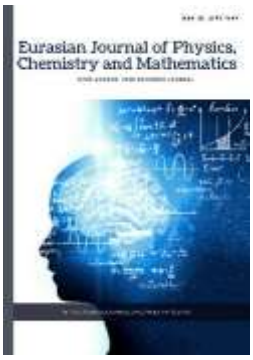

Innovative Approaches to the Use of Information Technologies in the Process of Teaching Mathematics

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ABSTRACT

Among the means of teaching mathematics, information technology has occupied its important place for a long time. The use of multimedia presentations, test shells, electronic textbooks, specialized programs for graphing functions or geometric objects has become an integral part of the process of teaching mathematics. The constant development of information technology offers other options for their use in the educational process, discussed in this article. The use of interactive exercises, mobile devices, interactive whiteboards, services for creating mental maps, microblogging, applications based on augmented reality allows implementing innovative approaches to the process of math teaching. This article analyzes the applications that allow these opportunities to be implemented, the directions of their application in the educational process are considered, and guidelines for their use in the process of teaching mathematics are given in order to increase the cognitive activity and interest of students, as well as the effectiveness of the learning process as a whole.

Keywords: training of mathematics, innovative technologies in training, information technologies in training, online services in training, online boards, augmented reality in the training of mathematics, mental maps, microblogging

Currently, society is at a stage when information technology is becoming an integral part of everyday life and professional activities. The education system, however, does not stand aside, since it is precisely it depends on how well our citizens will be prepared for the transition to digital economy. Within the framework of the federal project "Digital School" integration into the process of teaching individual subjects of modern technology, including functioning on the basis of virtual and augmented reality, which will allow to train highly qualified personnel with relevant competencies in the field of modern technologies. But, in addition to this, the use of modern developments in the field of information technology will make it possible to activate the process of teaching individual disciplines in the system of continuous education, holistically building the levels of education from school to university and beyond.The subject area "mathematics" provides great opportunities for application information technology in the learning process. They can be used as at various stages of the learning process (when studying new material, consolidating and systematizing previously studied material, controlling knowledge and learned methods of activity, generalizing and repeating material), and at different stages of classes (when updating knowledge, presenting new material, etc.) and, of course, in extracurricular activities, which are an integral part of the learning process. An analysis of the work experience of mathematics teachers in the

framework of the activities of the virtual methodological association of teachers of the Omsk region (https://vmo.obr55.ru/) made it possible to identify the main information technology tools that are traditionally used in the process of teaching mathematics. These include:

- multimedia presentations that most often accompany the study theoretical material and its primary consolidation;
- electronic textbooks with built-in video clips, test questions and questions for self-control;
- plotter programs used in the process of teaching algebra
(Excel, AdvancedGrapher, MathCad, etc.);
- virtual constructors used in teaching geometry ("Live
geometry", WinGeom, "Stereoconstructor", etc.);
- test environments.

The current rapid development of information technologies, including those that can be successfully used in the process training, significantly updates this list. Modern information technology tools allow not only to receive ready-made information from
various sources, but also to collect and analyze information in order to independently draw conclusions and obtain results, which corresponds to the tasks facing teachers in the context of the implementation of the Federal State Educational Standard.Conversations with mathematics teachers showed that most of them are ready to introduce modern information technologies into the learning process, but the following difficulties interfere with this process: lack of necessary material and technical support: in schools there is not always the necessary set of equipment (mostly computer science classrooms are equipped) or the equipment used in the learning process does not allow to realize the existing possibilities of information technologies;

- lack of necessary training of teachers (especially of middle and older age) in the field of application of modern information technologies;
- insufficient methodological elaboration of innovative approaches to the use of information technology, and self-preparation and development of training materials requires a very large amount of time, which the teacher most often does not have.The emergence of new information technology tools in Russian education, due to socio-economic innovations, the entry of educational institutions into market relations, a systematic change in the composition and the volume of academic disciplines, as well as the transformation of the role of the teacher, requires new approaches to the organization of the process of teaching the subject. As noted by R. S. Khataeva and D. A. Abdullaev, “the active use of digital educational resources leads to a change in the content of education, learning technology and in the relationship between participants in the educational process, allows you to individualize learning, make it more adequate to the abilities and pace of perception of students » [9, p. 74]. In this regard, a problem arises, which is the need to study the modern possibilities of information technologies and develop guidelines for their application in the process of teaching mathematics at school, and then in secondary specialized and higher educational institutions. The resolution of this problem will allow us to talk about the implementation of innovative technologies in the learning process, by which we mean “the use of new ways, methods and techniques of interaction between teachers and students that ensure the effective achievement of the result of pedagogical activity” [3, p. 135]. The purpose of the article is to analyze modern information technology tools that operate on the basis of online services, mobile devices, etc., and develop guidelines for their use as part of the implementation of innovative approaches to the process of teaching mathematics. Innovations in the field of education can be associated with various conditions, including the use of information technology. As V. A. Krasilnikova notes: “…computer learning and control technologies are becoming the basis of innovative educational technologies, since they make it possible to realize the individual needs of the student, ensure personal development and increase the level of accessibility to education and continuous professional

development" [5, p. 55]. Taking into account the increased possibilities of the Internet, we will understand information technologies in the education system as a set of technical means and capabilities of the global network that ensure the continuous receipt and processing of information in order to use it to expand students' knowledge. According to S. A. Sokolova [8], innovative information technologies are teaching and learning methods aimed at using a set of means and methods of interaction between a teacher and students using information technologies and interactive equipment that helps in converting general information into personal knowledge and skills. Considering innovative information technologies, S. A. Sokolova [8] identifies the following types of innovations in educational activities: hypertext technologies for information presentation; use of interactive equipment (electronic boards); creation and demonstration of presentations; application of distance education technologies, video conferencing; development of interactive educational complexes. Thus, under innovative approaches to the use of information technologies in teaching mathematics, we mean the use of computer programs, special applications and Internet resources that provide interactivity, remoteness, and mobility of all participants in the educational process. 5 Among the new ways of organizing interaction between participants in the educational process include the use of various online services on the Internet, interactive online whiteboards, educational platforms with the ability to integrate information of various kinds, etc. This is due to several reasons: firstly, they imply mental activity of each student; secondly, there is an opportunity to receive education regardless of the location of one's educational institution; thirdly, it allows you to remove the limitation in the use of information technology tools associated with the list of free software that can be used in educational institutions. This fact, of course, speaks of the benefits of these funds. At the same time, it should be noted that the use of modern information technologies will allow students to form not only a certain system of knowledge and subject skills, but also the necessary ICT competencies that they can use while continuing their education in secondary specialized and higher educational institutions, which allows us to talk about continuity education. Let's consider innovative directions of introducing information technologies into the process of teaching mathematics. Interactive exercises created using online services Interactive teaching methods imply a form of interaction in the course of the educational process, focused on wider communication of students not only with the teacher, but also with each other, as well as the dominance of student activity in the learning process. Today, pedagogical research offers many different forms of interactive exercises and tasks: creative and discussion tasks, small group work, educational games, POPS formula, project methods, brainstorming, six hats, interviews, case method, training. A variety of forms of interactive tasks allow you to activate the mental activity of students and keep their attention on the material being studied.Working with a video lecture can be organized in one of three ways:

- the video lecture is broadcast using projection equipment for

all students in the class, and they answer questions during a frontal conversation;

- students get acquainted with the material of the lecture in groups, studying its content and answering questions using tablets or laptops (it is important to generalize to the class as a whole after this);
- students, having scanned the QR code, work with the lecture material on their own smartphones.

The choice of method is determined by the content of the studied material and its place in educational process:

- if this is new material, and the lecture has voice or sound accompaniment, then it is advisable to use frontal work;
- if the lecture material is aimed at systematizing and summarizing previously studied material on a topic or section and can be studied without sound accompaniment, then group work can be used;

- if the lecture material is aimed at deepening or expanding students' knowledge on a particular topic, then it can be offered for independent studying at home. Even more interesting are the possibilities of this online service for organizing the stages of updating and monitoring students' knowledge during the lesson, and as well as extracurricular activities. This is due to the fact that it contains a large number of different 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 educational process allows you to: individualize the educational process in accordance with the personal characteristics and needs of students; organize educational material taking into account various ways of educational activities; enhance visual perception and facilitate the assimilation of educational material; to activate the cognitive activity of students.The use of mobile devices in mathematics lessons.Another option for using information technology in the process teaching mathematics is to work with mobile devices and special applications for them.Let's take a closer look at the options for using mobile devices when teaching mathematics.Mobile devices (smartphones and tablets) after installing special applications on them can be used as rulers or protractors.However, it should be noted that the use of these features is not allowed.With their help, you can take measurements on the ground, solve practice-oriented problems in geometry, or organize a quest related to measuring objects. This will not only make students interested in the study of geometry, but also show the connections between the studied disciplines and practice. Specialized programs and applications installed on mobiledevices, make them real assistants to teachers and students. Note the most interesting features of working with such applications:

use of specialized calculators (with their help you can

organize a mini-study to obtain independent conclusions and rules

or self-control in solving problems). For example, the application for working with common fractions and mixed numbers can be used when learning

arithmetic operations with given numbers, when in the course of research work students will be able to independently formulate the corresponding rule Use of augmented reality technologyAugmented Reality (AR) technology allows you to see real objects combined with virtual images superimposed on them, which creates the effect of the user's presence in the same reality as the received object.There are two principles for building augmented reality: based on a marker; based on user coordinates [1].The use of specialized programs and applications running onbased on this technology, can make a significant contribution to the learning process mathematics, namely in the study of stereometry (including propaedeutic stage in grades 5–6). Information technology tools in teaching stereometry have long been a necessary attribute of the lesson. Teachers are looking for various opportunities to show students the geometric bodies they are learning and patterns from all sides and preferably in dynamics. This is due to the fact that course of stereometry is, perhaps, the only one in the course of which the development of spatial thinking of students. For this, it is proposed to use well-known programs, such as: "Live Geometry", Maple, "Stereoconstructor" and others. The development of AR technology opens a new page in the study of stereometric objects. O.P. Belova and A.A.

students' thinking Currently, there are applications for mobile devices, the use of which also allows you to see 3D objects. Thus, the ARRulerApp application allows you to measure objects around users using a smartphone camera (linear dimensions, angle, area and perimeter, volume and etc.). The use of such applications will be useful when studying new material, when an image of a geometric object is formed, as well as when conducting practical work on geometry.

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