APPLICATION OF THE PRINCIPLE OF SYSTEMICITY AS A MEANS OF INCREASING THE EFFECTIVENESS OF TEACHING IN BIOLOGY COURSES

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ABSTRACT

This article reveals the issues of using a systematic approach in teaching biology. The aim of the article is to clarify the possibilities of systematic teaching of natural science subjects in the process of teaching biology through pedagogical research, to systematize students' knowledge through integrated lessons, contributing to the formation of their worldview. The study was conducted in grades 7-9 of the secondary school No. 2 named after Khachatur Abovyan in Yerevan, in which 180 students from the experimental and control groups participated. The results of the experimental study indicate that the application of the principle of systemicity in the process of teaching biology contributes to the development of students' thinking, increases motivation to learn and helps to increase the level of knowledge.

Keywords: learning, biological system, integrity, system approach, method, activity, integration, pedagogical process, motivation to learn.

INTRODUCTION

In the learning process, the younger generations must assimilate what has already been accumulated by society, that is, to master the knowledge corresponding to their level of development, to master certain work skills, to assimilate the norms of behavior and the experience of society, to develop a certain system of views on life. To achieve this goal, it is important to introduce integrated learning, which determines the relevance of this work.

At the present stage of the development of biological science, the leading methodological direction is the system approach. As is known, the system approach in pedagogy involves an attitude to pedagogy as a system - a set of well-structured and closely interrelated elements. This approach, in contrast to the traditional subject-based approach, is more qualitative and modern. The principle of systemicity is a category of philosophy and methodology, according to which all objects and phenomena of the world are considered as holistic and complex systems of varying degrees.

An important methodological task in the learning process is to ensure that the knowledge acquired by students is not fragmented facts, but has a systematic character based on causal relationships. Biological knowledge will only be a formal assimilation of facts if they are not realized and not based on deep conviction. Both in nature and in the learning process, everything must be interconnected and purposeful. K.D. Ushinsky noted: "A head filled with fragmented, disjointed knowledge is like a pantry in which everything is in disarray and the owner himself cannot find anything" (Ushinsky, 1993).

The purpose of the work: The purpose of this work was to clarify the possibilities of systematic teaching of natural science subjects in the process of teaching biology through pedagogical research, to systematize students' knowledge through integrated lessons, contributing to the formation of their worldview. To this end, the task was set:

- to study the possibilities of organizing the implementation of the principle of systemicity in the courses "Biology" in the main school,
- to develop examples of biological systems, apply them in the course of biology, systematizing the knowledge and skills obtained in the natural science subjects.

LITERATURE REVIEW

The system approach became a recognized scientific direction in the late 1940s and early 1950s. Its founder is considered to be the Austrian biologist Ludwig von Bertalanffy (Blauberg, et all., 1978). The systemic way of thinking not only accumulates previous styles of thinking in a transformed form, but also acts as an integrator of various methodologies, ways, and methods of cognitive activity into a single systemic process of interdisciplinary research (Reshetova, 2002).

The principle of systematics suggests that nature should be viewed as a whole. Any biological object can be represented as a system, and in its study, one should first apply a macroscopic approach-considering the object as a whole and its functioning in the external world-and then a microscopic approach-isolating its components, identifying subsystems, and examining their interconnections. The forms of learning should also be systematic: lessons, excursions, homework, extracurricular and out-of-school activities (Vernadsky, 2001).

Afanasev wrote, "Only a systematic approach allows us to integrate heterogeneous specific tasks, bring them to a common denominator, and thus represent the most complex group of various tasks as a single problem" (Afanasev, 1986).

The systematic approach is not only a methodological tool that directs research and defines the nature of cognitive procedures, but also a means that determines the conceptual system produced (the elements of knowledge, their content, structure). A system is the unity of elements that depend on one another and exist in certain relationships, forming a particular integrity. An element is the foundation of the system's integrity: it represents a quantitative and qualitative unit of its structure. Regardless of the complexity of its organization, an element is viewed as an indivisible object within the system (for example, the system of natural numbers consists of whole numbers, not fractions; a ship's crew consists of individual people, not parts of the human body). Connections are the relationships between the elements (subsystems) of the system (internal connections) and between the system and the external environment (external connections). The system-forming factors are those that play a leading role at a given stage of the system's development in maintaining its integrity. The set of mechanisms that ensure the integrity of the system is called integration. Hierarchy reflects the multi-level organization of complex systems, where its elements and their sets are combined into relatively autonomous aggregates of different ranks (subsystems) (Tsibulevsky, 2008).

The number of different elements and their relationships that a system includes determines its complexity. If the absence of elements in a group does not affect either the group or an individual element, then such a group is not a system. For example, a pile of apples and an apple tree, or a pile of wheat grains and a single wheat seed. A single seed taken separately is a system, while a pile of seeds is not. In principle, the elements of systems can themselves be represented as systems, and a given system in another context can act as an element or subsystem of a more complex system. For instance, a tissue is a system for a cell and a subsystem for an organ. The cell, in turn, can also be considered a system.

When applying the principle of systematics in biology courses, examples should be presented that are common to all forms of the organic world-growth, development, nutrition, reproduction, etc-justifying the idea that all phenomena in nature are connected by causal relationships, have a systematic nature, and follow a certain developmental course. Students need to be convinced that biological systems also play a significant role in understanding the world.

In biology, unlike physics and chemistry, there are fewer generalizations accepted in the form of laws. This is due to the complex structure of living systems. A systematic interpretation of laws and regularities enhances the effectiveness of the acquired knowledge and understanding and can contribute to new discoveries, which can be achieved theoretically and experimentally. The creation of systems is

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necessary at all levels of biological organization: cell, organism, population, species, biocenosis, biosphere. It is much easier to see, perceive, and remember a biological phenomenon in a system than in an isolated state.

Knowledge based solely on mechanical memory is unstable and quickly forgotten. In contrast, systematically organized, sequentially acquired knowledge is much more stable, though more challenging to obtain. For example, a student may understand water absorption by roots and evaporation from leaves, but understanding the movement of water within the plant and the interrelation of organs in this process will be more complex. To facilitate this understanding, it is necessary to consider the plant as an integral system. Thus, water absorption by roots does not occur without the involvement of other organs of the plant; this is facilitated by the evaporation of water from leaves. At the same time, the question arises as to how water reaches the leaves. The stem serves as the intermediate link in the transportation of water in the plant-it is another element of the holistic system. The stem alone cannot transport water. The transportation of water through the stem involves root pressure-the force pushing water toward the stem-and the suction force from water evaporation at the leaves. However, the stem does not perform a passive transport function. It contains water-conducting vessels with capillary structure, through which water moves much more easily. Moreover, in the water-conducting vessels, there is a force of cohesion between water molecules-a force of mutual attraction. In other words, a connected, unified system for the absorption and transportation of water has been created. Ultimately, all processes occurring in the plant are directed toward a single common "goal"-the formation and maturation of reproductive organs-flowers, fruits, and seeds-ensuring the preservation of the species (Tangamyan, et all., 2011).

To activate students' learning activities and stimulate their cognitive interests, all means of organizing and conducting educational activities are employed-oral, didactic (demonstrative), and practical methods, methods of reproduction and search, as well as inductive and deductive methods (Gevorgyan, 2012).

METHODOLOGY

In the process of teaching biology, subject-oriented learning predominates, while systematic learning allows students to compare various biological phenomena and make different discoveries and interpretations through sequential and systematic connections. The use of traditional teaching methods in the educational process often makes the material uninteresting and dull. In contrast, a schematic representation of the lesson based on the principle of systematics has a positive impact on the quality of student learning, as it develops not only perception and thinking but also visual memory, reasoning, and logical analysis.

Considering these issues and aiming to study and interpret the discussed topics, we conducted an experiment at school No. 2 named after Khachatur Abovyan in Yerevan. Through the systems we developed, testing, and individual interviews, we carried out special surveys to determine the initial state of students' knowledge and their readiness to participate in the experiment. The study involved 180 students from grades 7-9. Based on the diagnostics, we selected methods, tools, and forms of research and transitioned to the formative stage. In the formative stage of teaching, we utilized a number of biological systems intended for educational purposes that were included in the school biology curriculum. Let's introduce some of the topics of the written works: "Protozoa", "Structure and diversity of flowering plants", (7th grade), "Organ, organ systems", "The internal environment of the organism", (8th grade), "Plastic and energy exchange", "Photosynthesis" (9th grade), (Esayan, et al, 2023; Tangamyan, Sisakyan, 2008; Tangamyan, Safaryan, 2014).

For the experiment, students with relatively equal levels of preparation were chosen. Teaching in the control classes was organized in a traditional manner, while in the experimental classes, thematic integrated systems were used. Upon completion of the research, a final assessment was conducted. For this purpose, the assignments also included broader philosophical questions, the answers to which were evaluated according to the levels established by V.P. Bespalko: correct, partially correct, incorrect, and erroneous answers (Bespalko, 1989).

RESULTS

Below are the results of the thematic work conducted in the experimental and control classes. In a 10-point grading system, scores of 8-10 were recognized as high, 6-7 as average, and 4-5 as low.

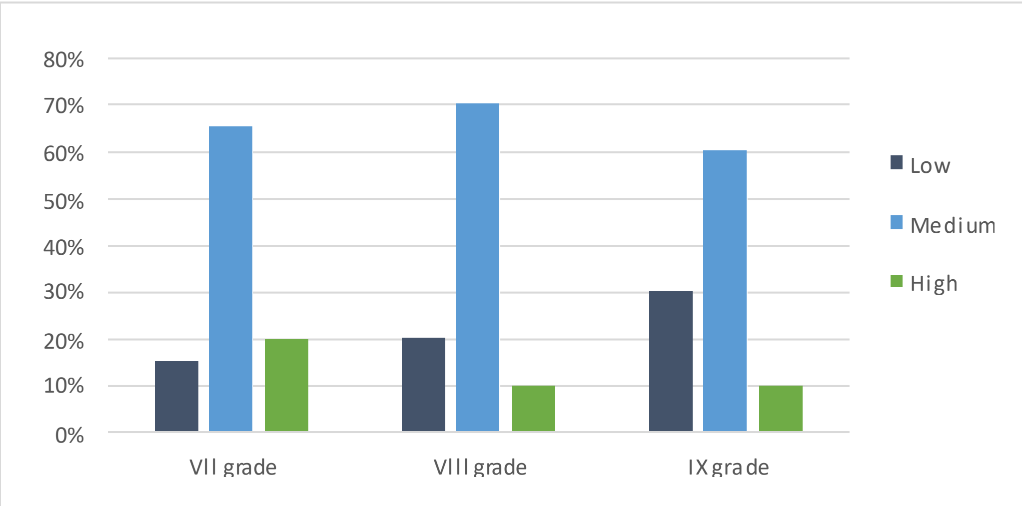

Diagram 1: Results of thematic written work in control classes

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The final results of the thematic work showed that in the control classes across all three grades, students predominantly demonstrated average results, with the percentage ranging from 60-70% (diagram 1).

High scores were recorded in the experimental 7th grade at 40%, in the 8th grade at 25%, and in the 9th grade at 15%. In contrast, the control classes showed the following results: 20% in the 7th grade, 10% in the 8th grade, and 10% in the 9th grade (diagrams 1and 2).

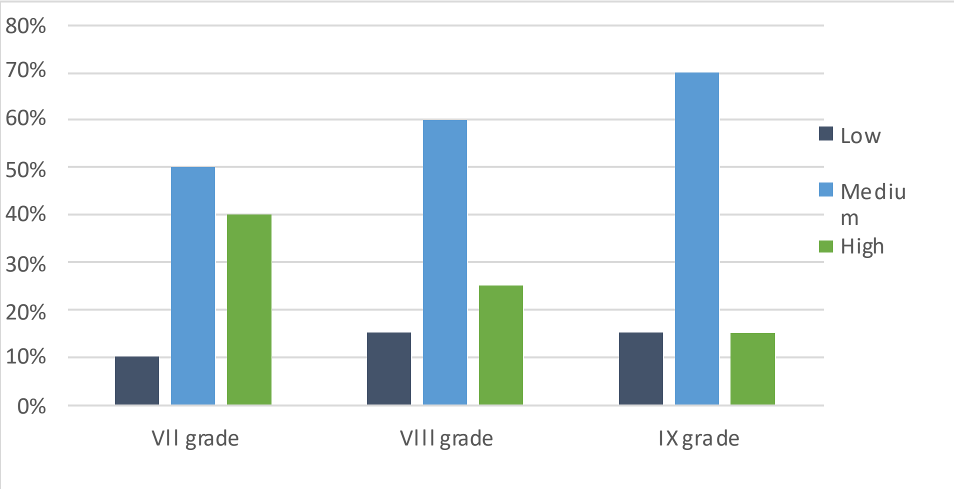

Diagram 2: Results of thematic written work in experimental classes

These results indicate that in the experimental classes, the application of a systematic approach increased the percentage of average and high scores. Therefore, we can conclude that systematic learning enhances the effectiveness of education.

To determine the effectiveness of the systematic approach to teaching, a comparison was also conducted at the end of the year. The assignments included broader questions based on the principle of systematics. The results are presented in Tables 3 and 4. In the experimental class, 40% of 7th graders answered correctly, while the control class had correct answers at 30%. In the 9th grade, the trend continued similarly: 60% in the experimental class compared to 70% in the control class.

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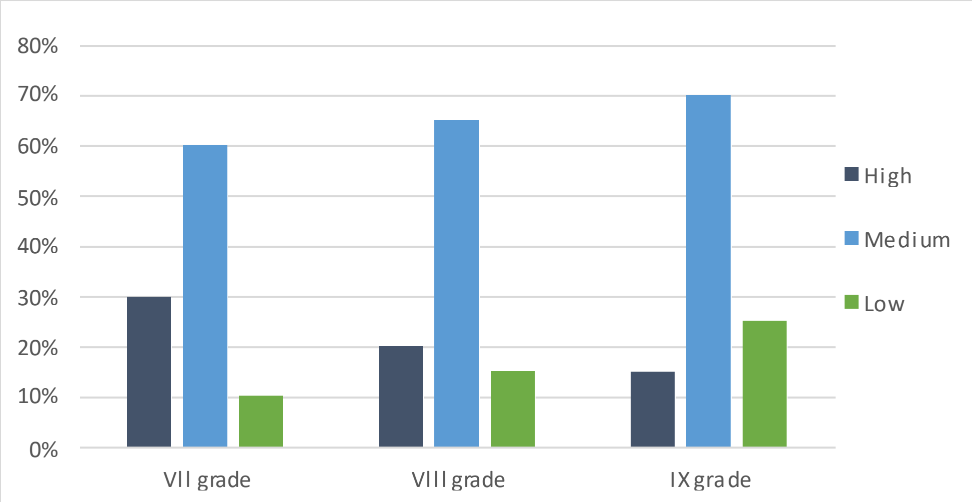

Diagram 3: Results of semester written assignments in control classes

In the 8th grade, the situation was as follows: 20% in the control class answered correctly, while 45% did so in the experimental class. Incorrect answers were also noted: in the control class, 15% were incorrect, whereas in the experimental class, only partially incorrect answers amounted to 55%.

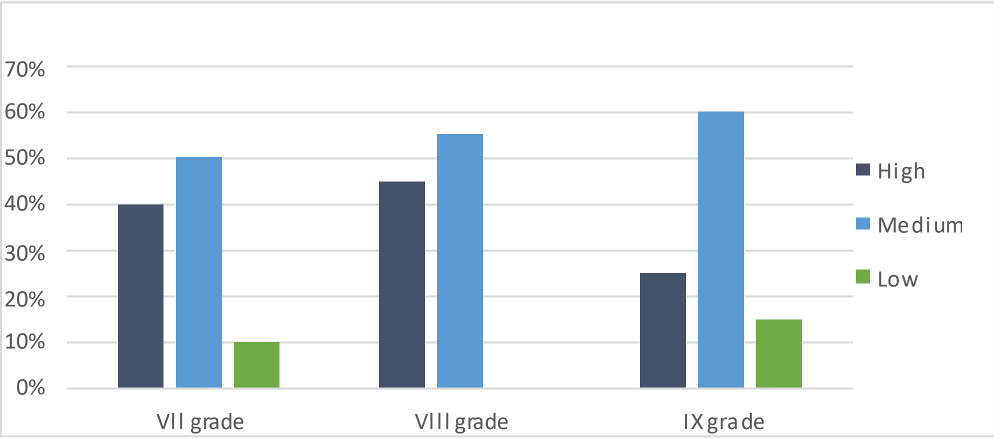

Diagram 4: Results of semester written assignments in experimental classes

Data at the end of the year further confirm that the trend persists: assignments based on the principle of systematics applied in the experimental classes had a positive impact, leading to more effective lessons and higher performance.

DISCUSSION AND CONCLUSION

Thus, the results of the experimental study indicate that the application of the principle of systematics in the process of teaching biology contributes to the development of students' thinking, increases motivation for learning, and enhances their level of knowledge.

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In our view, to improve the effectiveness of biology education, it is necessary to present the subject matter in a systematic form, ensuring interdisciplinary connections and interpretations of causal relationships of phenomena, so that students form holistic logical representations and beliefs about the objective world.

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