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INTEGRATION OF THE STEM APPROACH IN BIOLOGY TEACHING IN HIGHER EDUCATION

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Abstract: The article discusses the features of the implementation of the STEM approach in the system of biology teaching in higher education. Its potential as a tool for the formation of research and interdisciplinary competencies of students is revealed. Based on the analysis of modern pedagogical practices, the ways of integration of technologies, engineering thinking and mathematical apparatus in biological education are proposed. The effectiveness of the use of project-based research forms of education is substantiated.

Keywords: STEM approach, biological education, interdisciplinarity, higher education, innovative technologies.

Introduction.

Modern requirements for training specialists in the field of natural sciences involve not only the possession of fundamental knowledge, but also the ability to apply it in non-standard professional situations. In this regard, traditional methods of teaching biology are gradually giving way to integrative educational models.

One of such models is the STEM approach, which is based on the combination of scientific knowledge, technological tools, engineering solutions, and mathematical methods. Its implementation in the educational process is associated with the need to train specialists who are capable of analyzing complex biological systems, processing data, and solving practical problems.

Despite the active implementation of STEM in educational practice, the issues of its adaptation to the teaching of biology in higher education remain insufficiently developed, which determines the relevance of this study.

The purpose of the study is to identify the pedagogical potential of the STEM approach in teaching biology and to determine effective ways of its implementation in higher education.

Research Methods.

To achieve the set goal, the following methods were used:

-theoretical analysis of scientific and pedagogical sources;

-systematization of modern educational practices;

-comparative analysis of traditional and integrative approaches to teaching.

The methodological basis is based on the ideas of interdisciplinary learning, the competence approach and practice-oriented education. Special attention is paid to the analysis of forms of organization of educational activities that promote active involvement of students in the learning process.

Results.

The analysis conducted allowed to identify several key areas of integration of the STEM approach in teaching biology.

1. Interdisciplinary integration. Teaching biology within the framework of STEM involves establishing sustainable connections with mathematics, computer science and engineering disciplines. This allows to consider biological phenomena as complex systems that require quantitative analysis and modeling.

2. Project and research activities of students

One of the most effective tools of STEM is the organization of educational projects. In the process of their implementation, students:
-formulate a problem;
-put forward hypotheses;
-conduct experimental research;
-analyze the data obtained.
This format contributes to the formation of scientific thinking skills.
3. Use of digital technologies
Integration of STEM is impossible without the use of modern digital tools. In teaching biology, this may include:
-virtual laboratories;
-computer modeling of biological processes;
-processing of experimental data using specialized software.
4. Development of professional competencies
The implementation of the STEM approach contributes to the development of the following skills in students:
-analytical thinking;
-the ability to interpret data;
-the ability to engage in interdisciplinary interaction;
-readiness to solve applied problems.
Examples of implementing the STEM approach in teaching biology
Example 1. Topic: "Photosynthesis as a biochemical process"
Classroom format: hands-on STEM lesson
Student activities:
-studying the mechanism of photosynthesis (Science)
-using light sensors or mobile applications (Technology)
-developing a mini-greenhouse model (Engineering)
-analyzing plant growth and plotting graphs (Mathematics)
Result: students not only learn the theory, but also identify the dependence of photosynthesis intensity on external factors (**table-1**).
Example 2. Topic: "Ecosystems and Environmental Sustainability"
Format: project work
Task:Develop a model of a sustainable ecosystem (for example, an aquarium or a closed system).
Activities:
-analysis of ecosystem components
-modeling of interactions
-calculation of the balance of substances
-prediction of changes
Result: Formation of systemic thinking and understanding of environmental processes.
Example 3. Topic: "Human Physiology: Cardiovascular System"
Format: research work
Task: Measure heart rate and blood pressure before and after physical activity.
Stages:
-data collection
-statistical processing
-visualization of results
Result: Development of skills in analyzing biological data.
Table-1.

Table for integrating STEM components into biology education

Developed	Component Biology	STEM Content Example	Task Skills
Science	Biological processes	Study of photosynthesis	Scientific thinking
Technology	Digital tools	Working with sensors	Digital literacy
Engineering	Model construction	Ecosystem creation	Project thinking
Mathematics	Data analysis	Charting	Analytical skills

Table-2.
Comparison of traditional and STEM approaches

Criterion	Traditional education	STEM approach
The role of a student	Passive listener	Active researcher
types of tasks	Reproductive	Problem-solving and research tasks
Technology usage	Limited	Active
Learning outcome	Knowledge retention	Knowledge application
Motivation	Average	High

Discussion.

The results obtained confirm that the STEM approach has a significant educational potential. Its application allows the learning process to become more dynamic and closer to real professional activity.

At the same time, the implementation of STEM in biology teaching is accompanied by a number of problems. These include the need to revise curricula, the insufficient level of teacher training for interdisciplinary education, as well as the limited resources of educational institutions.

It is important to note that the effectiveness of STEM depends directly on the teacher's methodological readiness and the availability of conditions for implementing practice-oriented learning.

Conclusion.

The integration of the STEM approach into the teaching of biology in higher education is a promising direction for the development of modern education. It ensures that students acquire not only theoretical knowledge, but also practical skills necessary for their professional activities.

To successfully implement this approach, it is necessary to:

-update the content of educational programs;
-introduce active learning methods;
-develop a digital educational environment.

Thus, the STEM approach can be considered an effective tool for improving the quality of biological education and training competitive specialists.

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