ENHANCING COGNITIVE ABILITIES OF SCHOOL STUDENTS IN BIOLOGY THROUGH MODERN PEDAGOGICAL TECHNOLOGIES

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Abstract

This article discusses the influence of modern pedagogical technologies on improving the cognitive abilities of students in the field of biology. Taking into account the rapid development of technology and the growing interest in biology, the authors review and consider the features of modern types of technology used in the educational process. The article analyzes the impact of modern technologies on educational indicators in the context of the formation of critical thinking and active interaction of students.

Introduction.

Biology education is evolving, incorporating new approaches and techniques to enhance understanding of complex biological systems. Recognizing these changes, educational methods need to evolve to facilitate a deeper and more meaningful grasp of biological knowledge for students. In the modern era of educational information development, there are challenges that require the improvement of methods and technologies to effectively satisfy the needs of education in the information society. One of the fundamental aspects of modern pedagogy is the integration of advanced technologies into the learning process. This is particularly crucial for enhancing students' cognitive abilities in the field of biology.Our research aims to explore the potential of modern pedagogical technologies and their impact on the development of students' cognitive abilities in biology. To achieve this goal, we have set the following objectives: to adapt modern pedagogical technologies for teaching biology; to assess the practical effectiveness of these technologies; to study their impact on students' cognitive processes; to identify factors for successful integration of pedagogical technologies into the educational process. The findings of our research can contribute to the development of new teaching methods in biology that promote cognitive learning and are easily applicable in educational practice.

Literature review

Many biological processes possess complex characteristics. Imaginative thinking helps children to comprehend abstract concepts, without which they cannot visualize the process or understand it properly. The development of their ability to think abstractly is facilitated through visualization. Multimedia animation models help students to fully visualize biological processes, interactive models allow them to "manipulate" the process, correct errors, and learn independently. One advantage of using multimedia technology in education is that it enhances students' engagement and content mastery. The use of computers in lessons has become a new method of organizing students' effective and meaningful work, making lessons more engaging and interesting. Information technologies provide opportunities for: creating an open education system that individualizes the learning path for each student; structuring students' systemic thinking, changing the organization of the learning process; integrating pedagogical technologies into the educational process to introduce new cognitive tools. [1].

Teaching biology requires the use of modern educational technologies. We will adapt these technologies individually.

Firstly, the case technology. Currently, the case study method has been presented from two classical schools: the Harvard (American) and Manchester (European), which consider the case as a way to find the correct answer to the case's goal [2].

The collection and distribution of cases are handled by the Case Clearing House, established in 1973 in conjunction with the University of Britain and Ireland. Since 1991, it has been called the European Chamber of Commerce (ECCH) [3]. Currently, there are 340 organizations in the ECCH, each with its own collection of cases and the right to distribute them.Today, the use of the situational

analysis method is not limited to law, medicine, and business – the case method is increasingly being introduced into various fields of human knowledge. Teachers of various disciplines use it not only as a special course of study but also as a teaching technology in the classroom [4].

This method confirms the didactic significance and uniqueness of using case technology in teaching biology as an effective tool to enhance students' biological knowledge [5]. The essence of this method is that the study material is presented to students in the form of situations (cases), and knowledge is acquired through the results of active and creative research work. This method is used extensively in economics, law, medicine, management education, and others. It has several advantages, such as:

- developing skills to apply theoretical knowledge to solve practical problems;
- developing precise and clear expression of one's own views orally or in writing;
- developing the ability to formulate one's own point of view based on reliable evidence and to defend it;
- learning to accept a solution based on team discussion;
- learning to analyze and correct one's own and others' mistakes [7].

However, in school education, it is not widely used in teaching biology. There are several reasons for this:

lack of specialized literature on the use of case methods in biology;

lack of a methodology for creating cases;

lack of teaching experience in using the case method, and so on.

One of the peculiarities of this method is the creation of a simulated situation based on real-life facts. Furthermore, there are no specific solutions within the case itself. In such cases, it is necessary to correctly pose the learning task and prepare the case with various informational materials (articles, literary works, websites, statistical reports, etc.) to work with the case [8]. Below, we outline the stages of working with a case.

Stages	Content of the stages
Organizational stage	The case is presented to students directly in class. The main task of this stage is to create conditions for students' enthusiasm for lessons. About 15 minutes of class time will be given to study and familiarize with the case materials. At this stage, the training of students is the correct use of Internet resources, the mandatory implementation of links to them. Methods and approaches: informational, analytical, motivational stimulation of students
Group work to solve the problem	The main task of this stage: organization of problem solving activities. The teacher advises students, students discuss individual answers in groups, explain unclear moments to each other, develop a unified position. This period of the lesson lasts about 40 minutes. Methods and methods: oral, visual, conversation, self-monitoring, analysis

Protection of one's project according to the decision of the situation	At this stage, the teacher organizes the solution options of the groups and sends them for discussion, which takes about 20 minutes, taking into account the discussion of the proposed solutions. The main task of this stage is to create and organize a situation for the discussion of the solved tasks. Methods and approaches: discussion, oral, visual, explanatory-illustrative, abstract
Presentation and analysis of situational task results	The final part of the lesson takes about 10 minutes and is designed to summarize the results. The teacher conducts the final part of the lesson based on the solution options proposed by the groups. The main task of this stage is to create conditions for reflection. Methods: reflection, oral, visual, assessment of the practical importance of the learning content, predicting the results of the activity
Homework instruction	Each student is given an individual task. The main task of this stage is to instruct students on individual tasks at home. Methods and methods: informative method and motivation to solve homework
Reflection	Each student is given a questionnaire containing the following questions: 1. What did he learn during the lesson? 2. What happened during the lesson? Why? 3. What happened? What happened because of this? 4. What should I consider next time? 5. Rate yourself

Problem-based learning (PBL) is a pedagogical approach that enables students to acquire knowledge through meaningful engagement with important issues. It provides opportunities for students to solve problems collaboratively, develop their own learning strategies through experience and reflection, and integrate their own teaching methods. Thus, the fundamental philosophy of PBL is to engage students in learning as an "active, self-directed, collaborative, and contextual" process. The principle of constructivism places students as active seekers of knowledge and constructors of personal mental representations or schemas through new experiences that are organized by previous knowledge. This contributes to the social interaction of cognitive development and supports the social theories of learning that emphasize cooperative or collaborative learning [9].

Typically, the problem-solving method in the PBL approach begins with a problem that requires students' participation. Dewey characterized the cognitive element of student involvement as a "reflective or deliberative" thought process that emerges from a specific cognitive element "derived from a

particular thing." Students establish connections through resource searching for their own and group cognitive backgrounds, thus engaging in mutual learning through discussions in small groups and reinforcing their knowledge through reflexive writing. This learning experience allows students to understand the subject matter and content of the course, as well as to understand "their own and their context, as well as to adapt to the effective learning methods and situations" [10].

Problem-based learning as a pedagogical strategy challenges many educators because it provides an effective and group-based learning foundation that is based on the belief that effective teaching fosters social interaction among students and the creation of ideas through self-directed learning. It can be adapted to institutional settings and programs, but when properly implemented, it can be realized as an interactive process that runs from the problem-solving phase to the self-directed learning phase and ultimately to the problem-solving phase. Problem-based learning in biology can lead students to develop critical thinking skills and personal research interests [11].

Interactive teaching technology. The interactive method of teaching pays attention to students' active engagement with the study material, the teacher, and other students. This method helps students to deepen their understanding and knowledge through various learning activities [12]. As an example of interactive teaching, let us consider the following.

Materials and Methods. In the course of teaching biology, a study was conducted in the 7th grade of School-Lyceum No. 250 in the Karmakshy district of Kyzylorda region, Kazakhstan. The total number of students was 29. During the first semester of the academic year, a traditional teaching system with theoretical materials was used to teach students using traditional methods. However, in the second semester, modern technologies were employed, including case-based and problem-based learning techniques. A comparative analysis of the students' learning outcomes was conducted. One of the cases used in the biology subject will be examined.

The "Food List" Case

In 1953, an epidemic of unknown origin broke out in a village in Japan. It affected people in various ways: the coordination of movements was disrupted in patients, they lost their appetite, sight, and mental abilities.

Doctors diagnosed the condition as Minamata disease. But how did this epidemic happen? It turned out that it occurred near the Minamata Bay, where chemical waste, including mercury, was dumped, contaminating the sea. The size of the contamination in the sea was extensive.

Assignments:

How can the causes of this event be understood?

Identify the food lists, name their main types.

How do various food lists reduce the absorption of substances: water or soil? Provide examples.

How is the distribution of substances in the ecosystem carried out, what organisms play a key role in storing it?

In both the case and problem-based learning approaches, students work in small groups. This contributes to the development

of their teamwork skills and mutual cooperation.In the next section, we will introduce the problem-based learning technique. An example of a problem from biology will be presented.

Once, a delegation of farmers met with Charles Darwin to explain why the crops of their fields were failing. Before giving an answer, the great scientist conducted many experiments and conducted extensive research, only then advising the farmers.His friend and disciple Thomas Huxley later found this incident intriguing and formulated a curious question: "Who would agree that Britain was a great maritime power?".

Questions and Assignments:

Explain what advice Charles Darwin gave to the farmers.

Provide your own solution to the problem. After conducting the study, a questionnaire was administered to the students. The content of the questionnaire was as follows:

Did you find the situations provided to be understandable?

a) Yes

b) No

c) I am undecided

Did you conduct research on the topic independently?

a) Yes

b) No

c) I am undecided

Did you seek help from the teacher for the assignments given?

a) Yes

b) No

Were you able to solve the assignment?

a) Yes

b) No

c) I am undecided

Which method appealed to you more?

a) Case-based learning

b) Problem-based learning

c) Both

Would you consider using the technologies used earlier in future work?

a) Yes

b) No

c) I might consider using other technologies

Results of the Study. The results of the study will be presented in a graphical format. First, we will analyze the results of the first semester.

Analyzing the Results. Overall, students showed higher performance in the second semester compared to the first semester when comparing their academic achievement indicators. Specifically, when looking at students' performance in the "excellent" category, it increased by 17% from the first semester to the second semester, while the performance of students in the "good" and "satisfactory" levels decreased by 10%. In comparative terms, the increase in the number of excellent students does not indicate the effectiveness of the methods used. Additionally, 30% of students expressed an interest in using other technologies in future work. This suggests an increased need for biology teachers to work with other technologies in the future.

Conclusion. In conclusion, the use of modern pedagogical technologies in teaching biology helps students develop and enhance their analytical and communicative skills. Interactive teaching forms such as group discussions, case studies, problem-based learning, game methods, and project activities create

favorable conditions for students' active interaction, fostering their analytical and communicative skills. Moreover, modern technologies contribute to students' acquisition of knowledge and the diversification of their cognitive abilities, leading to personalized learning.The continuous development of biology and the recognition of the societal importance of this field highlight the essential role of integrating modern pedagogical technologies in teaching biology in shaping the future generation of scientists and professionals. Collaborative learning with modern educational technologies not only enhances educational standards but also encourages school students to participate in scientific research, which ultimately contributes to the long-term development of biological science and education.

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Appendix.

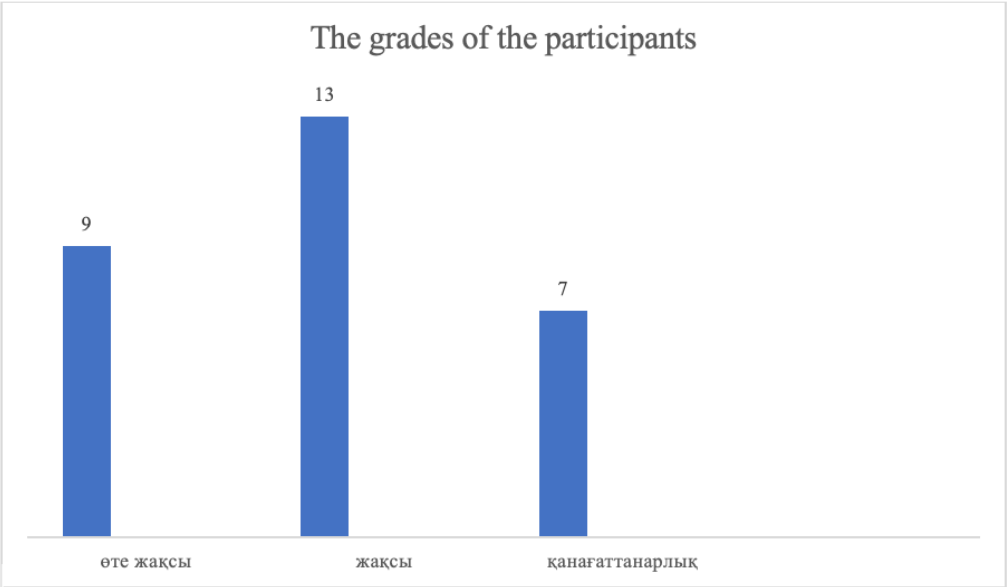

Table 1. Pre-test result

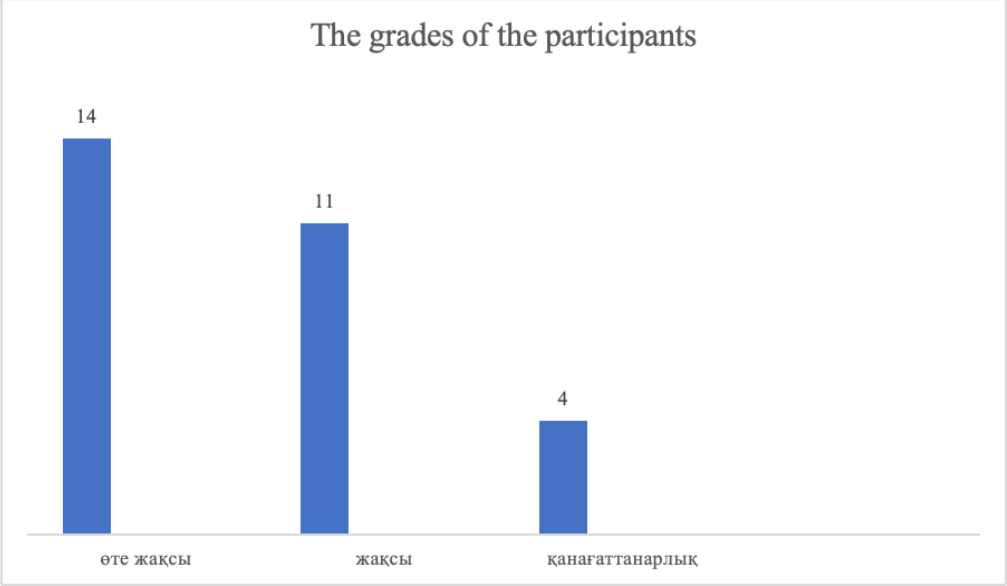

Table 2. Post-test results