises in biology, it is recommended that teachers use local pedagogical technologies such as “Case study,” “Cluster,” quick games, and various forms of educational games.

To systematize and consolidate students’ knowledge in biology, the “Cluster” method (“Network”) plays an important role. The word cluster in English means “tree” or “genealogy.” This local technology allows learners to understand the connections between ideas, theories, laws, and concepts, fostering analytical and critical thinking skills.

The “Cluster” method is implemented as follows: key concepts of the biology content are written or drawn in the center of the board or on paper, then related laws and concepts are linked as branches, and conclusions about the studied topic are made.

During lessons using the “Cluster” method, learners are divided into equal groups, given an educational task with its didactic purpose and execution procedure explained. Within the allotted time, they develop and defend their clusters, justify their ideas, and the best-designed cluster is identified and rewarded.

If the teacher uses this method repeatedly, students will gradually start to develop their own clusters independently, presenting topics in a structured way.

“Case study” (from English case studies, meaning “situation” or “process”) is based on analyzing a specific, real or artificially created problematic situation expressed through biology-related questions or exercises. Learners are encouraged to understand the problem and search for suitable solutions.

**Conclusion** In conclusion, interactive learning technologies play a crucial role in improving the quality and effectiveness of education. They strengthen collaboration among learners, establish ideological and emotional unity, and foster collective striving toward a common goal. They also create the necessary conditions and environment for each learner to realize their potential and express themselves as an individual.

Interactive methods, as key components of interactive learning, are inherently effective in achieving educational objectives. The most important aspect is that learners should select interactive methods in accordance with the topic, issue, or problem under study. Furthermore, considering learners’ age, psychological traits, worldview, and life experience when applying interactive methods further increases lesson efficiency and effectiveness.

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