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Methodology of Using Information Technology Software Tools in Teaching Mathematics

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Abstract: The use of modern information technology tools in the process of teaching mathematics and solving mathematical problems leads to an increase in the effectiveness, visuality and level of mastery of the educational process. The use of the created methodological and software tools in the lesson at the right place and time increases the effectiveness and visuality of the lesson, as well as the level of students' perception of information on the subject and their skills of independent work. The importance of computers in the field of education is incomparable. The use of computer tools in lessons: multimedia, virtual laboratories and virtual exhibitions serves as another factor in increasing the effectiveness of the lesson. In the educational process, analyzing the software tools created for teaching mathematics based on information technologies to date, creating and demonstrating methodological and software tools that are convenient for organizing the teaching process of mathematics, providing both theoretical knowledge and practical skills, and demonstrating them in the lesson

Keywords: Information technology, Software tools, Education

Introduction

Information technologies have long occupied an important place among the means of teaching mathematics. The use of multimedia presentations, test shells, electronic textbooks, special programs for drawing function graphs or geometric solids has become an integral part of the mathematics teaching process. The constant development of information technologies offers other options for their use in the educational process discussed in this article. The use of interactive exercises, mobile devices, interactive online whiteboards, mind mapping services, microblogs, applications based on augmented reality allows for the implementation of innovative approaches to the mathematics teaching process. This article provides an analysis of applications that allow the implementation of these opportunities, considers the directions of their application in the educational process, and provides methodological guidelines for their use in order to increase cognitive activity and interest in the mathematics teaching process. Currently, society is at a stage where information technologies are becoming an integral part of everyday life and professional activities. At the same time, the education system is not left out, because it depends on how ready our citizens are to transition to the digital economy.

In the secondary special education system of our country, a lot of scientific and research works dedicated to the improvement of information technology teaching have been conducted and are being conducted. In addition to studies on the integration of educational content, a certain place has been allocated to this issue in studies not related to pedagogical integration. During the following years, a number of monographs, scientific articles,

educational programs related to this issue were published. A lot of attention is paid to this issue, especially abroad. It also shows that the integration of educational content is one of the most interesting, socio-pedagogical and practical issues.

As part of the digitalization of educational institutions, it is necessary to integrate modern technologies into the process of teaching individual subjects, including those based on virtual and augmented reality, which will allow training highly qualified personnel with appropriate competencies. In addition, the use of modern developments in the field of information technology allows activating the process of teaching individual subjects in the continuous education system, comprehensively building educational levels from school to university and beyond (Mukasheva, 2009).

The field of mathematics provides great opportunities for the use of information technologies in the educational process. They can be used at different stages of the educational process (learning new material, consolidating and systematizing previously learned material, controlling knowledge and learned methods of activity, generalizing and repeating material) and at different stages of lessons (updating knowledge, presenting new material, etc.), and, of course, in extracurricular activities that are an integral part of the educational process. Analysis of the work experience of mathematics teachers allows us to identify the main tools of information technology traditionally used in the process of teaching mathematics. These include:

- multimedia presentations, which are often used to study theoretical material.
- electronic textbooks with embedded video clips, test questions and questions for self-control.
- drawing programs used in the process of teaching algebra (excel, advan-cedgrapher, math cad, etc.);
- virtual constructors used in teaching geometry ("Live Geometry", WinGeom, "Stereoconstructor", etc.).

The current rapid development of information technologies, which can be successfully used in the educational process, significantly updates this list. Modern information technology tools allow not only to obtain ready-made information from various sources, but also to independently collect and analyze data in order to draw conclusions and obtain results that correspond to the tasks facing teachers. Interviews with mathematics teachers show that most of them are ready to introduce modern information technologies into the educational process, but the following difficulties hinder this process:

- lack of necessary material and technical support: in schools - the necessary equipment is not always available (mainly mathematics classrooms are equipped) or the equipment used in the educational process does not allow realizing the existing capabilities of information technologies;
- lack of necessary training of teachers (especially middle and senior) in the field of using modern information technologies;
- methodologically insufficient development of innovative approaches to the use of information technologies, independent preparation and development of educational materials requires a lot of time, and the teacher often does not have enough time.

In this regard, the problem arises of the need to study the modern capabilities of information technologies and develop methodological guidelines for their application in the process of teaching mathematics at school, and then in secondary specialized and higher educational institutions. Solving this problem allows us to talk about the introduction of innovative technologies into the educational process, by which we mean the use of new methods of interaction between teachers and students, which ensures the effective achievement of this result (Udalov, 2005).

Materials and Methods

Thus, by innovative approaches to the use of information technologies in teaching mathematics, we understand the use of computer programs, special applications and Internet resources that ensure interactivity, remoteness and mobility of all participants in the educational process. At the same time, it is worth noting that the use of modern information technologies allows students to form not only certain knowledge and scientific skills, but also the necessary ICT competencies that they can use in continuing their studies in secondary specialized and higher educational institutions (Adolf, 1998). We will consider one of the innovative directions of introducing information technologies into the teaching process of mathematics - interactive exercises created using online services.

Interactive teaching methods are a form of interaction aimed at the wider communication of students not only with the teacher, but also with each other, as well as the dominance of students' activities in the learning process. Today, pedagogical research offers a wide variety of forms of interactive exercises and tasks: Creative and debatable tasks, work in small groups, educational games, the POPS formula, project methods, brainstorming, six hats, interviews, case studies, training and SMART interactive technologies.

The use of information technologies in the implementation of interactive methods involves the creation of special interactive exercises that can be used at different stages of the lesson or in extracurricular activities. You can create such exercises using special computer programs (for example, Hot Potatoes, etc.) or using online services on the Internet (Learning Apps, Kahoot, Quizizz, Flippity, etc.). Let's consider in more detail the specific features of these services and their potential in teaching mathematics.

The creators of many interactive exercises are Web 2.0 services, and their functionality and interface are periodically updated. These include services with ready-made templates with the ability to insert text, formulas, images and videos to present new information or test already acquired knowledge and skills; services for creating crosswords, rebuses and puzzles; services for creating didactic games, etc. With the help of a large number of online services, we can create a whole set of interactive tasks of the following nature: studying an interactive lecture and answering the questions posed; answering test questions, quizzes (with one or more correct answers); creating a timetable, etc. One of the most popular at the moment is the Learning Apps service (http://learningapps.org). It not only has a rich library of ready-made exercises in various subjects but also allows you to create your own tasks using ready-made templates. With the help of this interactive exercise constructor, it is possible to organize the study of new material using a video lecture template with built-in questions.

Figure 1. Example of a video lecture prepared in LearningApps.org

This format of presenting the material allows you to immediately monitor how well students have learned it and adjust subsequent work to consolidate it. At the same time, it should be noted that the tasks presented to students during the video lecture can also have a different format: simple test tasks, non-standard elements in the form of puzzles, etc.

The possibilities of this online service for organizing stages of updating and controlling students' knowledge during the lesson, as well as in extracurricular activities, are even more interesting. This is due to the fact that it contains a wide variety of templates that allow you to create tasks with a choice of answers in a non-standard (game) form. Thus, the use of online services for creating interactive exercises in the learning process allows you to: individualize the learning process in accordance with the personal characteristics and needs of students;

organize educational material taking into account various methods of educational activity; enhance visual perception and facilitate the assimilation of educational material; activate the cognitive activity of students.

A person, his all-round harmonious development and well-being, creating conditions and effective mechanisms for realizing individual interests, changing outdated patterns of thinking and social behavior are the main goal and driving force of the reforms being carried out in the republic. The formation of an excellent system of personnel training based on the rich intellectual heritage of the people and universal values, as well as the achievements of modern culture, economy, science, technology and engineering, is an important condition for the development of the country.

New information and communication technologies are one of the most relevant topics today, due to the need to use various methods for studying, researching and gaining experience in each field. Therefore, it is advisable to use new information and communication technologies from kindergarten to master a perfect profession. Modern specialists, regardless of their field of activity, must have extensive knowledge of mathematics, sufficient skills in modern computing, information and communication systems, technical means and their use, as well as knowledge of the basics of new information technology and technology, its future development. Due to the daily development of modern computing and information technology and the increasing informatization of society, a number of subjects on mathematics, computerization of production and management processes have been included in the middle and higher levels of the continuing education system.

We know that the Chinese philosopher Confucius, who said 3,500 years ago, “I remember what I hear, I remember what I see, and I understand what I do,” still holds true today. When using technology in teaching mathematics, students have the opportunity to think independently based on what they hear, see, and see. There are certain conditions for organizing lessons using modern technologies in teaching mathematics. First, there must be information resources. These include:

- a personal computer.
- a projector.
- multimedia tools.
- a scanner (for transferring complex diagrams and drawings, images from negative film to a computer);
- a digital camera.
- a video camera (for video conferences and other
- purposes);
- printer, copier (for copying and duplicating handouts and for other purposes) and other resources.

Secondly, special software. In the education system, these are special programs that are needed to create multimedia electronic educational literature, lectures, virtual laboratory work, various animation programs and other works. There are many of these programs, for example: Macromedia Flash MX is used to create animation videos. To create multimedia presentations, we all use the familiar Power Point, Canva, and Prezi programs. Mathematics teachers can use various software such as MS-Word, MS-Excel, MS-PowerPoint, GeoGebra Classic 5 and other web tools to create effective ICT for teaching. For example:

- MS-Word can be used to develop questionnaires, texts, images and other electronic documents.
- MS-Excel can be used where column presentations are required, such as drawing the differences between living and non-living organs.
- High-quality images can be created in Photoshop.
- GeoGebra Classic 5 can be used to teach various concepts.

Definition 1. The locus of points in a plane whose sum of distances to two fixed points is constant is called an ellipse. Let us be given two fixed points. These two fixed points are called foci. Let us be given two points $F1$ and $F2$ in a plane. Let us draw a straight line through points $F1$ and $F2$ and give a direction to the straight line and call it the abscissa axis. Let us draw the ordinate axis through the middle of points $F1$ and $F2$. Using the given, we will show the students that we can draw an arbitrary ellipse on a plane using the GeoGebra Classic 5 program.

This image can easily accommodate photos developed in Photoshop or animations created with Flash. In order to increase the interest of students in teaching mathematics, it is necessary to display them using various programs. Animations, films and presentations created using the programs presented above can be effectively used by teachers in teaching mathematics. The use of electronic textbooks and study guides in teaching mathematics further increases the effectiveness of the lesson.

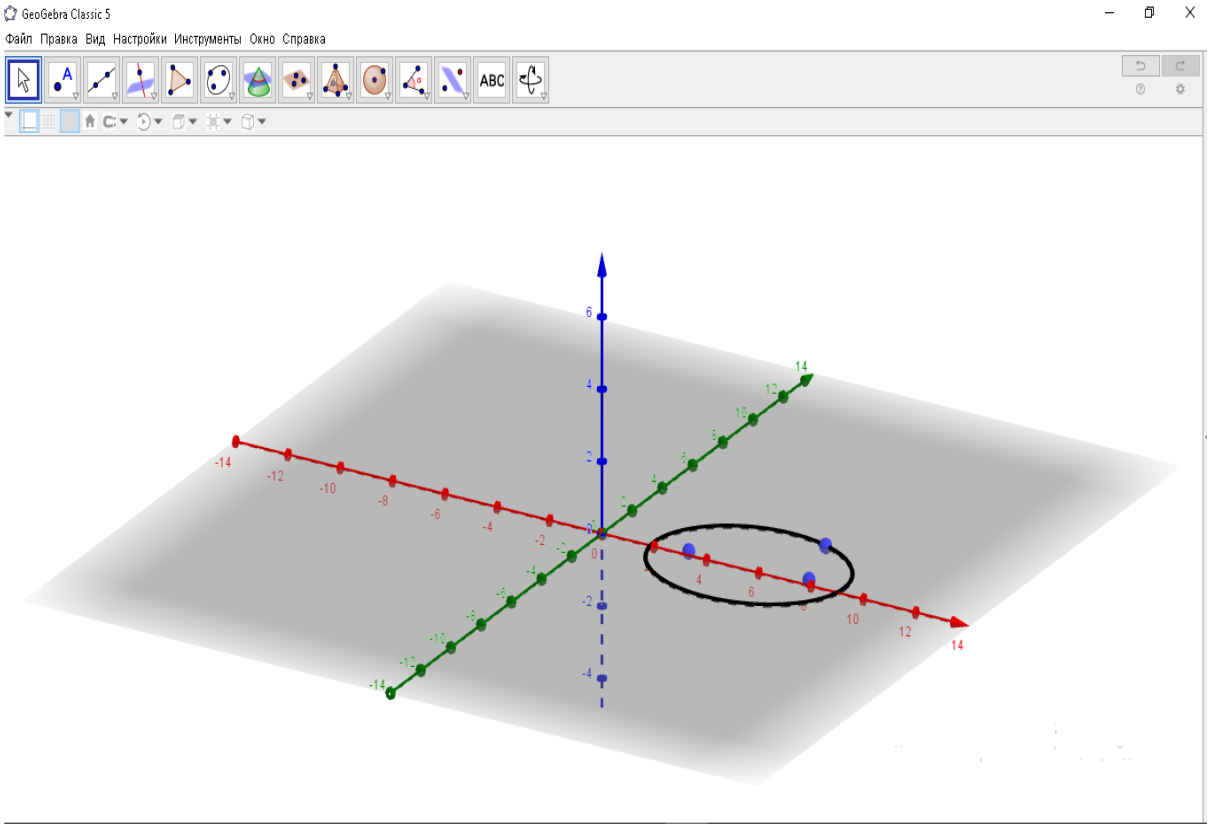

Figure 2. GeoGebra application

When the necessary equipment for demonstration classes in mathematics is lacking, using virtual and visual representations helps students develop general subject-related competencies and form their own independent thinking. It should be noted that the use of various advanced pedagogical technologies and the works of our great scientists in lessons increases efficiency. This will help students improve their knowledge and conduct scientific research in the future.

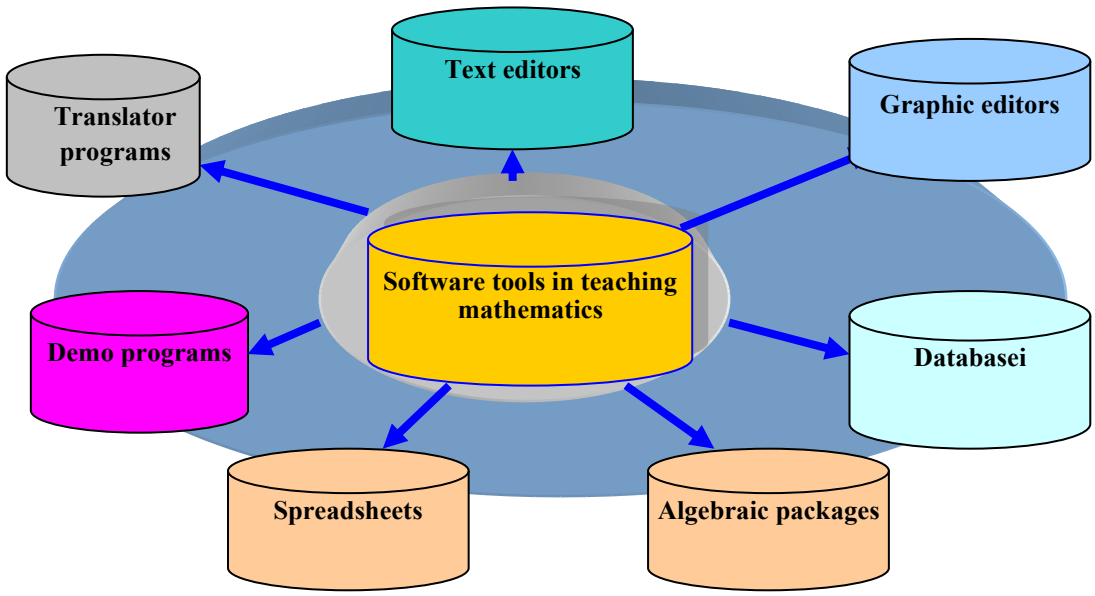

Figure 3. Application package

Over the past decade, the use of computers in teaching mathematics has been carried out in several main directions. These include computer-assisted assessment of knowledge, the development and development of various types of educational programs, the development of mathematical games for cognition, and others. The use of information technologies in teaching mathematics in secondary schools also has a good effect on the

problem-solving process and the creation of function graphs. The use of computer technologies in creating function graphs makes it easier for students to imagine the process of creating graphs. Software tools have been developed to help create function graphs. It is enough to download these programs to a computer and enter the function. It is not necessary to have a high level of computer literacy to work in the program. An example of such a program is GeoGebra

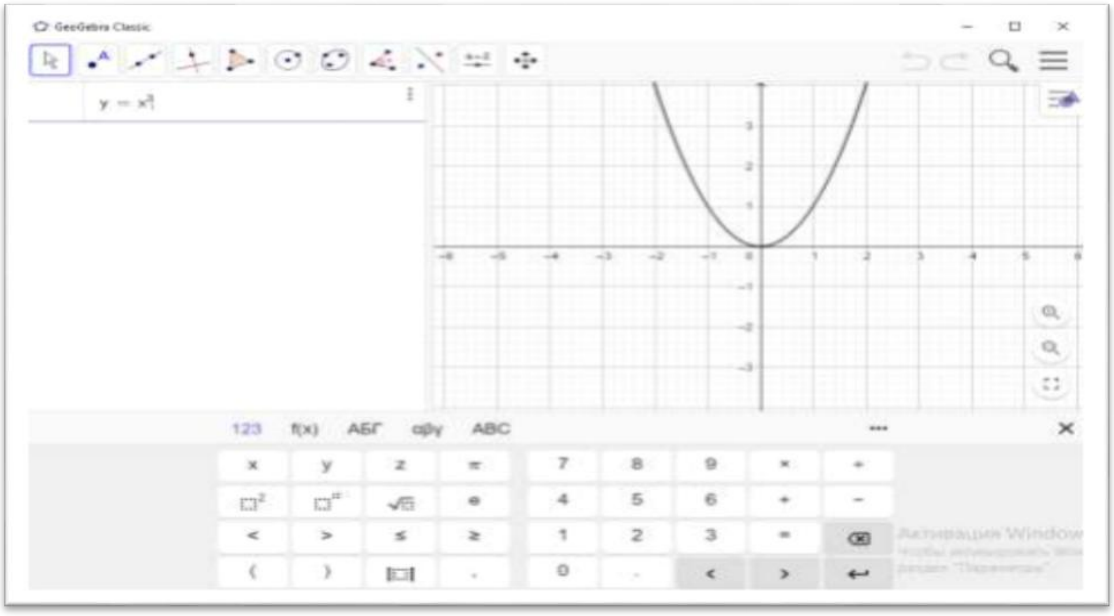

Figure 4. GeoGebra program interface

In the above picture, a graph of a quadratic function is created in the GeoGebra program. The function is entered in the line at the top of the program, and a graph is immediately created in the center. In the upper part of the program window, there is an auxiliary keyboard for entering degrees, roots, and other symbols. The program also allows you to create graphs in three-dimensional space. Such software tools can be used to teach the topic of functions in secondary schools. While much attention is paid to teaching mathematics in secondary schools in our country, teachers are required to cover the topics of science using modern innovative technologies.

In the current era of rapid introduction of new technical means, including computers and other information technologies, into the teaching of mathematics, one of the pressing issues is the use of mathematical achievements to ensure interdisciplinary coherence. The introduction of computer technology in educational institutions opens a wide range of opportunities for optimizing the teaching process. Although spreadsheets are mainly designed to solve economic problems, the tools included in them also help solve problems related to other areas, for example, performing calculations using formulas, building graphs and diagrams. Using a spreadsheet, you can solve problems based on a given algorithm, create various forms based on the values in the table, and print them. Using the autofill feature in Excel, you can make it easier to enter numerical values and text elements. This feature is especially helpful when tabulating function values. Calculating function values with a certain step is found in many departments of mathematics. Using these features, students at the faculty of mathematics can create graphs of functions and thus clearly see the properties of some more complex functions on the screen. The function wizard in Excel helps to enter a function and its arguments in a semi-automatic manner. Using the function wizard ensures that the function is written and all its arguments are entered in the syntactically correct order. This, in turn, greatly helps students learn the properties of functions easily and quickly.

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quickly. In particular, diagrams are very useful for visually depicting very large numbers and determining the relationship between them.

Scenario of a lecture based on multimedia developments. The group gives a briefing on the topic and purpose of the lesson, as well as brief information on the technologies used during the lesson. To introduce new subject concepts, questions and quick-to-solve tasks prepared in the form of electronic visual aids are displayed on the screen to repeat, organize, and focus on the set goal the mathematical concepts and statements that have been learned. The teacher evaluates the students' answers and draws attention to the active participation of all students in this question-and-answer session.

When moving to a new topic, in order to determine how familiar students are with sets and operations performed on them from school mathematics, and to supplement and deepen their knowledge based on the requirements of higher education, new concepts are introduced by asking students targeted questions and filling in their answers (cluster formation can be assigned), sorting. Students are given information about Euler-Venn diagrams using electronic visual aids and several examples are solved together. During the lesson, operations performed on sets and Euler-Venn diagrams are demonstrated using electronic visual aids prepared using the PowerPoint program using multimedia capabilities.

In order to organize and consolidate the knowledge gained by students during the lesson, each student is given individually structured tasks through the screen. Students complete the tasks for 10 minutes and give them to their partner next to them for checking. When the teacher collects the notebooks, he checks the tasks and evaluates each student. At the end of the lesson, students are given questions and homework assignments on the screen to prepare for the next lesson topic.

Results

Based on the results of the above research, we determined the purpose of the pilot study, such as developing electronic educational resources for teaching mathematics to students and using them to increase educational efficiency. In order to use electronic educational resources in the process of teaching mathematics, we used a set of complementary methods to organize pilot study. The pilot study was conducted among students of school No. 43 in the Kashtegirmon neighborhood of the Qo'shrobot district of the Samarkand region during the 2022-2023 and 2024-2025 academic years.

As a result of the research, 128 out of 258 students were involved in the experimental group and 130 in the control group. The experimental group will be taught in a conversational manner based on the e-learning resources we offer, while the control group will be taught in a traditional manner. During the experimental study, students' interest in developing and using e-learning resources in teaching mathematics was analyzed. Initially, we determined the level of knowledge of the students. For this, we conducted a test consisting of 20 questions on the basic concepts of mathematics in both selected groups. The average percentage of students who answered correctly is: 299/20*20=299/400, which gives their percentage of 71.19%.

This data shows that the groups have a similar level of knowledge, and a pedagogical experiment was conducted in both groups. Group 1 was selected as the experimental group, and they were taught using electronic learning resources prepared on a computer. Group 2 was selected as the control group, and they were taught in the traditional way as usual. After both groups had fully covered the topics of the section, two test surveys related to the topics of this section were administered to both groups. The first test consisted of 30 tests and the second test consisted of 15 questions. The results of the test conducted in the control group (group 2) were as follows:

We have determined teachers' interest in mathematics lessons through these e-learning resources. During the pilot study, we witnessed that teachers have mastered the topics covered in developing electronic learning resources for teaching mathematics and organizing lessons using them. The results of our pilot study were good. Through this, we learned about their interest in developing innovative methods for teaching mathematics and organizing lessons using them, as well as their independent thinking skills.

Table 1. Experimental and control group information

Groups	Number of students	Grades			
		2	3	4	5
Experimental group	n=128	n_1=1	n_2=49	n_3=49	n_4=29
Control group	m=130	m_1=5	m_2=79	m_3=35	m_4=11

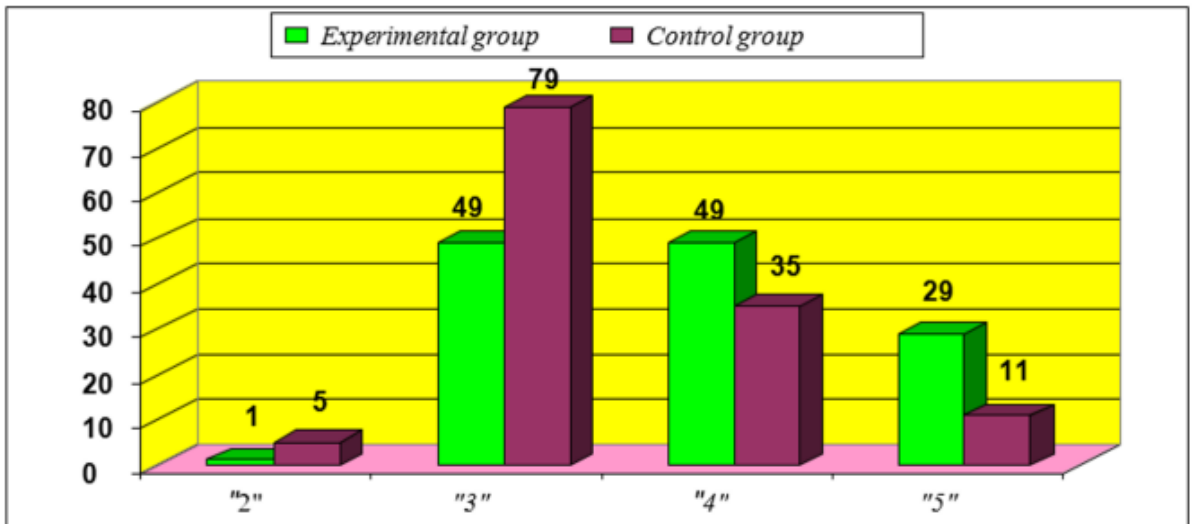

Figure 5. Its diagram looks like this

Practice shows that teaching students using electronic educational resources is twice as effective and time-saving. When learning using electronic educational resources, up to 30% of time can be saved, and the acquired knowledge is retained in memory for a long time. If students perceive the materials presented visually, the retention of information in memory increases by 25-30%. In addition, if educational materials are presented in the form of audio, video and graphics, the retention of materials in memory increases by 75%. We were once again convinced of this in the process of studying mathematics using electronic educational resources.

- Teaching students on the basis of electronic educational resources has the following advantages:
- the possibility of deeper and more complete mastery of the materials provided.
- the desire to get acquainted with new areas of education increases.
- the opportunity to save time as a result of reducing the time spent on education.
- the knowledge gained is retained in a person's memory for a long time and can be applied in practice if necessary.

Conclusion

It is dedicated to the basics and importance of teaching mathematics using software tools and it is dedicated to the basics and importance of teaching mathematics using software tools and technologies, and it highlights the main capabilities, features and effectiveness of modern information and pedagogical technologies used in teaching mathematics. In general, as a result of using the above-mentioned basic tools of information technologies in the educational process, our main goal is to achieve the following:

- develop students' all-round mental thinking and imagination skills, prepare them for independent thinking and work in a modern information society, that is, to make independent decisions in the implementation of any complex processes, to teach them to express their thoughts and opinions, to form diligent and inquisitive activity.
- create and involve new information and pedagogical technologies in all education systems to accelerate learning processes and increase their efficiency;
- increase the perfection, productivity, quality and efficiency of education by introducing all the capabilities of information and telecommunications technologies and software tools into it;
- organize independent work of students using information and telecommunications technologies and thereby expand and activate their independent thinking and imagination;
- deepen interdisciplinary ties using information and telecommunications technologies, while introducing modern technologies into all areas;
- creation, implementation and improvement of modern educational systems based on network technologies, including distance learning systems.

In general, the use of modern technologies and electronic educational resources in organizing mathematics lessons has the following advantages:

- The use of software tools in studying mathematics ensures the fundamentals of mathematical and technical education and the improvement of students' skills in applying theoretical knowledge to practice;
- When directly interacting with software tools in the educational process, students see and understand that computer technology tools are a means of solving professional problems and will have the opportunity to use them in their practical activities in the future;
- They learn methods for solving complex examples using software tools, their mathematical knowledge increases, and they also assign time-consuming calculations to software tools;
- Their knowledge and the scope of logical thinking in mathematics expand and they feel that complex calculations can be performed quickly and without errors in software tools
- The teacher connects mathematics and mathematical disciplines during the lesson and forms the initial skills of automation problems; students develop a need for knowledge;
- activates students' cognitive activity;
- increases students' interest in studying science;
- introduces the world to modern methods of scientific knowledge related to the use of information technologies and software;
- increases the level of student individuality in education;
- develops students' creative abilities;
- ensures the diversity of the content of materials;
- expands the range of educational materials used in education;
- enhances demonstration in education.

In increasing the effectiveness of the educational process using electronic educational resources, the role and importance of teachers with excellent knowledge, skills and experience in computer technologies will be great. In other words, for the perfect use of electronic educational resources in the educational process, the main attention should be paid, first of all, to creating the necessary conditions for the teacher and the student and the effective use of computer technologies in educational processes. At the same time, in order to organize the educational process on the basis of modern information and computer technologies, it is necessary to provide modern software tools along with electronic educational resources. We believe that this will be carried out jointly with the participation of qualified specialists, subject teachers and pedagogical psychologists.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

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Conflict of Interest

* The authors declare that they have no conflicts of interest

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References

Adolph, V. A. (1998). Formation of professional competence of the future teacher. *Pedagogy*, *(1),* 72-75.

Henner, E. K., & Shestakov, A. P. (2004). Information and communication competence of the teacher: the structure, requirements and measurement system. *Computer Science and Education*, *12*, 5-9.

Karakozov, S.D. (2000). Information culture in the context of the general theory of personality culture. *Pedagogical Informatics*,*6*(2), 41-55.

Mukasheva, A.A. (2009). *Formation of computer and information competence of university students in the process of professional training*. (Doctoral dissertation). Chelyabinsk State University.

Shamsutdinova, T. M. (2013). Formation of professional competences of students in the context of informatization of higher education. *Open Education*, *6*, 36-44.

Smolyaninova O.G. (2012). Formation of information and communicative competence of the future teacher on the basis of multimedia technologies. *Journal of Informatics and Education*, *(9)* 48-55.

Suyarov, A.M. (2023). Formation of information and communication competence of the teacher as an one of the main tasks of modern education. *Web of Scientist: International Scientific Research Journal, 4*(4), 243-257.

Suyarov, A.M. (2023). Ways and models of providing integration of information technology science with mathematical sciences. *E3S Web of Conferences, 402*, 03016.

Udalov, S. R. (2005). *Methodical bases of training teachers for the use of information media and information technologies in professional activity*. Retrieved from http://port.kspu.ru/ivt/magazine

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