

DEVELOPMENT OF STUDENTS' RESEARCH SKILLS USING VIRTUAL PROGRAMS AND DIDACTIC TOOLS

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Abstract. *This study is devoted to the development and improvement of methods for using virtual programs and didactic tools in the educational process in biology with the aim of effectively developing students' research skills. The study allows us to conclude that the use of virtual programs and didactic tools using the developed methodology contributes to more effective development of students' research skills in the process of teaching biology. The presented results can be used in educational practice to improve the quality of education and motivate students to active learning activities.*

Keywords: *modern technologies, virtual programs, didactic tools, teaching methods, teaching biology, pedagogy.*

The relevance of the study is due to the need to adapt educational methods to modern technological requirements and the needs of students. In the context of the rapid development of virtual technologies, the use of virtual programs in teaching biology is a promising approach that helps improve the quality of education and increase students' motivation for learning activities.

The purpose of the study is to develop an effective methodology for using virtual programs and didactic tools in order to develop students' research skills in the field of biology.

To achieve this goal, the following stages of the study were carried out:

1. Analysis of existing virtual programs and didactic tools for teaching biology.
2. Identification of features of the development of research skills in students.
3. Development and testing of methods for using virtual programs in the educational process.
4. Assessing the effectiveness of using the developed methodology based on a comparative analysis of learning results.

Didactic tools for developing students' research skills in teaching biology are tools used by teachers to create a stimulating and effective educational environment. They help students develop the skills of observation, analysis, interpretation of data, conducting experiments and drawing conclusions based on the results obtained [1,2].

One of the key didactic tools is laboratory work. They provide a unique opportunity for students to practically apply theoretical knowledge, as well as develop skills in working with biological materials and laboratory equipment. Laboratory work can include both classical research methods (for example, microscopy, cultivation of microorganisms) and modern biotechnological techniques (polymerase chain reaction, DNA sequencing, etc.) [5].

In addition, visual aids such as anatomical models, diagrams, diagrams and animations are important tools. They make it possible to clearly demonstrate the anatomical and physiological characteristics of organisms, the processes of biochemical reactions, as well as the interaction of molecules and cells [3].

Case methods and problem-oriented scenarios are also widely used to stimulate students' research skills. They involve solving real or simulated problems that require analysis and search for solutions based on acquired knowledge [6].

Interactive technologies and virtual environments, such as computer simulators and virtual laboratories, provide the opportunity to conduct experiments in a virtual environment, which is especially important in cases where access to real laboratories is limited [4].

A variety of educational materials, including textbooks, articles, scientific publications and videos, is also considered an important component of the didactic base. They provide students with the opportunity to become familiar with modern scientific advances and research methods in the field of biology.

Thus, the use of a variety of didactic tools in teaching biology helps students develop the skills of independent work, critical thinking, data analysis and making informed decisions based on scientific data and knowledge. This is an important component of the modern educational process aimed at training qualified specialists in the field of biology [7].

Virtual programs for developing students' research skills in teaching biology are innovative educational tools based on the use of information technology [9].

1. Virtual Labs: Virtual lab environments offer students the opportunity to conduct a variety of experiments in a virtual environment. For example, with the help of virtual microscopes, they can study cellular structures and organelles, and simulations of biochemical reactions allow them to analyze molecular interactions. These virtual labs provide safety and accessibility for students who may have limited physical access to lab equipment.

2. Biological Modeling and Simulation: Programs that offer modeling of biological processes allow students to analyze the dynamics of biological systems under various conditions. For example, computer programs can be used to simulate population dynamics, evolutionary processes, or biochemical reactions.

3. Virtual anatomical atlases: These programs provide detailed 3D models of organs and tissues of human or other organisms. Students can explore internal anatomy and study the relationships between organs without the need to use actual anatomical specimens.

4. Virtual Field Studies: These programs allow students to immerse themselves in different ecosystems and study their biodiversity, dynamics, and species interactions. They can make observations and analyze data as if they were in a real field study.

5. Molecular Modeling: Using molecular modeling software, students can study the three-dimensional structures of proteins, nucleic acids and other molecules. This allows us to understand the principles of interaction of molecules inside a cell.

It is important to note that virtual programs complement, but do not replace, real-life laboratory classes. They provide additional opportunities for learning and research, especially in cases where real-life experiments are not available due to restrictions or safety.

The use of virtual programs in teaching biology helps students develop critical thinking, analytical skills and the ability to work with modern technologies, which are important aspects of their preparation in the field of biology.

The study carried out a comprehensive analysis of existing pedagogical tools for teaching biology, taking into account their potential for stimulating and developing research skills in students. Key aspects of the development of research competencies in the context of this subject

area have been identified, which served as the basis for the further development of modified methods for using didactic tools.

As a result of testing new approaches to the use of didactic tools, a significant increase in the activity of research work among students was recorded. The observed positive changes in the level of development of research skills indicate the high effectiveness of the optimized methods.

We used several research methods such as:

Questioning students:

Development of questionnaires with questions about the perception and effectiveness of the use of virtual programs and didactic tools for the development of research skills.

Analysis of the obtained data to identify the general opinion of students and their preferences.

Observation of the learning process:

Observation of student interaction with virtual programs and didactic tools during classes.

Analysis of student reaction, level of involvement and understanding of the material presented.

Experimental groups:

Dividing students into control and experimental groups.

Conducting classes using virtual programs and didactic tools in the experimental group, and without them in the control group.

Comparison of research skills results in both groups.

Testing and evaluations:

Development of test tasks that allow assessing the level of development of students' research skills.

Conducting testing before and after using virtual programs and teaching aids to assess progress.

Focus groups:

Conduct group discussions with students to gain a deeper understanding of their opinions regarding the effectiveness of teaching methods.

Analysis of written work:

Assess essays, reports, and other written work by students based on developing research skills.

Comparative analysis with other teaching methods:

Comparison of learning results using virtual programs and didactic tools with results using traditional methods.

Teacher survey:

A survey of teachers to assess their perceptions of the effectiveness of virtual programs and didactic tools for developing students' research skills.

Progress monitoring:

Comparing the performance of students participating in the study with those not participating to identify differences in performance.

These methods can help you gain a wide range of information about the impact of virtual programs and teaching aids on the development of students' research skills.

Thus, based on the results of the study, we can conclude that improving the methods of using pedagogical tools in the process of teaching biology contributes to the effective development of students' research skills. The developed methodological recommendations represent a valuable contribution to the field of pedagogical practice and can be successfully integrated into the

educational process to improve the quality of biology teaching and the formation of highly qualified specialists in this field.

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