American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 02, March, 2022

PROGRAMMING AND ROBOTICS BASED IN STEAM LEARNING

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Winner of the selection of grants 100 innovative
projects of women of Uzbekistan, head of the project "Creation of a children's educational institution" ROBO-DEMO "with an online resource, information technology and computer programs for the development of children from 1 month to 7 years

Annotation

This article shows which areas of Steam education need to be developed to train small and highly qualified specialists. The author shows the future development of production, mechanical engineering and robotics, engineering and invention, now and in the future, the creation and application of Smart technologies, the construction of Smart houses and apartments, Smart cities is based on the level of knowledge and preparedness of small and highly qualified specialists who need to be trained on additional education courses, because there is barely enough time in an educational institution to cover the material on the curriculum and the standard of education.

The article reveals the material and gives definitions of concepts like STEM; STEAM; STREAM. An idea of the development of the components of STEAM education is given: science, technology and communication with them technology, art, mathematics, technology. This requires the development of such robotics modules in the TRIK studio and programming in Scratch and C ++, Python, Arduino and teaching Scratch, Tinkercad, Arduino programs, knowledge of electrical engineering in TinkerCad Circuits is required; programming in Scratch and C ++, Python; Mechanics in Algodoo; 3D modeling; knowledge is required in onShape;

in imitation robotics at TRIK studio., skills in working with Scratch, TinkerCad, Arduino programs, programming in Python, C ++.

Keywords: Electrical Engineering at TinkerCad Circuits; Scratch and C ++ programming; Mechanics in Algodoo; 3D modeling; Required knowledge in onShape**;** Simulation robotics in TRIK studio., Scratch program, TinkerCad program; TinkerCad Program, Arduino Program, Python Programming.

Introduction

The problem of training good specialists has been and remains one of the main tasks in any state, including ours. Innovations in science and technology, carries with it the development of modeling, programming, design, engineering and mechanical engineering, and at the present stage and robotics.

The development of society, the economy and the power of the country depends on the correct solution to this problem, since the ability to use the necessary programs, technologies, assembly of parts, devices of large complexes leads to the strengthening of the power of our state, and in order to collect parts of machines, devices, equipment, installations programs require knowledge of design, engineering, machine parts, programming, biology to represent the work of a robot, to make the arms and legs of a robot that are somewhat similar to parts of the human body. And to solve this problem, you need good specialists who know all these technologies in general, who have potential in several sciences at once, who are able to design, program and use this knowledge in creating machines, robots, and in engineering.

And for this, we must raise the level of such learning by developing all the elements of STEAM learning, starting with preschoolers and schoolchildren in the direction of Steam learning, starting with electrical engineering in TinkerCad Circuits; programming in Scratch and C ++; studying mechanics at Algodoo; studying 3D modeling; knowledge in onShape; raise the level of imitation robotics in TRIK studio, teach children from an early age to work on a computer, work with a flash drive, be able to save their projects, work and create original block logic codes from logical blocks in the Scratch Program, be able to simulate in the TinkerCad program;

be able to control the movement of a robot in a straight line, along black and white lines on an Arduino board, be able to program in C ++ and Python, develop your skills and update them throughout your life.

This problem also applies to such our works as the teaching methodology of Scratch, Tinkercad and others. Steam education at this stage is very relevant, it is already being studied and applied in life, although all aspects and connections between objects have not been deeply studied.

Photo 1. A robot assisting the teacher in conducting scientific conferences, controlled from a distance at the teacher's fingertip.

But an innovation in this education is the use of computer programs and information technologies, step by step in the stages of education, as well as the methodology of teaching work in the field of studying the Scratch program in preschool education and at the more initial and subsequent stages of education.

Also, involving children at an earlier age in entering ready-made short codes on graphics that would display very beautiful patterns on the screen, a small number of such lessons together with mentors or parents, with the most beautiful results of various ornaments and patterns on laptop screens. It is necessary to consistently and step-by-step for continuous training of the Tincercad, Scratch programs to form deep knowledge and skills, work experience in them, for the application of knowledge at later stages of education.

We put the idea of using Lego learning for children on the basis of block programming higher than writing the codes itself. We put forward the following hypothesis: the improvement of children from an early age on the basis of games and computer programs of lego-design, programming, creation of mini programs using various blocks of programs in Scratch, teaching them the basics of modeling in the Tincercad program, which will serve to study and use these programs at the subsequent stages of continuing education, which ultimately will serve to train highly specialized specialists

There is a hypothesis of a deeper and more accurate assimilation of knowledge through the use of information technologies and programs in teaching, suggesting

that such an idea will lead to a deeper improvement in the assimilation of innovations and knowledge on the use of information technologies and programs, with their implementation. One of the first hypotheses is the use of information and communication technologies and programs at continuing education levels and the second hypothesis is the development and improvement of learning elements or constituent elements of STEAM education, such as science, technology, technology and education, art and mathematics, teaching these subjects at the level of art and craftsmanship.

This will greatly help future specialists to be able to orient themselves to work in a technological environment, rely on their knowledge of mathematics and programming, on scientific and technical knowledge at the skill level.

The development of science and technology, technology requires from a modern person the ability and skills to use them in various industries, mechanical engineering, robotics and education. The requirement by the century of knowledge in these areas, which is associated with the development of science and technology, requires education from education to prepare knowledgeable, intelligent small specialists in this area.

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Indeed, at this stage, although the demand for highly specialized specialists in all areas is growing, admission to the university for each school graduate is not guaranteed, it depends on their knowledge and skills. And in order to guarantee him a job in small enterprises, in business structures and in production, we must train them with highly qualified small specialists, and this is where STEM education will help us, which has now grown into its other forms, such as STREAM and STEAM.

In addition, the construction of Smart homes and cities, robots that help teachers in education or provide their high-quality services in all industries and services

and education, or the creation and invention of Smart devices, Smart devices require a modern person to simultaneously know all subjects. So let's discuss what STEAM is, where the letter A is ART, art, skill, skills and in what ways all the elements of this education can be developed in order to form the knowledge of future small specialists or highly specialized personnel, scientists who can easily integrate in the process of production, science and technology, after graduation from school and university.

So let's define what kind of education we need to develop and raise its level, what elements of such training we need to develop in order to prepare young specialists for their future profession as a specialist. So that he could easily rotate in this environment of requirements for a specialist and could perform the work allocated to him without labor and effort, intellectually understanding devices, mechanisms and parts, using modern programs, equipment, detailing devices and machines.

STEM (Science, Technology, Engineering, Mathematics) education is a model that combines natural sciences and engineering subjects into a single system. It is based on an integrative approach: biology, physics, chemistry and mathematics are taught not separately, but in connection with each other to solve real technological problems. At the present stage, the STEM approach is used by philologists as a STREAM approach, where R is Reading - "Reading" in the modern world, thanks to the development of technology, technology has moved to the level of STEAM technologies, where the use of the Internet, programming, technology is brought to the level of art, or vice versa, art is used in teaching. Science, technology, engineering, mathematics (STEM) is a term commonly used in defining educational methodology and curriculum selection in schools to improve competitiveness in science and technology development. STEM education takes part in the development of the workforce, national security interests and immigration policy.

The acronym's popularity spread shortly after the famous Science Education Meeting held at the US National Science Foundation under the direction of NSF Director Rita Colwell. The director of the Science Office of Human Resource Development for Educators and Scientists, Peter Faletra, proposed changing the acronym from the legacy METS to STEM. Colwell, expressing some dislike for the old acronym, suggested that NSF accept the change of the acronym. One of the first NSF projects to use the acronym was STEMTEC: Science, Technology,

Engineering, and Mathematics in Teacher Education at the University of Massachusetts at Amherst, which was founded in 1998. Communicating with e-learning on the Internet, online resources, using specialized computer programs. Further, we offer preschool education at 4-5 years old using Seguin electronic boards, Montessori boards for the development of mathematical abilities and increasing the knowledge of children. We propose at this stage the use of the programs we have created for the Development of Memory, which is called "Computer + Memory + Logical Thinking", "Computer + the alphabet of three languages: Uzbek, Russian and English.

Materials and methods. Our idea of teaching children from an early age in preschool institutions according to the Froebel, Montessori method, based on his gifts, on his teaching methods using colored balls suspended on a thread or painted in different colors of glass bottles, using rainbow colors, rotating balls or bottles on threads, volumetric figures: a ball, a cube, a parallelepiped and a demonstration of such figures that are found in everyday life.

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Further, for children of 5 years of age, we propose to use and study the Tincercad program with their parents at home or with mentors of preschool institutions for the development of their volumetric representation of geometric shapes, for the development of their knowledge at the level of art. This process must be carried out as an experiment in preschool institutions that are equipped with laptops, tablets. You can also organize a scientific experiment in preschool institutions.

Our research objects are STEAM education, with its components: science and technology, technology, education, art and mathematics, and here you can use the art of using computer programs and technologies, including teaching science and technology using information technology and computer programs at the level craftsmanship, art. We investigate this process of development of STEAM education components at various stages of lifelong education, including preschool, school and higher education.

Next, we consider learning in the STEAM environment for schoolchildren from 4 to 5 years old, from 6 to 7 years old, then for schoolchildren from 8 to 9 years old, from 9 to 16 years old and older. We consider training in this environment for graduate students in the specialty "Informatics", "Information technology". At the stage of preschool education for children 4-5 years old, as a preparation for school, we use STEAM training using the Froebel methodology, Montessori methodology, for children 5 years old we use programs and information technology, online resources using information technology and computer programs. The programs “Computer + memory + logical thinking”, “Computer + alphabet of three languages: Uzbek, Russian, English” were used. In order for children to learn well the alphabet of their native language and the alphabets of the Russian and English languages in order to better understand the similarities and differences between letters and their pronunciation. Further, for children 5 years old, we offer small mini-programs of games, stories on the SCARTCH program, with a sequential presentation of the meanings of each block, i.e. with a logical interpretation of the execution of small block structures with their logical explanation. We offer lessons with mentors or with parents at home.

Further, for preschoolers 6-7 years old, the long-term use of the "ILK KADAM" program is used - the initial step, with the entire methodology and structure and exercises for preparing children for school, together with the consistent and long-term use of computer programs "Computer + memory + logical thinking", "Computer + alphabet of three languages: Uzbek, Russian, English ”. An experiment of control and experimental groups is carried out with the use of STEAM training and computer programs according to the program "Ilk kadam" -Initial step. Further, for preschoolers 6-7 years old, the long-term use of the "ILK QADAM" program is used - the initial step, with the entire methodology and structure and exercises for preparing children for school, together with the consistent and long-term use of computer programs "Computer + memory + logical thinking", "Computer + alphabet of three languages: Uzbek, Russian, English ”. An experiment of control and experimental groups is carried out with the use of STEAM training and computer programs according to the program "Ilk qadam" -Initial step.

This process can be done in several steps and lessons. Here you can choose e-learning methods, traditional, combined, methods of using computer programs and information technology. In training in higher educational institutions, the

subject of informatics and the methods of teaching it is taught, here you need to prepare students for teaching topics in continuous areas of education, and in particular at school. It's no secret that the computer science curriculum included the Scratch program, starting from grade 5, for children from 11 years of age and older, and in earlier periods of study, as well as learning the Python programming language, starting from grade 9 for teenage children in from the age of 15.

And therefore, a special teaching methodology is needed in Scratch and Python programs. To prepare future specialists, teachers of the subject of computer science with the study of these programs and programming in these languages. In this work, the following methods were used: analysis and comparison of the work done, observation and comparison of objects, survey, testing, experimental analysis, the initial stages of modeling, study, generalization, etc.

For graduate students, training and acquisition of skills and abilities, experience in the use of Scratch, Tinkercad programs are offered, as well as we have been trained and introduced into this learning process of other programs such as the study of the Electrical Engineering program in TinkerCad Circuits, Scratch and C ++ programming,

Mechanics in Algodoo, 3D modeling. Tincercad, onShape, TRIK studio-simulation of robotics.Figure 1. A robot helping a teacher conduct conferences and lectures

Literature Review

By reviewing new articles from international journals indexed in Scopus, Science direct etc. [3,4,7-10,14,17, 24-29,32-34]. We realized that we were on the right path, that our hypothesis was correct, that teaching engineering, programming, engineering and technology should be started from childhood [28,34], this is even noticeable in children with physical disabilities and scientific works reviewed in this area, written articles by foreign researchers and scientists, materials of international conferences, as well as the works of scientists from neighboring countries and our republic served us as the basis of our methodology [1,2,20,21,31,36-40].

Making a literary review of materials and existing articles, developments, books and various literature, I would like to dwell on some important aspects that teachers, specialists and scientists relied on and which we can take as a basis. Considering the works [5], [41]: Belova G.V., Yudina A. "Programming in the

Logo environment", which is aimed at teaching children logo design, using logical constructions, which is very important at the initial stages for introducing a child into programming , methodological developments and manuals for teachers of grades 2-4, on teaching computer science in games and tasks [15]: Goryachev A.V., Volkova T.O., Gorina gives information on teaching children computer science in the early period of education, based on games, starting from grade 2, the following works are important for the environment of use and for teaching Scratch [12] : Eremina E.A., on programming, because it should be taught at the level of art [11,12,13, 16,18]: Knut E. Donald, Python programming [14-18], [44]: Zlatopolsky D.M., Lutz M., Lubanovich, Bill, Reitz K., Schlusser T, textbook analysis is done and materials for elementary grades teaching computer science [5,6,10,11,13,15], [19]: Konopatova N.K., Matveeva N.V., Pankratova L.P., Chelak E.N., Nurova N.A., Pervin Yu. A.., Sheludko, V.M. on working with preschoolers and schoolchildren in computer science, on the methodology of teaching computer science at an early age and at school [29,42,43]:Pervin Yu.A., Yashuyev R.G., Yakhovsky N.G., on algorithmization and making of programms [12,13];Ershov A.P. studied materials for schoolchildren and for elementary grades, as well as for preschoolers on programming [42], [43]: Yashuev R.N.,. Yakovsky N.G. give ideas for teaching computer science, programming for children from an early age, in stages based on specially developed methods, techniques and existing programs. We studied the methodology of teaching computer science in our country, the introduction of innovations in the education system of computer science, the introduction of the Scratch 5th grade program, Python programming from the 9th grade. I would like to note a number of works by major scientists in the field of computer science M. Aripov, U. Yuldashev, A.A. Aduqodirov A.A., Zakirova F.M.., Khusanov K.O., [1,2,36], whose made a huge contribution to the science of computer science and also support the idea of comprehensive training from early childhood using information technologies and computer programs, introducing children from an early age to technology, to computers and tablets.Among the works devoted to the use of computer programs in the early development of children, I would like to mention the works of Yunusova G.N.[40].

In this methodology, we present the idea of teaching children using Froebel's gifts through traditional classes and classes on a computer online, preferring to conduct special exercises according to Froebel's method, on Seguin boards, teaching

mathematics on the basis of Montessori boards, using her methodology and exercises. Learning at an early age the alphabet of three or five languages, some basic words in three languages, we offer exercises for the development of the children's hand, for its motor skills, as well as for older children who are preparing for school to teach them to write, starting with dashes and lines, circles and stars, etc., and then smoothly moving on to the study of letters and numbers.

Figure 2. Conducting a master class lesson for grade 2 students with the aim of effectively teaching the English alphabet using information technology to compare the English alphabet with the alphabet of the native Uzbek or Russian language.

E-learning is very important here, so that children are not time consuming, bored, they need to be taught with the help of games, this is where computer games are very important.

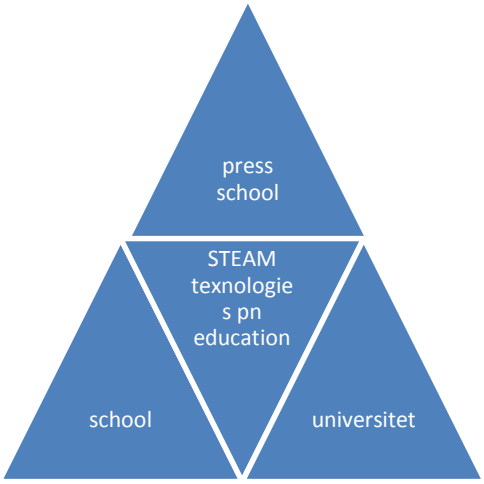
Results

We hypothesized that training with the development of the components of STEAM education in the environment of information technology and computer programs enhances the degree of assimilation of the material and prepares the strongest person or future specialist for the next stages of training, has brought good results.

We have conducted pedagogical experiments in this area for those brought up in children's educational institutions, for schoolchildren and university students.In our research, we used the methods of comparison and analysis of traditional teaching methods, conducted experiments on the correctness of our hypothesis of enhancing the learning of STEAM education components, subjects related to them, as well as related sciences on which these subjects are based. When conducting an experiment on the reliability of the hypotheses identified by us for strengthening the components of STEAM education, as well as improving the assimilation of these materials with the help of information technologies and computer programs created by us. We conducted an experiment on the reliability of our methodology and hypotheses using the Chi-square method, as an experiment, we conducted master classes in children's educational institutions (preschool educational institution № 5 in Namangan), general educational schools (school № 7, "№. 49, № 1, № 7, № 31 of the city of Namangan, schools № 23,№24 of the Namangan region of the Namangan region), among the educated and students, trainees were selected for the control and experimental group.

After teaching by the traditional method and our methodology, a survey, questionnaires, testing were organized, knowledge on the topics of the master classes held according to the traditional methodology and according to the new methodology of teaching children, pupils and students improved by us, i.e. STEAM training using information technology, online resources, platforms and computer programs created by us in the areas of continuing education (DOE + SCHOOL + UNIVERSITY). Figure 1. The STEAM Learning Connection Triangle is used in continuing education sections. Picture 1.:

Picture 1. STEAM learning communication triangle



We taught the children and thus reviewed the traditional method of using the teaching of children under the "Ilk qadam" - "Initial Step" program in preschool educational institution № 5 in Namangan. Then we held a master class on the use of the proposed methodology for teaching children, using the Froebel methodology with the use of computer programs for Froebel exercises, exercises on Seguin boards, on Montessori boards and other computer programs:

Exercises with multi-colored balls of woolen threads suspended from an iron rail, in multi-colored colors of the rainbow, a clear example of the movement of these balls on their threads, backward, forward, left and right;

- Exercises to familiarize children with various spatial figures: a cube, a parallelepiped, a ball suspended from a rail on a string, their movement backward, forward, left and right, up and down, observation exercises;
- Using an intellectual computer game of the Seguin board, an electronic method of using this technique;
- Using the mathematical game of the Montessori board, an electronic version of this technique;
- The first simple constructions in the Scratch program, mini programs, fairy tales, cartoons in the form of a game, outlining the implementation of each block structure, performing exercises with a mentor;
- Elements of modeling in the Tincercad program, work together with a trainer-mentor;
- Elements of programming in Python.

When conducting experiments for school children in schools in Namangan city № 31, № 7 and in schools № 23, № 24 of the Namangan region, in universities, we added material to the upper teaching methodology that should be taught to

schoolchildren and students in order to become the most trained small and highly skilled professionals, integrating science and knowledge in multiple subjects, including simulation, robotics and programming: Electrical Engineering at TinkerCad Circuits;

- Programming Scratch and C + ;,
- Mechanics in Algodoo;
- 3D modeling: Tincercad;
- onShape;
- TRIK studio-simulation of robotics;

Experiments were carried out and the results were calculated by the methods of mathematical statistics Chi-cavadrat [6].

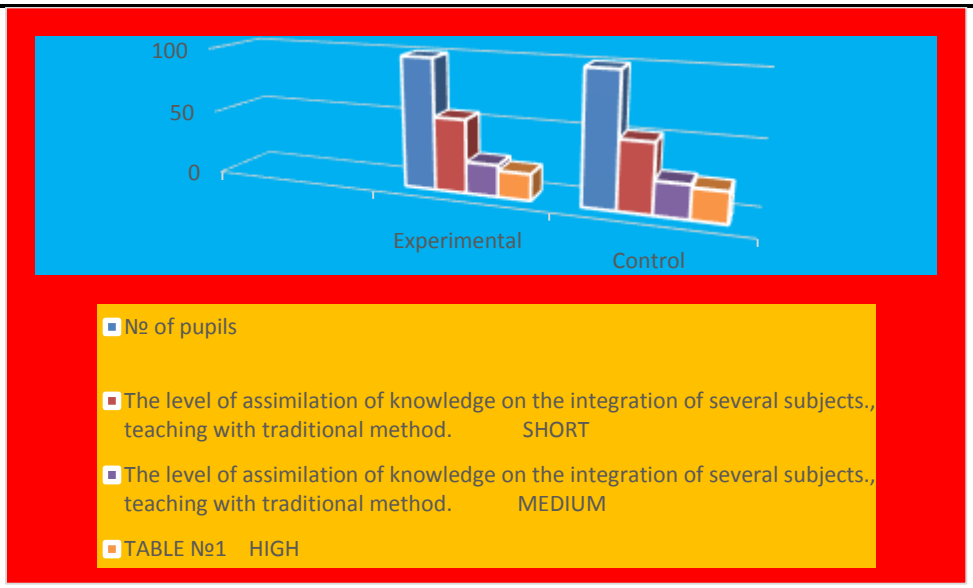
Consider the data obtained after conducting experiments in our study, use the methods of mathematical statistics Chi-square, look at the table of experimental data, and then apply the calculation formula and draw a diagram of the experimental data processing.

The level of knowledge of children when teaching children according to the traditional method according to the program "Ilk kadam" - "Initial step".

TABLE №1

№ of pupils	The level of assimilation of knowledge on the integration of several subjects., teaching with traditional method.		
	SHORT	**MEDIUM**	**HIGH**
100	56	24	20
100	52	25	23

Let's look at the following diagram, which clearly shows the dependence of children's knowledge on the criteria in the samples of the control and experimental



groups.

Calculations are performed according to the following formula:
Tobserved is the observed value (Table №2).

TABLE №2

Groups	№ of pupils	The level of assimilation of knowledge on the integration of several subjects Short	MEDIUM	HIGH
Experimental	100	12	30	58
Control	100	100	24	38

The following diagram clearly shows the higher level of learning when applying our proposed teaching methodology.
According to this table and diagrams, it is possible to establish an increase in the assimilation of knowledge, which proves the effectiveness of the application of our methodology:

Table №2

If according to the table from the source [6] we will compare with the value in the first method T observed <Tcritical, Tnab. = 0.5, Tcr. = 5.991. 5.991> 0.5. In the carried out method according to the second method, T observed = 18.3, it can be seen that this value is about 3.5 times greater than the critical value.

From these conclusions, we can conclude that with the strengthening of the components of STEAM training and the use of information technologies and computer programs, the result of mastering the material is much higher, and the activity of children turned out to be high. We conducted an experiment and used the method of statistical data processing according to the Chi-square test.

With this method, we conducted an experiment, teaching pupils of school №31, № 7, as well as university students and obtained similar results, which proved the reliability of our hypothesis of strengthening the learning of the components of STEAM education, which will lead us to the final goal of improving the efficiency of assimilation of knowledge in the integration of subjects and even more effective assimilation of materials using information technology and computer

Our work is of a pedagogical nature and is aimed at a person's whole life, so that later, when he becomes a specialist, he continues to work on himself and to learn, to improve his skills, his skills and intellect. As a result of our training, the application of the methodology for teaching children computer games and information technology, with the teaching of Scratch and Tincercad, as well as the use of Froebel's methodology, Seguin boards, Montessori and computer programs at an even earlier age, then abundant training in block programming

using Scratch, modeling in Tincercad and other programming skills in the Scratch and Python environment.

Further, we have developed methods of teaching Steam education using teaching computer science at an earlier age, and the same will create a continuous teaching methodology for Steam education, based on information technology and computer programs, as a result of which a new generation of future specialists will be formed, who will be comprehensively developed in all branches of science, technology, production, mathematics and technology, engineering and design, assembly of machines and robots for parts

Photo1. Assembly by parts of the object in robotics, the basics of design and engineering. Teaching children by parents. Or junior seniors.

Methods and Methodology

In our research, we used the methods of comparison and analysis of traditional teaching methods, conducted experiments on the correctness of our hypothesis of enhancing the learning of STEAM education components, subjects related to them, as well as related sciences on which these subjects are based. When conducting an experiment on the reliability of the hypotheses identified by us for strengthening the components of STEAM education, as well as improving the assimilation of these materials with the help of information technologies and computer programs created by us.

The level of knowledge of children when teaching children according to the traditional method according to the program "Ilk kadam" - "Initial step".

American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
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Table №1

Groups	Number of pupils in children's educational institutions	The level of assimilation of knowledge on the integration of several subjects		
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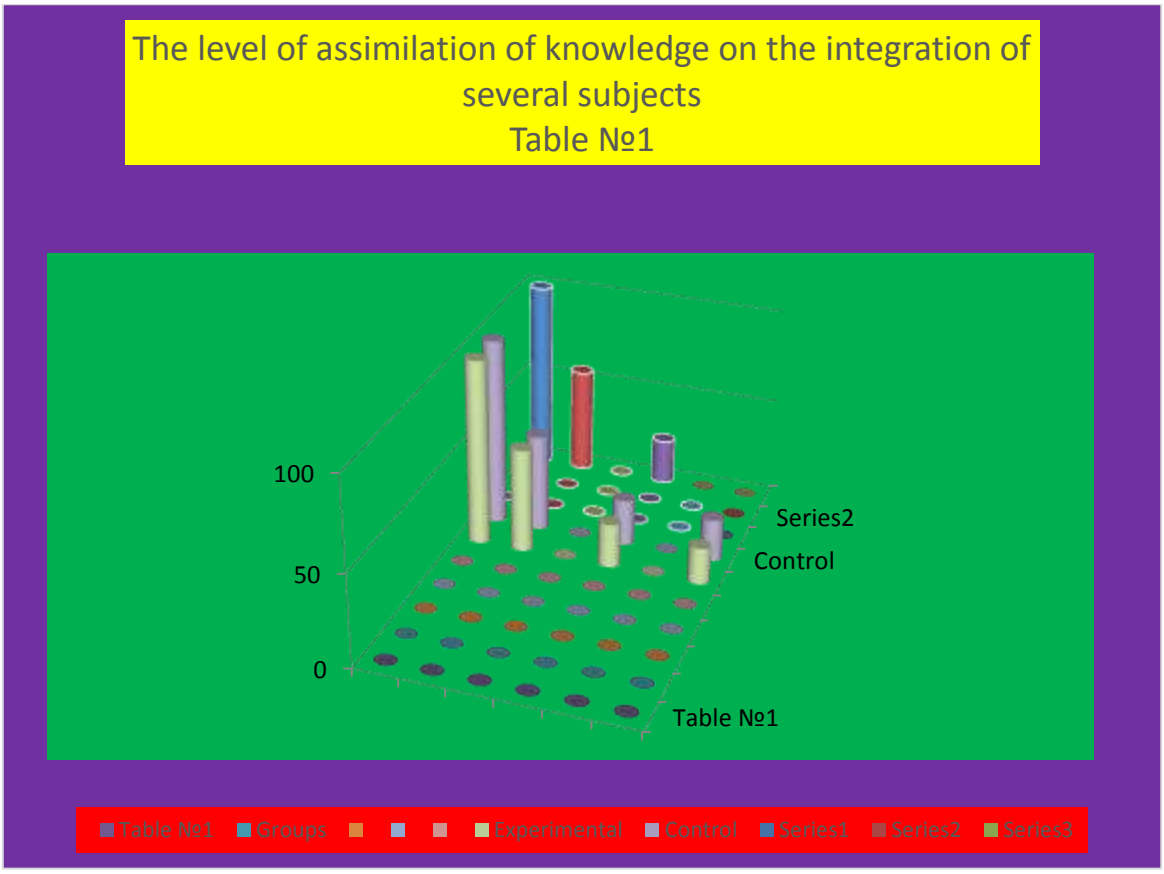
Control	100	52	25	23

Let's look at the following diagram, which clearly shows the dependence of children's knowledge on the criteria in the samples of the control and experimental groups.



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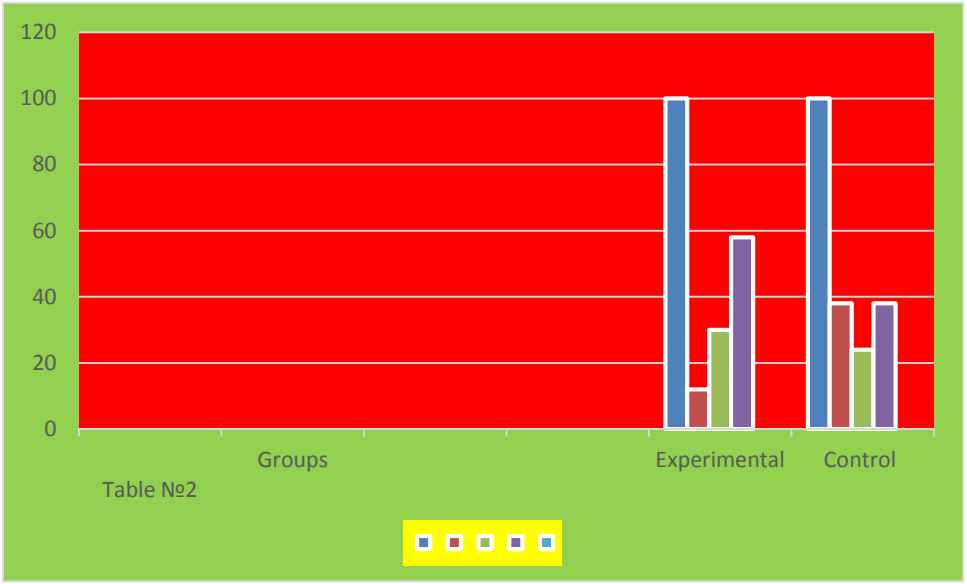

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Discussion

Analyzing the literature and getting acquainted with examples of robots created in different countries of the world, with the development of various types of robots: in Germany, China, Russia, Dubai, Korea, we think about the sketch of the robot we are using. And we think that it costs a lot of money.

Figure 4. A robot that can be controlled from a distance.

To do this, for young people to have certain knowledge and skills in mathematics, in instrumentation, in detailing parts of a machine or robot, in engineering, in programming, in using ready-made software and the ability to program in block devices of programs that can be translated into highly required programming languages as C ++, Python.

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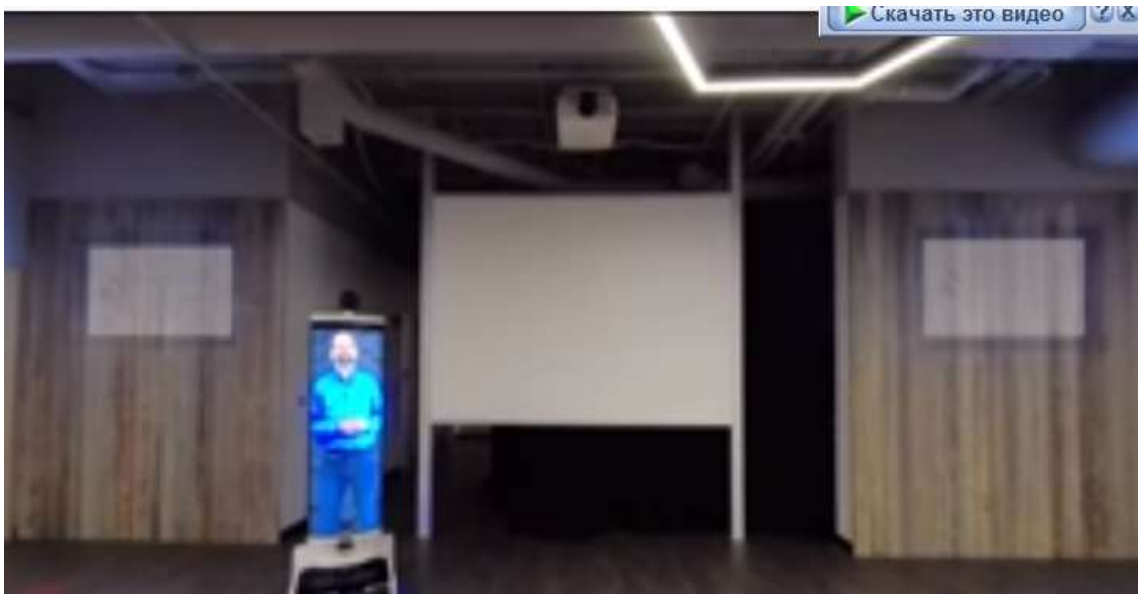

Figure 5. Robot assisting in teaching or presentations.

When you come abroad and see how robotic waiters are serving you or a robot making coffee and serving you, you involuntarily think about creating such robots that work not only in industry, but also in education, in everyday life and in household work.

Figure 6. A robot preparing and bringing coffee. Dubai.

Integral parts of robotics are such areas that are included in science: electrical engineering, programming, mechanics, circuitry and 3D modeling. The knowledge gained in these areas will allow students to move on to creating a

virtual robot model in a special simulation environment. Children can create a working model of the robot and test it in many different programs, for example, when the robot moves in a straight line, when it moves along a black line, or along a white line.

Students should receive step-by-step knowledge of how to create a robot: from modeling the case to creating and programming in a virtual environment of an autonomous electrical device, so that students can link their knowledge into a single project and implement a simulation model of a real robot in real-world conditions. For this, the student must master a number of programs and knowledge on them

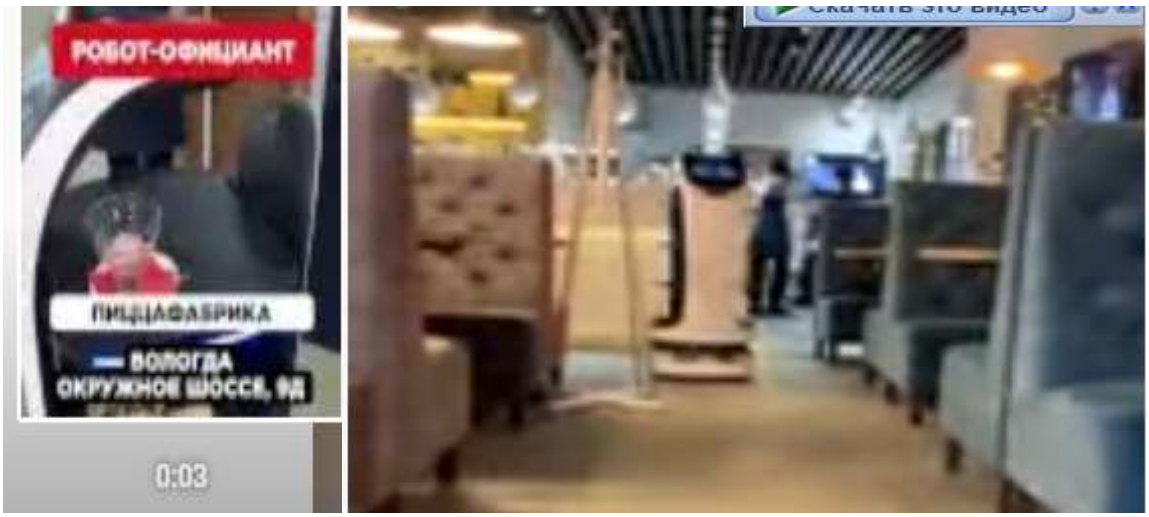

Figure 7. Robot waiter.

First is the Electrical Engineering program at Tinkercad Circuits.

Secondly, every student must learn the basics of programming in Scratch and C ++, Python. Thirdly, he must get knowledge of Mechanics in Algodoo, know 3D modeling (basic course in TinkerCAD and advanced course in onShape), and also must be familiar with Simulation Robotics in TRIK studio.

Electrical Engineering at TinkerCad Circuits.

Electronics helps to give knowledge about how the robot works, its movement, what programming languages it operates in, for example, it requires knowledge of programming in Scratch, C ++, python. In the study of electrical engineering using TinkerCad Circuits, an environment that simulates the operation of electrical circuits. In this part of the robotics course, students will become familiar with the main electrical components: resistors and buttons of various types, LEDs, light bulbs, capacitors, electric motors, galvanic cells, and others.

Pupils will study the principle of operation of each of the listed elements and understand how they work. In addition, at this stage, children will master basic concepts such as: current strength, Ohm's law, parallel and series connection of elements in electrical engineering, voltage, resistance, and others. Students will instantly master the theoretical knowledge gained in practice, assembling electrical circuits with many elements in the TinkerCad Circuits simulation environment. They will learn how to use a virtual multi-meter to test student-assembled circuits. At the heart of robotics and electrical engineering, students will get acquainted with the most famous board for creating robots and smart home systems - Arduino.

Studying this part of electronics, pupils or students will program a seven-segment indicator, learn how to determine the level of carbon dioxide in a room (using a sensor), create a smart parking system (with a distance sensor) and many other projects that include working with sensors and programming.

Students 10-13 years of age and older should gain experience with LED strip, LCD displays and servo motors. Having mastered these electrical components and how to interact with them, children will be able to independently assemble an automatic lamp, a lighting system in the room (on addressable LED strips) and many other devices. In addition, they must learn to work in a 3D printer, learn the basics of creating a robot in parts. They should understand well the structure of the arms and legs of the robot, the function of its work and movement, the composition of the wires, etc.

2. Programming Scratch and C ++. The creation of a robot cannot be imagined without programming. It is the code that the developer puts into the microcontroller that turns an ordinary electrical device into an autonomous machine that makes decisions on its own. As part of this module, children acquire key skills in the visual programming language Scratch and learn basic programming tools - conditions (simple and complex), loops (infinite and with a

finite number of repetitions), learn to work with variables, understand what arrays, procedures, and function

After studying the materials and basics of programming in Scratch, students will immerse themselves in the basics of programming and the process of writing games. At this stage, children will create virtual models of game objects, master the process of creating character animation, changing costumes, learn to program the behavior and interaction of their favorite hero so that he can run, jump, shoot, catch up with others and perform many other actions at the same time.

The key project that unites the programming skills acquired by the child is the creation of a workable version of the popular games "Shooter", "Catch-up", "Dinosaur", "Cats and Mice", "Parrot Banana" or "Fruit Ninja". After that, the child will be able to independently write almost any games in Scratch. The acquired skills of programming virtual objects can be well applied to real robotic devices.Children 10-13 years old will also learn the basics of programming in the most common language for programming microcontrollers - C ++. They will need this in order to program the interaction of the Arduino controller with the LED strip, LCD display, IR remote control and keypad when studying advanced electrical engineering. It is necessary to write a program code to move the robot along a straight line or along a black line, etc. You need an Arduino board on which you can program using Scratch, C ++, Arduino.

At the end of the educational block, having received knowledge of mechanics, children will begin to master the laws of translational-rotational motion and implement a key project that combines all the skills they have acquired - they will independently assemble the mechanism of a walking robot.

3. 3D modeling. This requires the ability to work in the Trencercad program and use the Scratch program blocks in its environment.

In robotics, the study of simulation is essential. After all, every detail of the robot, from the body to the wheels, is initially developed in a virtual environment and only then, according to drawings and models, is transferred to the real world. It has been and will always be so. Pupils and students find it difficult to learn the basics of 3D modeling. There are still more advanced modeling programs, but at the initial stage we offer a program

Trincercad. TinkerCAD is a free tool and can be used by beginners as a simple environment to build their first 3D objects and prepare them for 3D printing.

During online classes, children will learn how to create models of varying complexity, transfer objects from real life to a virtual environment, use precise dimensional positioning when building models and analyze the mobility of objects. Also, children learn to read various drawings.

Required knowledge in on Shape , However, the modeling limited to the TinkerCAD environment is not enough to work confidently with 3D models. Therefore, after creating complex models, students will move on to a more serious level and learn how to work in onShape. onShape is a professional cloud-based computer-aided design (CAD) system.

4. Simulation robotics at TRIK studio. At the end, students will combine all the knowledge gained in electrical engineering, programming, mechanics and modeling classes and start working in a specialized environment that simulates robot behavior - TRIK studio.

In this environment, children learn to build special algorithms to perform specific tasks, for example, driving a robot along a line, along a white line or black line, white and black line.

At the end, students will combine all the knowledge gained in electrical engineering, programming, mechanics and modeling classes and start working in a specialized environment that simulates robot behavior - TRIK studio.

In this environment, children learn to build special algorithms for performing specific tasks, for example, driving a robot along a line, along a white line or black line, white and black line. As part of this block, students will get acquainted with proportional, differential and integral controllers, learn how to create programs, using which the robot will get out of any maze, help a person collect waste on the street, clean the yard from glass and debris, clean the room

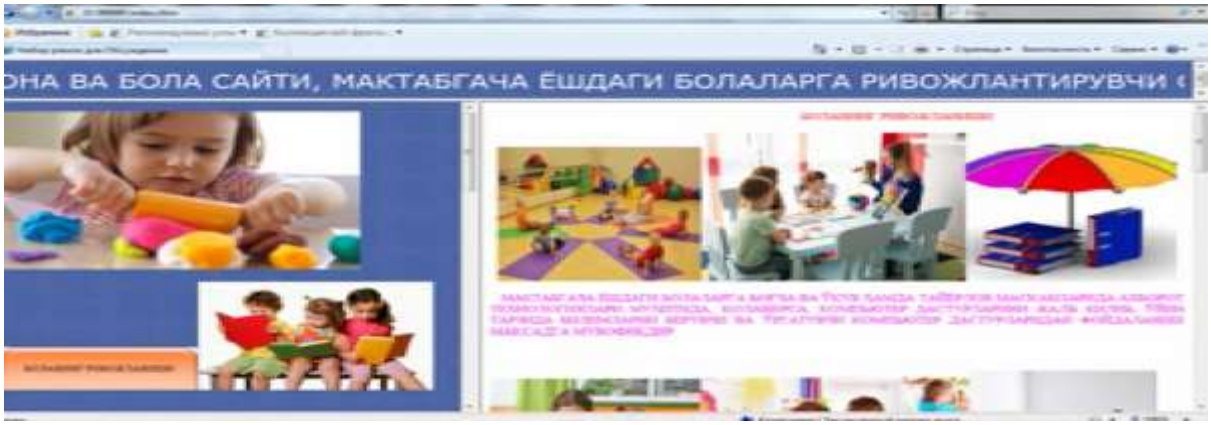

Figure 8a). We have created a website for children aged 1 month to 7 years, for

learning from 3 years old with their parents and up to 1-year-old to monitor the development of the child and compare it with the development standard for each month.

Conclusion

STEAM-based education should continue in all areas of lifelong education, especially they gave good results when using information technology, the Internet and online, e-learning, the multimedia use of computer programs helped to better assimilate the material, since STEAM education itself provides simultaneous material on several subjects.

The hypothesis of the development of Steam education through the development of the components of such an education, as well as our hypothesis of the use of information technology and computer programs in continuous areas of education, prepares young people, future specialists who are most deeply versed in electrical engineering, engineering, modeling, robotics, information technology and computer programs, in programming languages with programming skills from simple block structures to programming in Python or C ++ in Arduino.

Figure 9. Conducting master classes for informatics teachers on STEAM education.

Acknowledgments

We have gratitude and certificates from the intellectual property agency for the training seminars and master classes we conducted in preschool institutions and schools with the use and implementation of our proposed teaching methodology

in the STEAM environment using computer programs and information technologies to increase the level of mastering several subjects simultaneously.

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