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Strengthening the Integrated Steam of Technologies in the Environment of Information Technologies and Computer Programs

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AnnotationThis article reveals the aspects of strengthening integrated learning in the content of STEAM learning technology by means of information technology and computer programs. The author submits the idea of earlier teaching computer science, teaching children, together with their parents, programming in the Scratch program and in the Python programming language based on different methods, divided by age and intellectual characteristics of children, i.e. here we are talking about the training program for preschoolers, school students and finally graduate students, who will teach computer science and information technology in the future. Preference will also be given to additional education, circle lessons aimed at teaching and learning subjects in the style of STEAM technologies in continuous areas of education.

And this is based on the fact that after graduating from school or university, graduates should be able to continue working in a production facility equipped with new equipment and technologies and be able to apply their knowledge in information technology and programming, in using a finished software product. Future specialists should be able to build a smart home, smart apartment, Smart technologies in the future. To be able not only to build and plan, but also to calculate information technology, create a program and insert it into the right place. Ator points out that there is a problem of education and training of specialists who are ready in all areas of education, covered by many subjects and their secrets.

Key words: STEAM education; STEAM training; Smart House; Smart apartment; Smart technologies; improved Froebel technique; Seguin boards; Montessori; Scratch program; Tincercad; Electrical Engineering at TinkerCad Circuits; Programming Scratch and C + ;, Mechanics in Algodoo; 3D-modeling: Tincercad; onShape; TRIK studio-simulation of robotics.

Introduction. At the present time, when it becomes a requirement of the century to improve the living conditions of a person, the task is to make his life and even the conditions of his working environment comfortable, easy, so that a person can live happily and beautifully. To create such conditions in the workplace, in everyday life and in life, specialists are needed who could build smart houses, apartments, technologies. One of the tasks of fulfilling such a problem is to train specialists who are trained in various fields: mathematics, physics, computer science, engineering, technology, information technology, programming, robotics.

And we are faced with the problem of training future specialists in the field of these sciences and technologies. And for training in this direction, we will use STEAM education, use its methods, develop its directions, or, if I can say its consisting, science and technology, education and mathematics, robotics and programming at the level of art and skill, and applying the art itself separately too. It is possible, for example, to teach future specialists the art of programming, assembly of machine parts, equipment, information systems, and robot parts.

In order to improve the life of people or humanity in general, it is necessary to build smart houses, smart apartments, Smart technologies, modern robots, which have already begun to be used in education, in services

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and in everyday life. It is necessary to train highly qualified specialists who are proficient in several areas at once. Currently, not all school graduates become students, nor can everyone enter universities. But on the other hand, they will be able to work and this is where they will need the knowledge that they received by studying the STEAM method, in various areas of science and technology, education and mathematics, physics and computer science, programming and robotics, in order to continue their work in highly specialized enterprises or high-tech corporations with modern equipment and instrumentation. For the construction of smart houses, apartments and technologies, robots, knowledge is needed in the integration of basic and related sciences, as well as the strengthening of integrated learning and STEAM education. The latest information technologies and computer programs will help us in this. We need to strengthen the components of STEAM education, the fields of sciences and related sciences, and this process we mean to strengthen and increase its efficiency, improve the use of information technologies and computer programs created by us, as well as created or more improved teaching methods in this area.

Who can teach computer science along with physics, study robot parts, as well as engineering, instrumentation, machine assembly. This requires knowledge of technology, robotics and programming at the level of modernity, the requirements of the century and at the level of using skills and art, as well as art separately for creative creativity and the use of good results. The problem of personnel training has always been an important policy of every state. And the training of highly qualified versatile trained small specialists and highly professional specialists with higher education is one of the most urgent tasks. Every person, no matter what education he would have, general secondary or higher, should be in demand at high-tech enterprises, corporations and should be easily versed in science and technology, technology, production, detailing and engineering, invention, should be a highly demanded specialist. Here the task of training such specialists arises, as well as the preparation of materials and the development of training methods for such comprehensively trained specialists. This issue is considered one of the most relevant in pedagogy and the scientific novelty is that an improved methodology for training future specialists has been created, through partial use of teaching computer science or programming children from an early age, in the form of a game, conversation, design. We got good results, where the indicators of the assimilation of materials by children, pupils and students reached their climax. The results of the study proved our hypothesis of improving the level of assimilation of sciences in an integrated form in the STEAM learning environment, the level of assimilation of integrated learning depends on the strengthening of the learning of its components, its sciences and subjects, as well as related sciences.

And this is precisely where information technologies and computer programs created by us, and our improved methodology helped us. We had to explain the structure, the content of training in order to receive, in the end result, highly qualified and in-demand specialists. 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. 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

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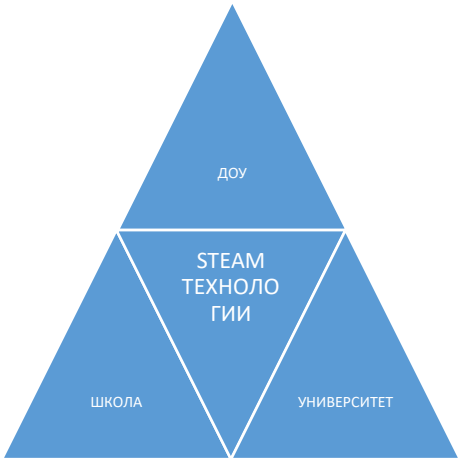

We taught the children and thus reviewed the traditional method of using the teaching of children under the "Ilk kadam" - "Initial Step" program in preschool educational institution # 5 in Namangan. Then we held a master class on the use of the proposed methodology for teaching children, using the Froebel 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 schoolchildren 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".

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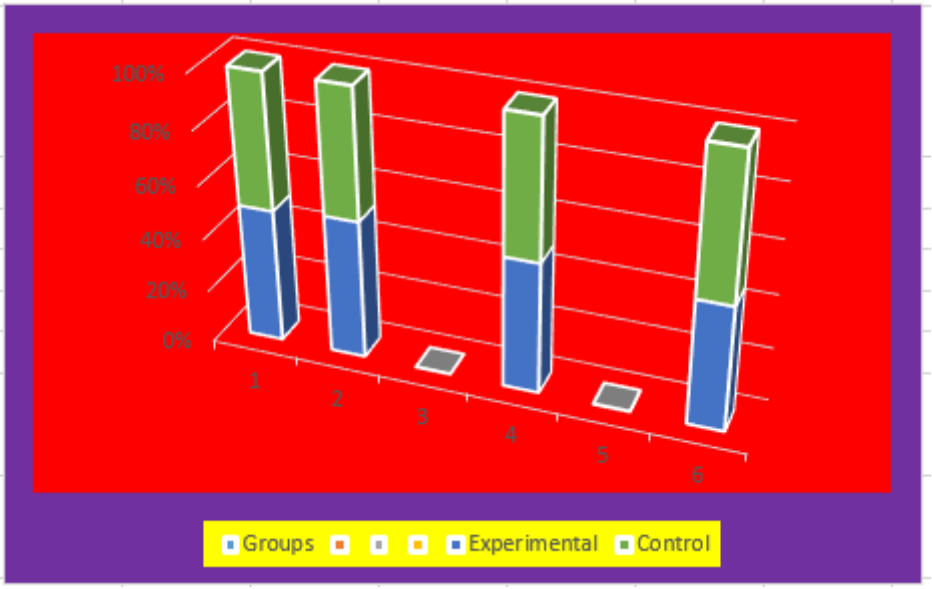
Table №1				
Groups	Number of pupils in children's educational institutions	The level of assimilation of knowledge on the integration of several subjects		
		Short	Medium	High
Experimental	100	56	24	20
Control	100	52	25	23

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.



Calculations are performed according to the following formula:

$$T_{кузэ} = 1/n1^{*}n2^{*}\sum_{i=1}^{C}\frac{(n_1{}^{*}Q_2 i\ n_2{}^{*}Q_1)^2}{Q_1 i + Q_2 i} = 0{,}5$$ where T_{kuz} is the observed value (Table №2).

Table №2				
Groups	Number of pupils in children's educational institutions	The level of assimilation of knowledge on the integration of several subjects		
		Short	Medium	High
Experimental	100	12	30	58
Control	100	38	24	38

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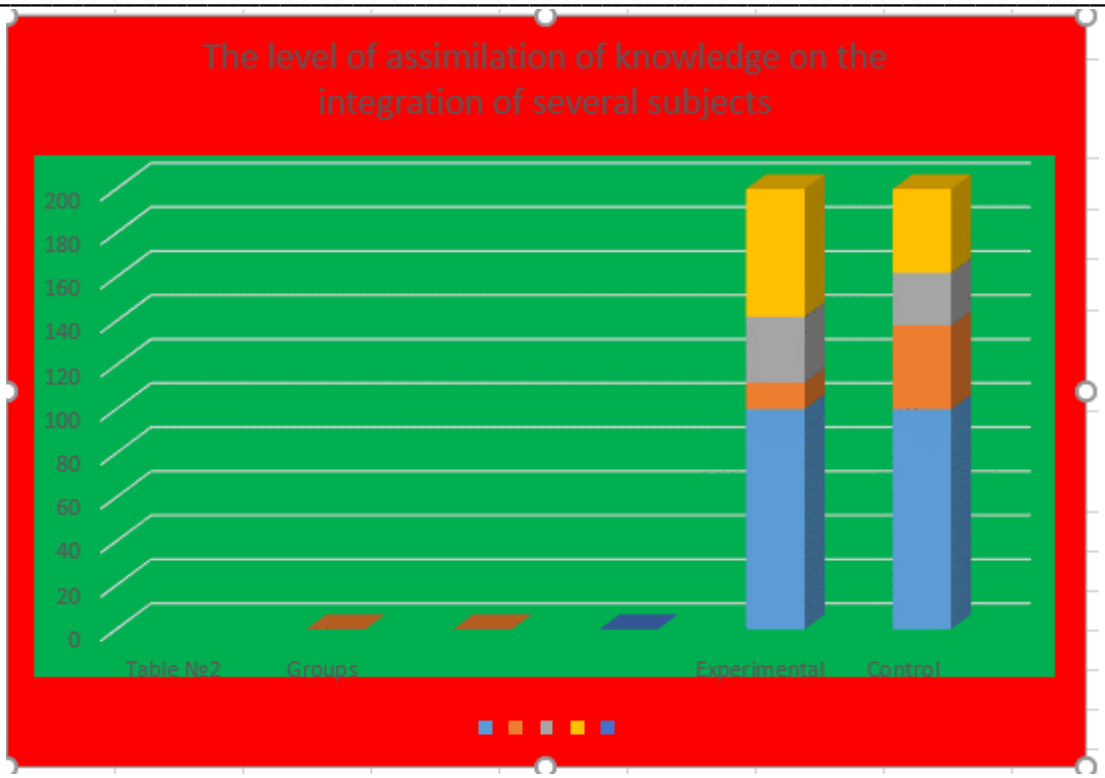

The following diagram clearly shows the higher level of learning when applying our proposed teaching methodology.

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:

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 programs.

Literature review

Making a review of existing sources and books, educational resources and Internet resources on computer science and methods of teaching it, of course, we note the main works of major scientists who have made a huge contribution to the development of computer science and the methodology of its teaching both in our country and in foreign countries, in Russia, one cannot but mention the works [1,2,3, 10,11, 15,16,19,20,21]: Abdukodirov A.A., Aripov M.M., Yuldashev U.Yu., Zakirova F.M., Ershova, A.P., Belova G.V., Pervin Yu.A., Khusanov K.O., in the field of programming, I would like to mention the works [7,8,11,12,16,17]: Gaddis T, Dawson M., Lutz M. and many others. Among them, I would like to separately emphasize the work of methodologists involved in the early teaching of computer science or programming [3,4,5,7,11,14,16,20], [21-25, 26], Bokuchava TP, Belova G.V., Velikovich L., Tsvetkova M., Goryachev A.V., Volkova T.O., Gorina T.I., Pervin Yu.A., work in the field of web applications of educational materials, as well as an educational platform for teaching children, as well as work on the early education of computer science: Khusanov K.O ., Yudina A., Yunusova G.N., on working with schoolchildren in the field of computer science and on teaching programming in elementary school [27,28]: Yashuev R.N. Yakhovsky N.G.

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Analyzing the materials and articles of modern scientists [16], we determined that some of them "consider the problems of developing and using web applications of educational materials", [16, p. 17]. To the question for what technologies are needed, the answer is the following: "it is advisable to use technologies for expansion, enrichment, implementation, individualization, etc. etc. ", [16, p. 17], means they are needed for a more convenient and flexible organization of improvement of materials, individual assimilation or learning with everyone in a group.

Being engaged in the methodology of STEAM technologies, its improvement, thinking about the secrets of integrated education, we came to the conclusion that continuous and at the same time non-intrusive teaching of children in this direction from childhood was necessary, we worked on a method of teaching children the necessary knowledge in preparation for school [22-25], and further with the help of additional education or training in existing circles, the necessary knowledge in the formation of a small specialist, because it is no secret to anyone that after graduation, not everyone will become a university student.

And in order to get a profitable job in an enterprise with high-tech equipment or in a corporation with highly qualified personnel, knowledge is needed in the integration of science and technology, production and mechanical engineering, in technology and programming, in modeling and robotics, even if this is necessary for the needs of artificial intelligence too.

And so that the graduate in the future does not face such a problem and does not look for special courses in the development of all sciences and innovations, it is necessary to organize such training from a young age, in a preschool educational institution with mentors, at home with parents, keeping in mind the age and mental characteristics of children.

This idea is presented in papers [22,23,24,25].

The work [25] reveals the effective ways of using "computers and computer games for preschool children using the latest technologies and methods in order to", [25, p.8] to increase their level of knowledge. It is here that the idea of "development of memory and logical thinking of children from an early age" is presented with the use of computer programs, [25, p.8], which can be continued with children at the next stages of their development, using Scratch, Python programming, since it is by working in these programs that children can further develop their logical thinking.

Discussion

You are probably wondering how we conducted and continue to conduct our training in an integrated environment, starting with children and continuing through the whole life of a specialist, learning in an integrated environment of subjects, science and technology, information technology and programming. In early childhood, we offer games with lego-construction, developing the logic of children, developing their intelligence and knowledge in understanding colors, paints, in solving some problems for assembling puzzles, for building houses from cubes.

Further, these exercises gradually become more complicated and at some period reach the performance of exercises with Seguin boards, i.e. we can select the smartest children and work with them separately, and separately developing and lagging behind, so that they reach the level of more active and purposeful. Even in early childhood, we propose to use Froebel's method to develop the mental abilities of children, i.e. we strive to influence his thinking through his senses: sight, touch, we show them seven identical seven-colored glomeruli suspended from an iron rail, suspended from threads of the same color.

And we start demoing them by moving them to the right, left, up and down. You can throw them up, while organizing the observation of children what happens to the hanging ball, then there is a discussion of this demonstration, each child can be asked what he saw, all the answers are carefully listened to. Then you can use a computer program or video resource with a demonstration of this exercise and the children's responses to what they observed. After completing these exercises, at the next stage of their learning, children are shown three types of objects: a ball, a cylinder and a cube, you can also enter a parallelepiped here.

Showing the child the sides of the edges of the parallelepiped, count with them, show that the ball is round and ask what it looks like, show other objects that are in the form of a ball, cube and parallelepiped. Then you can use an electronic resource with a demonstration of this exercise. Or use a computer program for this exercise.

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After that, together with the children, discuss the exercises and draw conclusions together. Further, after the children got acquainted with the colors, they have a clear definition of the difference between colors, they understand what dark blue and light blue are, etc. You can move on to exercises teaching numbers, a certain amount of time is also given to this process until the children achieve the necessary knowledge and skills, then we move on to teaching mathematics, its basics, addition, subtraction operations, using the Montessori technique and boards.

Children must take this course at a specific time until they learn to count quickly. Further, using the programs created by us, you can teach children the alphabet of three languages: Uzbek, Russian and English, or even the alphabet of five languages: Uzbek, Russian, English German, French or 7 languages: Uzbek, Russian, English, French, German, Chinese, Japanese and Korean ... But we offer the last 2 methods to the most advanced children, because I would not like to overload the child either, so everything is used here in a playful way, with the help of computer programs

At this stage, you can use the computer program "Computer + Memory + Logical Thinking" to improve the logical thinking of children, to develop their logic, analysis and comparison, as well as the ability to draw conclusions and conclusions. During this period and a little earlier, a child with his parents can learn to work in the Scratch program, you can create some kind of stories and cartoons, choosing different characters, except for the Cat-Scratch, write together with them block constructions of a story or cartoon and discuss with them and explain the action of each construction, also, parents can show ready-made programs for outputting pictures in Python, and then explain how pictures or a very beautiful pattern came out on the screen, i.e. at the level of skill and art, to give children the first basics of programming. You can use computer programs to take the first steps, performing the first writing exercises, displaying letters of the alphabet in a computer program. And so is the preparation of the child for school.

In the first grade, the child fully adapts to the school, to the environment, finds new friends and adapts to his teacher, to the requirements of the school. Learn to write, count, teach the alphabet, i.e. he repeats the knowledge that was already given to him in the preschool period. In the first grade, children who have studied the alphabet of their native language during the preschool period will find it easy to learn it and improve their knowledge.

After graduating from the first grade, parents can give their children the basics of 3D modeling, teaching them to work in the Tincercad program, they can easily study the geomeric figures of the plane and in volume, i.e. in three-dimensional space. In the second grade, it will be much easier for these children to learn the material related to teaching the alphabets of Russian and foreign languages. Here we offer as an additional assignment to engage with children to continue learning how to work on the Scratch program. And to repeat to look at patterns, drawings, displayed in the Python program. Start taking your first steps. With the explanation of each line of code by his parents or mentors, while the child does not have to write the code himself. He starts writing his block constructs in Scratch. And this process does not last long. Let's go back to this teaching in grade 4. We will teach children to program with block constructions, working on their logical thinking. It will be easier for children in the 5th grade to understand construction in Scratch, because they already know her, they know her. And they will be happy to complete the tasks of the textbook with their computer science teacher

At this age, it is proposed to teach children to complete various math problems in Python so that children can represent linear constructs, smoothly moving to branching and looping programs. You can take these children in grades 6-8 in centers for additional education or in additional lessons or circles in computer science. In the 9th grade, a child at a higher level can start learning on his own, programming deeper in the Python environment. And until he finishes high school, he should have a background in programming in this programming language.

In a higher educational institution of computer science, they study C ++, C #. This is where they will need their knowledge of Scratch and Python, because Scratch supports Python and C ++. But for a deeper study of everything there is to know, we offer additional education for school graduates and students in TinkerCad programs and master courses: Electrical Engineering in TinkerCad Circuits; Programming Scratch and C + ;, Mechanics in Algodoo; 3D-modeling: Tincercad; onShape; TRIK studio-simulation of robotics.

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Results

As a result of our classes and lessons, as a result of our teaching for several years, we managed to raise more advanced children, using the example of students who easily work in computer programs, using them themselves in teaching alphabets, in studying modeling, due to systemic learning according to our methodology, the knowledge of our pupils has increased, their level of knowledge, preparedness for the most difficult tasks and exercises has risen, as a result of such classes, children have become much prepared for school.

Experiments carried out among preschoolers, schoolchildren and students gave good results in using the proposed methodology, but the best result is given by the teaching methodology under the "Ilk Kadam" program in the Republic of Uzbekistan, applying together the proposed methodology. As a result, I would like to say that the combined method gave the best result.

Conclusions

Based on our conclusions, we can draw a number of significant conclusions in the field of the use of integrated learning, the use of STEAM education in continuous areas of education:

- STEAM education gives good results for its application in all areas of continuous education: preschool educational institution, school, university;
- Strengthening the components or modules, as well as the use of information technology, computer programs enhances the process of assimilation of the integrated material;
- STEAM education requires knowledge of physics, biology, programming, engineering and technology, information technology, modeling and programming;
- STEAM technologies require knowledge of innovations in science and technology, programming, knowledge of assembling parts, machines, robots, as well as the ability to use ready-made programs and slowly teach how to create your own computer programs for in-depth training of certain aspects of application in production, robotics, programming your knowledge.

Conclusion

In the near future, high-tech enterprises, highly equipped production will need specialists knowledgeable in various areas of science and technology, technology and mechanical engineering, in the creation of robots, machines, various SMART technologies, information systems used in the management of modern houses, apartments, SMART cities, in building them and launching information systems to control a smart home or apartment, its ability to open and close blinds, watering flowers, spying on the house, and protecting security. The application of the above proposed methodology in lifelong education, starting from childhood and continuing this training and further throughout a person's life and continuing his whole life, will serve as a solution to the training of such highly qualified specialists and comprehensively trained, well-versed personnel.

Acknowledgments

During the period of our research, we conducted master classes and training seminars at preschool educational institutions for children and their parents, students at schools, students at universities. It was interesting for children and pupils to participate in the lessons, they worked with interest in computer programs. And we found that the effectiveness of integrated learning, STEAM education can be even more enhanced by the use of information technology and computer programs.

We received letters of commendation and gratitude for conducting master classes and training seminars with children of preschool educational institutions and schools with the participation of methodologists and educators, as well as parents of the educated and students. We received approval and gratitude from educators, methodologists and trained parents.

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