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THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN HIGH SCHOOL BIOLOGY CLASSES

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Summary

The computer programs as a didactic aid are often described in didactic literature all over the world. It is not enough that they play, for instance, motivational, exercising, synthesizing or supervising function, they are to be made an independent source of reliable, easily comprehensible information, given in a way that activates students. It is also important not to replace various functions and tasks of didactic aids applied in the process of teaching-learning Biology with each other, but only to interfere skillfully. The article considers the possibilities of using information and communication technologies in biology lessons in secondary schools. The issue of using information and communication technologies as the main tool for mastering the content of educational material determines the aspect of the general teaching methodology inherent in any subject. In this regard, information and communication technologies acquire special significance in professional activities, human culture, and the process of special education. The article presents biology lesson plans using this technology, based on the effectiveness of using ICT in the learning process.

Keywords: *information and communication technology (ICT), biology, learning and teaching, knowledge*

Introduction. The rapid development of information and communication technologies (ICT) has coincided with the beginning of a revolutionary era in education, which has contributed to the way biology is taught and taught. As a source of improving the educational experience of students, the movement to incorporate technology into biology teaching has received significant attention in recent years. Teachers want to make biology more interesting, dynamic, and ultimately more effective through the use of technology [1].

Nowadays we are all overloaded with information, so the main task of the school should be to teach each child to navigate this growing flow of information, filter out unnecessary information and look for what is sufficient to justify what is necessary[2]. The main tool for thinking about any topic is the basic information system. Having defined the system and each concept, having ensured the correspondence between the teacher and the students, we can talk about the assimilation of social experience by students, that is, knowledge, skills and abilities in this area.Such study of students' knowledge helps the teacher to create the most favorable conditions and opportunities for the realization of their abilities, taking into account their individual perception of information and ways of working with it. The advantage of modern education in the conditions of computerization is the freedom of the teacher in choosing methods and technologies, textbooks and programs. But the effectiveness of pedagogical activity has always depended and will depend on how skillfully the teacher can organize work with educational information, and the main criterion for the effectiveness of the choice of a teacher remains the quality of the educational process and the knowledge of students [3].

In order to keep up not only with the times, with modern technologies in the teaching process, but also with the students themselves, the teacher himself has to additionally learn computer literacy. The educational process in a modern school gives each student the opportunity to realize himself in knowledge, relying on his inclinations, interests. And what should a teacher do in these conditions? A teacher must use new technologies, and in order to use them,

new technologies, and in order to use them, you need to be able to master the content of your subject, be able to model your lesson, and be proficient in a computer at least at the user level[4]. There are many forms of presenting material by a teacher in a lesson using computer technologies: a presentation, electronic textbooks, virtual practical and laboratory work, tests, trainings. I believe that a presentation with the inclusion of additional technologies is the most convenient and uncomplicated form for a teacher when conducting a lesson. The main thing in a presentation is thesis for the teacher and clarity for the student. The presentation can show the most advantageous moments of the topic: spectacular transformations in the form of animation, portraits of scientists, diagrams, tables, quotes, graphs, soundtrack, etc. [5].

Materials and methods. This section presents a description of the materials and methods used in the study of the use of ICT technologies in teaching biology to 7th grade students. The study is aimed at assessing the effectiveness of using various ICT tools in the educational process and their impact on student performance and engagement.

*1. Source Materials.*A group of 25 7th graders were selected for the study.Biology instruction was conducted over the course of one academic year (9 months). The following were used as the main teaching materials: 7th-grade biology textbooks. Interactive teaching aids and simulations, including PhET platforms, ExploreLearning Gizmos, and other educational resources. Videos available on YouTube and other educational platforms (e.g., Crash Course, National Geographic). Online games and quizzes, such as Kahoot!, Quizlet, and Quizizz, for reinforcement.

2. Research Methodology. The research was conducted in several stages:

Stage 1. Preparing the students. Before using ICT, teachers conducted diagnostic testing to determine the students' level of knowledge on key biology topics, such as photosynthesis, human organs, and ecosystems. These tests included questions on understanding key biological concepts[6].

Stage 2. Integrating ICT into the learning process. During the school year, biology lessons were conducted using the following ICT tools:

Interactive simulations: Using PhET and ExploreLearning Gizmos platforms to demonstrate biological processes, such as photosynthesis, cell division, or ecosystem interactions.

Videos and animations: Watching educational videos on biology-related topics (e.g., "Crash Course Biology") to deepen understanding and make theoretical material more visual.

Online quizzes and games: Conducting quizzes through Kahoot! or Quizizz to review the material and receive feedback on the assimilation of knowledge.

Virtual excursions: Using Google Expeditions for virtual excursions into ecosystems (e.g. tropical forest, coral reefs), which allowed students to explore biodiversity.

Stage 3. Evaluation of results. A system of midterm tests and assessments on the main topics of the course was used to evaluate the results. Students took tests at the beginning and end of the learning period to identify changes in their level of knowledge.

Evaluation of engagement: Student engagement was measured through the amount of time they spent with ICT tools, as well as through activity on the platform (e.g. the number of quizzes played or simulations completed).

Evaluation of academic performance: A comparative assessment of students' academic performance in the subject was conducted based on the results of tests and assessments. The results were compared before and after the use of ICT technologies.

Stage 4. Feedback. After completing the study, students and teachers were given questionnaires to collect feedback on the perception and effectiveness of using ICT in the learning process. The questionnaires asked how interesting and useful the use of ICT tools was, as well as their impact on understanding biological concepts.

4. Data Analysis Methods. The following methods were used to analyze the collected data:

Statistical Analysis – the average scores of students before and after the use of ICT tools were calculated. Percentage

Statistical Analysis – the average scores of students before and after the use of ICT tools were calculated. Percentage changes were used to determine the level of improvement.

Qualitative Analysis – feedback questionnaires were analyzed to determine the overall perception of students and teachers on the effectiveness of ICT.

Systematic analysis – the results of pre - and post-ICT assessments and tasks were analyzed to assess the impact of current information tools on students' academic achievement.

Results and discussion. The introduction of ICT has been shown to be very effective for teachers, offering unique and convenient teaching methods. In this study, 7th grade students covered 16 topics using ICT. To demonstrate its effectiveness, we will review the results of biology lessons that included ICT and consider its use in teaching the topic "Cell and its structure" (Table 1).

By applying the presented methods to the topics, the students' knowledge expanded and they showed good results. The presentations increased the students' creativity, increasing their activity in individual, pair and group work [7]. The 3D models allowed the students to study biological processes in more depth, which significantly contributed to their understanding of the topic. The students developed practical skills and understanding of biological processes. The table shows how the students' performance improved due to the use of ICT (Table 2).

The presented chart shows the percentage of students' achievement in grade 7 before and after the use of information and communication technologies (ICT) in biology lessons. Before the use of ICT, students showed different levels of understanding on different topics, with an average percentage of achievement of 48%. However, after the introduction of ICT tools such as creative presentations, 3D models, interactive whiteboards and online quizzes, the percentage of knowledge increased significantly to 52%. This improvement demonstrates the positive impact of ICT on student engagement and understanding of the material. The use of information tools increased students' ability to understand complex biological concepts, leading to a significant increase in their academic achievement (Figure 1).

Table 1. ICT methods used during the lesson and results

ICT method	Description of application	Results
Creative presentation	A presentation with images of cell types and diagrams of cell organelles, as well as animations demonstrating cell division.	Students will fully understand the structure and functions of cells.
3D models	Using 3D models of cells and organelles to study their structure and function.	Students will fully understand how each part of a cell affects its functioning.
Network technologies	Students demonstrate the function of cellular organelles using systems that allow them to "interact" with a model cell.	Students develop practical skills and understanding of biological processes.
Online Quizzes	Interactive tests and games to reinforce knowledge of cell structure and function, as well as topics such as photosynthesis and respiration.	Students conduct self-assessment, systematize their knowledge and receive quick feedback.

Table 2. The percentage of student performance before and after the use of ICT

ICT method	Before ICT	After ICT	Change
Creative presentation	10 out of 25 (40%)	22 out of 25 (88%)	+48%
3D models	7 out of 25 (28%)	20 out of 25 (80%)	+52%
Network technologies	12 out of 25 (48%)	20 out of 25 (80%)	+32%
Online Quizzes	10 out of 25 (40%)	22 out of 25 (88%)	+48%

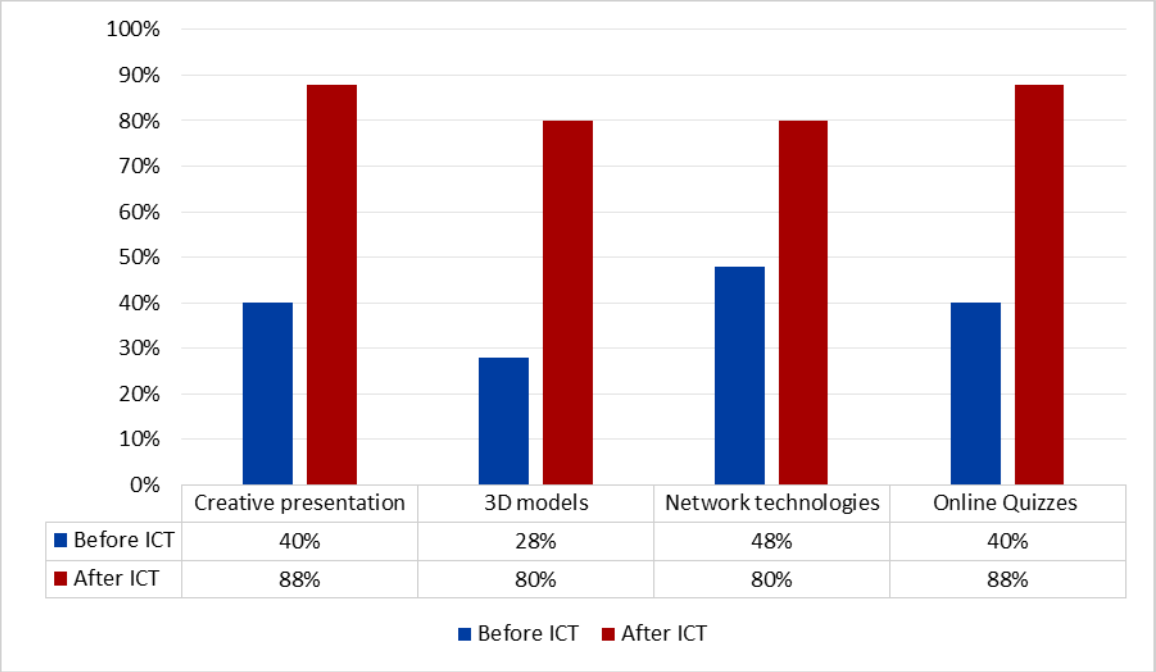

Figure 1. Diagram of the Results of Using ICT Methods

The students' knowledge level was determined by the rating scale and the topics of the sections. The rating scale (1-5) is as follows:

1–Very Low: The student has little understanding of the topics, limited knowledge and understanding.

2–Low: The student understands some basic concepts, but has not fully mastered the topic.

3–Average: Has basic knowledge and can answer some questions.

4 – Good: The student has a good understanding of the topic and answers most questions correctly.

5 – Excellent: The student has a deep understanding of the topic and can clearly explain complex concepts [8]. The students' results are presented in the table below (Table 3).

The diagram shows the levels of student achievement in each subject before and after the use of ICT. A significant improvement in results is observed after the introduction of ICT (Figure 2).

The use of information and communication technologies (ICT) in biology lessons had a positive impact on students' performance and engagement in the learning process. The combination of multimedia presentations, 3D models, interactive whiteboards and online quizzes helped students gain a deeper understanding of biological processes. In addition, this approach made the learning process more interesting and interactive. Test results showed that students significantly improved their knowledge of cell structure, photosynthesis and other biological systems when using ICT tools.

Table 3.Test Results by Topics (Scale 1-5)

Topics	Before ICT	After ICT	Change
Ecosystems	3.3	4.7	+1.4
Systematization of living organisms	3.4	4.8	+1.4
Cell biology	3.5	4.6	+1.1
Photosynthesis	3.2	4.4	+1.2

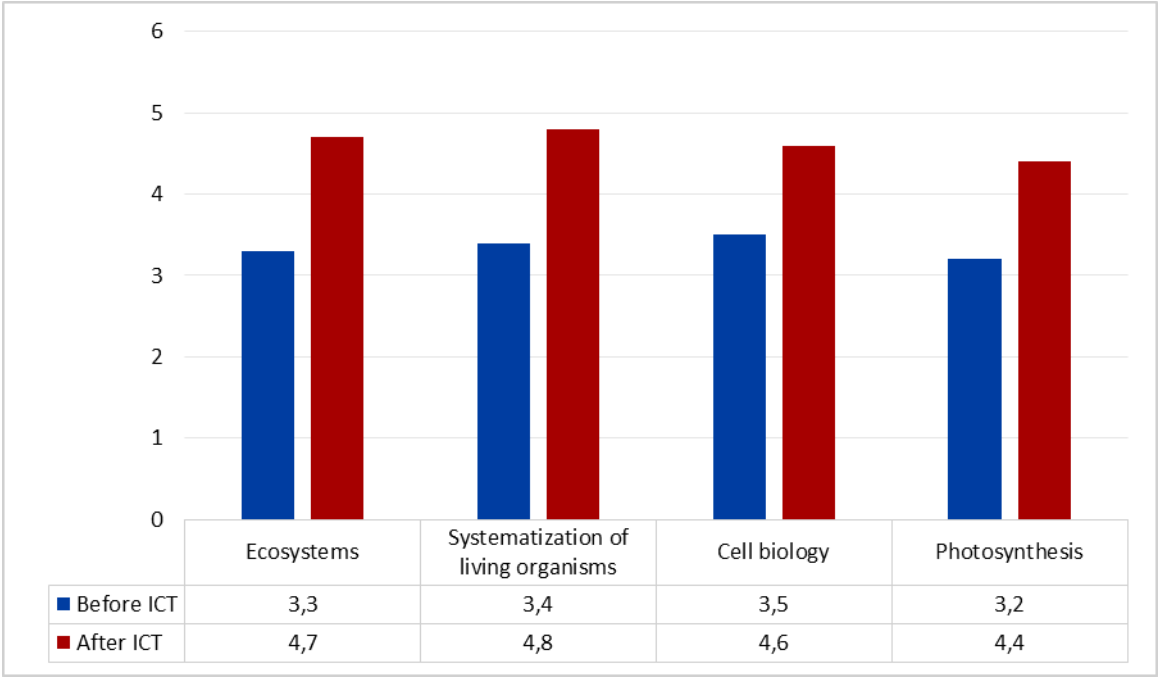

Figure 2. The results of students' academic performance

Conclusion. The introduction of information and communication technologies (ICT) into the educational process in biology lessons in the 7th grade has proven its effectiveness in improving the quality of education and has allowed us to achieve high results. The use of multimedia presentations, 3D models, interactive boards and online games not only increased students' interest in the subject, but also contributed to a deeper understanding of complex biological processes.

1). The results of the study showed that after the use of ICT, the average score increased by 1.1-1.4 points across all key course topics. This indicates that the level of material acquisition has increased significantly. Students who used technology gained a deeper understanding of the theoretical and practical aspects of biology and showed higher test results.

2). In addition, the introduction of ICT had a positive impact on the level of student participation in the learning process. Although the attendance rate was low before the introduction of technology, the introduction of interactive methods such as online games and quizzes increased student interest and engagement. The results of the comparative analysis showed an increase in the number of lesson participants from 40% to 88%, which indicates the effectiveness of the use of information educational technologies.

3). Using 3D models to study the structure of a cell or the process of photosynthesis allowed students to not only visualize complex biological concepts but also to absorb the material more deeply. Creative presentations helped to present information in a clear and interesting way, which facilitated the learning process, especially for 7th

for 7th grade students.

The use of ICT contributed to the development of critical thinking skills of students and improved their independent information search skills. Completing assignments through online platforms allowed for instant feedback, which allowed for timely correction of errors and accelerated the process of better assimilation of the material.

Thus, the results of the study prove that the introduction of modern technologies into the educational process significantly improves the quality of education. ICT not only contributes to a deeper understanding of the educational material, but also increases the motivation, interest and activity of students. These technologies can serve as a basis for developing innovative and interesting approaches to learning in the future.

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Жоғары сыныптарда биология сабақтарында ақпараттық-коммуникациялық технологияларды қолдану

Аңдатпа

Компьютерлік бағдарламалар дидактикалық құрал ретінде дүние жүзіндегі дидактикалық әдебиеттерде жиі сипатталады. Олар, мысалы, ынталандыру, жаттықтыру, синтездеу немесе бақылау функцияларын орындап қана қоймайды, сонымен қатар олар студенттерді белсендіретіндей түрде ұсынылатын сенімді, оңай қабылданатын ақпараттың тәуелсіз көзі болуы керек. Сондай-ақ биологияны оқыту мен оқу процесінде қолданылатын дидактикалық құралдардың әртүрлі қызметтері мен міндеттерін бірін-бірі алмастырмай, тек шеберлікпен араласу маңызды. Мақалада жалпы білім беретін мектептердегі биология сабақтарында ақпараттық-коммуникациялық технологияларды қолдану мүмкіндіктері қарастырылған. Ақпараттық-коммуникациялық технологияларды оқу материалының мазмұнын меңгерудің негізгі құралы ретінде пайдалану мәселесі кез келген пәнге тән жалпы оқыту әдісте-

Осыған байланысты ақпараттық-коммуникациялық технологиялар кәсіби қызметте, адам мәдениетінде және арнайы білім беру процесінде ерекше мәнге ие болады. Мақалада оқу процесінде АКТ қолдану тиімділігіне негізделген осы технологияны пайдалана отырып, биология сабағының жоспарлары берілген.

Түйінді сөздер: *ақпараттық-коммуникациялық технологиялар (АКТ), биология, оқу және оқыту, білім.*

Материал баспаға 20.11.24 түсті

Применение информационно - коммуникационных технологий в старших классах на уроках биологии

Аннотация

Компьютерные программы как дидактическое средство часто описываются в дидактической литературе по всему миру. Мало того, что они выполняют, например, мотивирующую, тренирующую, синтезирующую или контролирующую функцию, их необходимо сделать самостоятельным источником достоверной, легко воспринимаемой информации, подаваемой таким образом, чтобы активизировать учащихся. Важно также не подменять друг друга различные функции и задачи дидактических средств, применяемых в процессе обучения-изучения биологии, а лишь умело мешать. В статье рассматриваются возможности использования информационно-коммуникационных технологий на уроках биологии в общеобразовательных школах. Вопрос использования информационно-коммуникационных технологий как основного инструмента усвоения содержания учебного материала определяет аспект общей методики обучения, присущий любому предмету.

В связи с этим информационно-коммуникационные технологии приобретают особое значение в профессиональной деятельности, человеческой культуре и процессе специального образования. В статье представлены планы уроков биологии с использованием данной технологии, основанные на эффективности использования ИКТ в процессе обучения.

Ключевые слова: *информационно-коммуникационные технологии (ИКТ), биология, обучение и преподавание, знания*

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Authors' contribution. The largest contribution is distributed as follows:

N.M. Konys contributed to the conceptualization of the study, development of the research framework, and manuscript writing.

B.B. Gabdulkhayeva was responsible for data collection, statistical analysis, and interpretation of results.

S.Zh. Kabiyeva worked on the literature review, methodology design, and revision of the manuscript.

B.A. Abeldinova contributed to proofreading, editing, and finalizing the manuscript for publication.

Conflict of interest. The authors declare no conflict of interest.