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# CREATING A COMPLEX OF SIMULATORS AND EDUCATIONAL GAMES OF MATHEMATICS

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**Abstract**
Information technology of education is a new methodological system that allows to consider the student not as an object of learning, but as a subject of learning, and the computer as a learning tool. The student moves to a new category, because the form of computer training is individual, independent, but is carried out according to the general methodology implemented in the curriculum. There are several types of educational programs: informational, reference, monitoring, combined. Some educational programs are able to monitor student knowledge, others include "training" elements, others help mastering new learning material, and others are designed to stimulate students' interest in the subject being studied. intended. To save the teacher's time, increase motivation, encourage students' initiative and creative thinking, as well as to bring educational activities closer to the game, simulators and game curricula that introduce students to mathematics. the goal of creating a plan was set. Allows you to check the "interesting" properties of numbers, the learned material and perform arithmetic operations during the game. The mysterious world of numbers and how these numbers are created is explained. The program allows you to implement the concept of the "zone of proximal development", known in pedagogy. During the game, the child sometimes performs "not yet completed" objective actions, because from the point of view of his development, he is already ready to perform these actions using the knowledge acquired at the everyday level.

**Keywords**: game, knowledge, training, numbers, programs, motivation, prime number, friendly numbers

## INTRODUCTION

Mathematical science, with its formulas, integrals and sigmas, seems to be separated from the outside world by a great wall. What is going on behind this great wall is hidden to those who do not know mathematics, and when this "mask" is opened, they face the world of "dead numbers" that live by their own internal laws. If dead numbers are studied with great interest, they become "wonderful numbers".

The achievements of the great mathematicians who lived in ancient times still amaze people today. Names like Euclid, Archimedes, Pythagoras, Heron are familiar to anyone who has been more or less involved in mathematics. The great German mathematician K. Gauss (1777-1855) called arithmetic "the queen of mathematics". In mathematics, especially in arithmetic, there are problems that are simple in terms of structure, but very complex in terms of solution.

Mathematician N. Gezanski, who lived in the 1st century, said the following words: "Great numbers are beautiful. It is known that beautiful things are rare"[1]. A math teacher can play a big role in extracting these beautiful numbers in the world of numbers and skillfully conveying them to students.

One of the main directions of the process of informatization of modern society is the informatization of education, which ensures the widespread introduction into practice of psychological and pedagogical developments aimed at the intensity of the learning process, the implementation of the ideas of

developmental education, and the improvement of forms and methods of organizing the educational process. The use of computers and information technologies in education has a significant impact on the content, methods and organization of the educational process in various disciplines. In this regard, there is currently an intensive development of educational, gaming and monitoring programs that help to significantly save the teacher's time, develop the student's creative abilities by creating a favorable environment, train in solving problems of a certain class and receive adequate assessments of their knowledge.

However, the process of informatization also has negative consequences: children are increasingly interested in computers and computer games, therefore, attention should be drawn to the child's education through the computer implementation of educational games. In preschool age, play is the child's leading activity. When the child arrives at school, the leading activity turns from playful to educational. The main activity of the child should be learning. Therefore, in primary school it is necessary to lay the foundations of educational activity in students.

However, this process is complicated by the age-related characteristics of younger schoolchildren: weak switching of attention, its instability, involuntary memory and thinking.

To overcome this, playful forms of children's activity should be widely used in learning - the educational activity of a primary school student should be permeated with playful moments. In order to save teacher time, increase motivation, stimulate initiative and creative thinking of students, as well as bring educational activities and games closer together, the goal was set - to create a set of simulators and game training programs in mathematics, which introduces the student to the "interesting" properties of numbers, makes it possible to check learned material, and, while playing, practice performing arithmetic operations.

The game allows you to simply implement the concept of the "zone of proximal development", known in pedagogy.

General secondary schools have always responded to important changes in the socio-economic and cultural life of society. Today, the demands placed on the education system are to educate young people who can think independently, appreciate our national heritage, are creative, moral, and have matured in all aspects. In order to fulfill these requirements, a teacher of the present time is required to constantly search for creativity, a new attitude to study and dedication[2,3].

The article talks about the possibilities of the "Journey to the World of Amazing Numbers" program, which interests schoolchildren in the mysterious world of mathematics. The mysterious world of numbers and how these numbers are created is explained. The main purpose of using the program is to activate the interest of students, and to form the ability of science teachers to conduct lessons in a way that is connected with computer science[4].

## Method

**Didactic games** - A didactic game is a form of learning that was also used in the pre-computer era; paper technology was used for this. The didactic game is most often used for young children. During the game, students unnoticed perform various exercises, where they themselves have to compare, perform arithmetic operations, practice mental calculation, solve problems; it develops independence and active thinking in children. The game puts students in search conditions, awakens interest in winning, therefore, children strive to be fast, resourceful, accurately complete tasks, and follow the rules of the game. Interest in it, the desire to fulfill it is activated by game actions. The more diverse and meaningful they are, the more interesting the game itself is for children and the more successfully cognitive and gaming tasks are solved. For example, a task on mastering counting to 10 can be offered in the usual form "Fill out the table" Figure.1.1[6]

| | | | | |
|---|---|---|---|---|
| 1 | 2 | | | |
| 10 | 9 | | | |

Figure.1.1

Or you can create a game situation: “Help Dunno decorate the New Year’s tree with number balls.” In Figure 1.2 you can see an illustration of this task.[6]

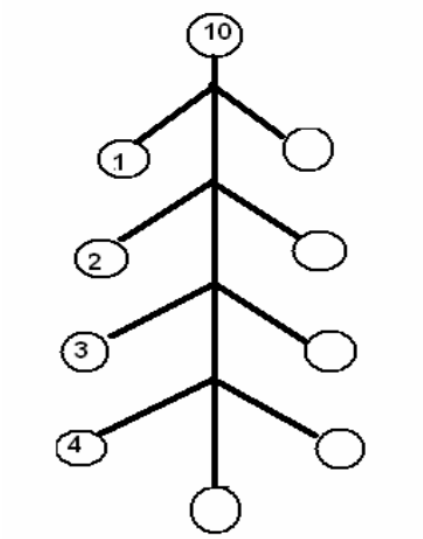



Figure.1.2

The result of a didactic game is an indicator of the level of achievement of children in mastering knowledge, in the development of mental activity, relationships, and not just a gain obtained in any way. Didactic play influences the formation of such qualities of the mind as its mobility and flexibility, develops attention, imagination, and shapes the will of children. For younger schoolchildren, learning is a new and unusual thing. Therefore, when getting acquainted with school life, the game helps to remove the barrier between the “external world of knowledge” and the child’s psyche[6,7].

Game action allows you to master something that in advance causes fear of the unknown in the younger student, constantly instilled respect for school wisdom, which interferes with the free acquisition of knowledge. In addition, children have not yet developed an attitude toward completing academic work. Therefore, the main type of didactic games used in the initial stages are games that form a stable interest in learning and relieve the tension that arises during the period of adaptation of the child to the school regime. The game helps to make any educational material exciting, causes deep satisfaction in students, creates a joyful working mood, and facilitates the process of learning knowledge. Game tasks develop children's ingenuity, resourcefulness, and intelligence. At first, children show interest only in the game, and then in the educational material without which the game is impossible. The peculiarity of didactic games is that the educational tasks in them do not appear in an explicit form - the game task comes to the fore for the student[8].

**Functional structure of a game-based training program**

Games in learning are one of the forms of computer-based educational programs.

The psychological justification for the use of games in education is determined by the fact that the student uses the most appropriate type of activity to solve the main educational task - obtaining and assimilating new knowledge and consolidating this knowledge as a result of its repeated use during the game.

From the point of view of the player, the game represents a certain task - it has conditions, a goal and means of achieving it.

The thesis examines mathematical games belonging to the class of logic games or puzzles. Solving a problem is a process controlled by the player in real time according to established rules. The progress of the process is assessed according to the established criterion.

In this regard, in a game-based training program (hereinafter IEP), three functional components can be distinguished: the gaming environment (hereinafter IS), the algorithm for interaction between the computer and the player, and the assessment of the results of the game situation.

Given the obvious connection and interdependence of these components, they can be considered as independent, which will facilitate the work of programming them.

**The gaming environment** is the totality of all objects and connections in the game and the laws of their change. In other words, the IP is the basis, the "world" in which the game action develops. Thus, in chess, the playing environment will be a set that includes: a board, two sets of pieces, rules for moving pieces around the board, as well as rules for capturing (and moving) pieces. In gaming environments intended for learning new educational material, the gaming environment should be a convenient (most often graphical) model of the subject area.

**Interaction with the player** is a set of means provided to the player for changing the parameters of the game environment, i.e. for actions and changes in the game environment that occur when the player performs certain actions with objects of the game environment by clicking on certain control components located on the field environment. Note that educational games, unlike real-time games, always fundamentally contain some intellectual activity of the student related to the subject area.

An important property of game-based educational programs is that this subject area is a set of external actions with game objects hidden from the student.

A game, which is an activity interesting for a student, forces him to acquire new knowledge without pedagogical force (so-called latent learning).

**Assessment of a game situation** is the relationships and conditions that determine the task for the player in a given game. This includes a system of points and penalties for game actions, a description of the initial and final game situation. In the structure of the game training program, this problem is solved by the functional block of classification and registration of the student's actions during the game to perform actions in the subject area.

## RESULT AND DISCUSSION.

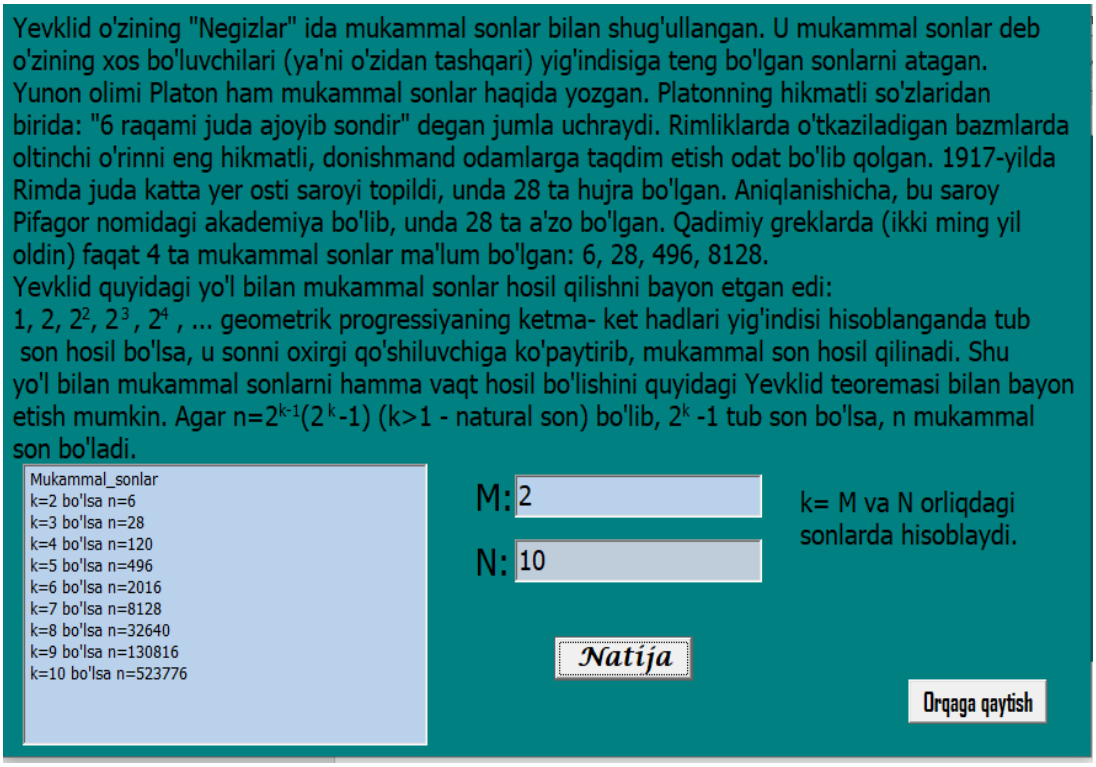
**Game educational program "Our journey into the world of amazing numbers"** consists of 3 parts:

1. When numbers enter the language. In the first part, there is a brief information about the wonderful numbers, such as Mersenne numbers, twin primes, friend's numbers, primes, square numbers, Pythagorean numbers, perfect numbers, triangular numbers, polygonal numbers;
2. Great equals. Pythagoras said in one of the meetings with his students that "Every number has its own wonder." One of his students asked: "If not, tell me what is so wonderful about 17 prime numbers?" Pythagoras asked: "17 is a very wonderful number. It consists of the sum of 2 squares and 2 4th powers. 17=12 + 42; 17=l4+24;
3. Questions and answers using the program.

Algorithms and its program for determining great numbers in an interval of numbers according to the first and second part are compiled in C++ environment. Below are pictures of how to use the program.

The program is intended to be used with the help of a computer, after going to its "Input" part, the user should select the button with its name in order to get information about the number he is interested in.


When the button is pressed, information about this number is displayed on the user's screen, a text describing its history and how it was created. Throughout the text we can see numbers of this type calculated between m and n.




Examples of great numbers: 6174 great numbers. We get an arbitrary 4-digit number whose digits are not repeated. We write down the digits of the number, subtract the original number from it, write down the digits of the resulting number and subtract from it. Repeating this algorithm successively, we generate 6174 wonderful numbers. For example, 2564, 6542-2456=4086, 8640-0468=8172. 8721-1278=7443, 7443-3447=3996, 9963-3699=6264, 6642-2466=4176, 7641-1467=6174, 7641-1467=6174. 145 is an amazing number. We get an arbitrary 3-digit number whose digits are not repeated. We add the middle number to the square of the number 1 and the 3rd number, and so on, we get the number 1 or 145 wonderful numbers. For example, 214, 4+1+16=21, 4+1=5, 25, 4+25=29, 4+81=85, 64+25=89, 64+81=145 [1,4].

Twin numbers. If two prime numbers differ by 2, they are called "twin" numbers. For example, 5 and 7, 11 and 13, 17 and 19 are "twin" numbers. Among the natural numbers, there are triple "twin" numbers (3,5,7; 7,11,13, etc.). How many "twin" numbers exist is not clear in modern science [4,5].

**Game educational program “Get on the road with mathematics”**

This educational program is intended for children in grades 3-6 who are already familiar with basic arithmetic operations: addition, multiplication, subtraction, division. And needs entertaining training of these skills.

It also makes it possible to repeat the multiplication tables in a playful way. The educational program allows the student to work with numbers ranging from -100 to 100, since not every primary school child knows how to operate with large numbers.

Along with knowledge of arithmetic operations, the student must be proficient in the operations of comparing ordinary fractions.

The educational program is intended for children with different mathematical knowledge and abilities, therefore, in many tasks - games, the child himself chooses the signs of arithmetic operations, as well as the

range, type and number of numbers with which he will operate, in accordance with his mathematical abilities. When displaying each task, the frame contains detailed information that the student may need when completing the current task.
The training program is a set of tasks - games, with educational material on the current topic. Developmental tasks-games are also implemented, which allow you to train in performing arithmetic operations in a playful way.

This program consists of the following blocks of tasks:
1. “Topics” - educational material on some topics is offered here.
2. “Control” - this block contains tasks - simulators that allow the student to test his ability to perform arithmetic operations.
3. “Games” is a block of educational games.

This training program is built in accordance with the principles of constructing training programs, which were discussed earlier.

**Programs with numbers:**
1 “Live multiplication table”
2 "Prime numbers"
3 "Fibonacci numbers"

**Programs - simulators**
1 “Evaluate an arithmetic expression”
2"Insert missing character"
3 “Comparison of ordinary fractions”
4 “Finding GCD”

**Game programs**
1"Patterns of a hundred-cell square"
2 “Arrange the numbers”
3 "Find the numbers"

## CONCLUSION

The use of computer technology in education is a way to increase motivation and individualize a child’s learning, develop creative abilities and create a friendly emotional background. When implementing computer didactic games, additional opportunities provided by the computer environment should be used: multimedia effects, interactive interaction.
Computer technologies have made it possible to widely use game programs in teaching. Every game program is essentially a didactic game. The subject area does not appear clearly for the student, but he masters it as he performs game actions.
As a result of the scientific work , a game-based educational program in mathematics for students in grades 3-6 was built, consisting of three sections, each of which contains educational, training and game tasks that promote the assimilation, training and development of mathematical skills. Thanks to the colorful design and

interesting formulation of tasks, the implemented educational game program can motivate children to use it repeatedly.

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