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FEATURES OF TEACHING ROBOTICS TO PRIMARY SCHOOL STUDENTS IN THE CONTEXT OF SMART EDUCATION

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ABSTRACT

The article carried out a theoretical analysis of the concepts of" robotics"," information and educational environment"," intellectual learning", the Constituent structural components of robotic training. Currently, the robotics course is one of the most relevant subjects for studying in elementary school. The development of creative abilities of high school students, the development of manual mechatronics from a young age, and a certain contribution to group and pair work will undoubtedly lead to significant results. It is also noted that teaching robotics to primary school students contributes to the development of an information culture, as well as the skillful study and processing of information, the use of modern technical means and methods. In this regard, the connection of the theory with the practice of its application on the way to turning the acquired knowledge into a real product is important for the educational activity of the teacher.

Keywords: Smart - Education, Robotics, Primary School, Curriculum, Robotics in Education.

"The main components of technical culture are technical literacy - technical knowledge and skills of students, technical competencies - basic, basic and special knowledge, the formation of which is necessary during the period of study at school. The main goal of the development of technical culture is the formation of a technically, technologically and computer literate person with the necessary knowledge, skills and abilities that meet the needs of the modern high-tech Information Society" [1].

The introduction of new methods of education and upbringing, educational technologies at the levels of basic general and secondary general education, increasing the acquisition of basic skills and abilities by students, their motivation for learning and participation in the educational process, as well as updating and improving the content of methods of teaching the discipline "computer science".

Design activities are widely introduced into educational practice. Design activities related to robotics contribute to the qualitative development of technical literacy of students.

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Insufficient methodological support for the formation of the foundations of project activities of schoolchildren using educational robotics actualizes the importance of the research topic.

"The project method is widely known and has long been used in World pedagogical practice. It was first described in 1918 in the book "The method of projects" by the American psychologist and educator William Kilpatrick, but it began to be used much earlier.

The project method spread very quickly in the United States, in the countries of Northern and Central Europe. It has earned the reputation of the most effective teaching method, especially when it comes to such academic disciplines that provide one or another practical activity. In the United States, it is used in schools where the ideas of Constructivism, a problematic approach to learning and research methods are being implemented. However, despite such wide popularity and a long history, there are still many ambiguities and contradictions in its interpretation, and therefore in its use.

In recent years, the method of projects has been revived in the Russian education system, but in a new quality. At the same time, we still do not have a clear idea of the essence of this method. Therefore, a project in real pedagogical practice is called a variety of activities. The ambiguity of the interpretation of this or that concept always reduces the effectiveness of its use " [2].

The project method is an innovative teaching technology in which students, step by step, independently, under the guidance of a teacher, receive new knowledge in the process of planning, developing, performing and producing complex tasks, aspects of the problem"[3].

The project is a way to solve some problem of personal importance for the student, which involves the use of all learned teaching methods and all available knowledge in various fields of Science, Technology and the creative sphere. The result of this work will be a found way to solve a problem that will be interesting and important not only for the student, but also for other children, and possibly adults" [4].

The competent, conscious use of the project method in the joint activities of students and teachers can bring a fundamentally different system of communication to the educational process in comparison with traditional teaching, a fundamentally different approach to cognitive activity based on respect for the intellectual and creative capabilities of students, cooperation, self-critical thinking" [5].

"The project is a work aimed at solving a specific problem, achieving a pre – planned result in an optimal way. The project can include elements of reports, abstracts, research and any other types of independent creative work of students, but only as ways to achieve the result of the project. For a student, a project is an opportunity to maximize their creative potential. This is an activity that allows you to express yourself individually or in a group, test your strength, apply the knowledge gained, make a profit, show the result achieved to the public. This is an attempt to solve an interesting problem that the students themselves have compiled. The result of this activity The found way to solve the problem – is experimental in nature and is important for the discoverers themselves.

And for the teacher, the educational project is an integrative didactic tool for development, teaching and education, which allows you to develop and develop specific skills and design skills: problematization, goal setting, action planning, reflection and introspection, presentation and self-presentation. As well as information search, practical application of academic knowledge, self-education, research and creative activity" [6].

"Project activity is work on a project that includes the following steps:

- project start;
- setting goals;
- planning of work on the project;
- practical work on the implementation of the project;
- project documentation;
- presentation of project results;
- student's portfolio.

Before starting a project, the teacher discusses project ideas with the students. The topic is selected and the reality of the expected results of the project is discussed. The role of the teacher is very important here, he must summarize the topics of projects that are relevant in terms of the subject being taught. The teacher can be advised to formulate more than 10 possible project topics for each class, using your literature and professional experience, and then conduct a discussion" [7].

"Discussing the possibility of completing a project with a student can help discourage him. If the guys want to submit a project for any competition, be sure to get to know them. They may be interested in talking about their projects in the lower classes. Interested parties can take part in the discussion: parents or the school administration. In fact, the main active link in project activities should be the schoolchildren themselves, so the topics and tasks themselves should be suitable for them. Therefore, projects should not be scientific, but educational, cognitive and research in nature. At the same time, it can be noted that within the framework of the implementation of project activities, the formation and development of almost all types of universal educational activities is taking place"[8].

"The goal of any work is a" model of the future " in the form of a final result, Product, Service, data set, staging, the greatest difficulty for students is associated with a description of what they want to do, what should happen as a result of project work. Figure 1 shows the goals of the project according to the" SMART " approach.

Robotics is a production technique based on the use of robots. "Robotics in the educational program of the school is at the initial stage of formation, and the circle movement in the technical direction, in particular robotics. Yu. a. Skurikhina in her work" methodological principles of teaching robotics in the framework of classroom and extracurricular activities " claims that at present there is no single established methodology for teaching robotics, but there are successful teaching practices that contribute to the formation of a technical culture of students [11].

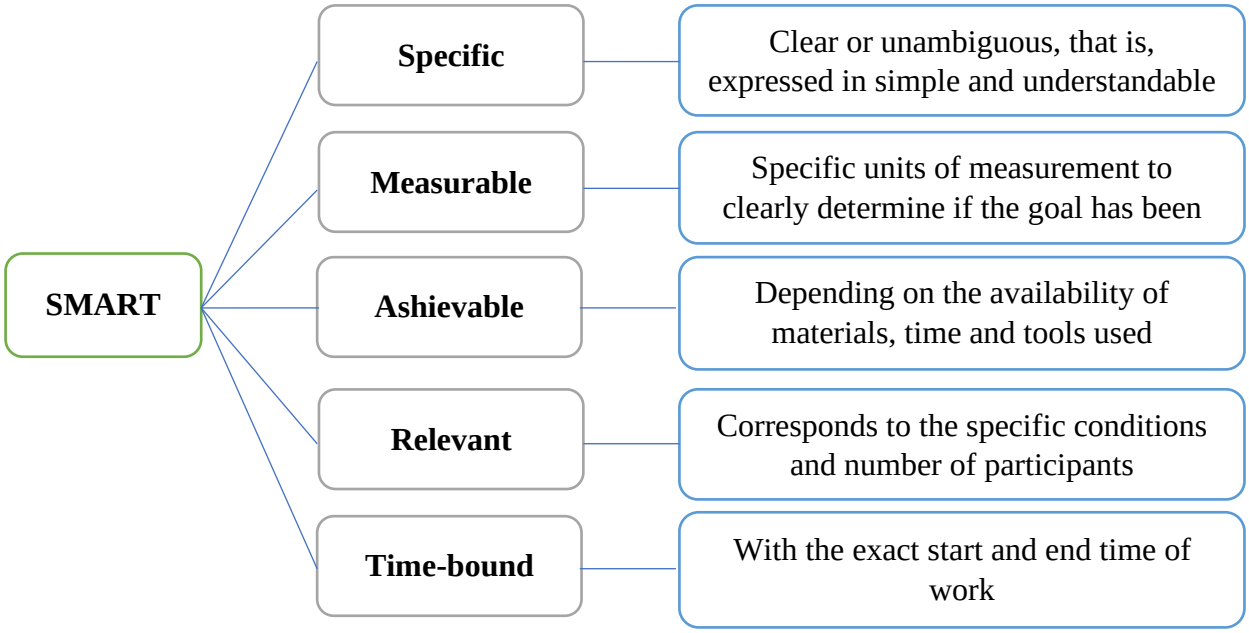

Figure 1: Project Goals According to The Smart Approach

It has been included in the curriculum of the school of robotics in Kazakhstan since 2017. This fact makes Robotics a full-fledged academic subject of the school curriculum from the subject of additional education. This means that schools are faced with the task of finding qualified specialists who are ready not only to conduct classes in the subject under discussion, but also to solve the global problems facing the education system. In turn, many teachers with experience in teaching robotics began to publish articles in scientific journals, increasing their work and manuals in books.

The question of the place of educational robotics in the fundamental training of future computer science teachers is necessary to justify the need for robotics training, to identify the main conceptual directions in the content of robotics training.

Zh. K. Nurbekov, A. Asanova, etc. studied the aspect of introducing the robotics course at school in their research. The most relevant is the use of robotics as a teaching tool for the integration of interdisciplinary knowledge such as physics, mathematics, computer science, programming. Here we are talking about competence in the field of robotics, which is part of the competence of students of a physical and mathematical profile. Many researchers and teachers agree that the inclusion of Science, Technology, Engineering and mathematics in the education of future educators provides a powerful incentive, a significant improvement in learning speed, strengthening subject knowledge and expanding professional competence.

Despite the fact that robotics abroad began to develop earlier, there is currently not enough research and publications translated into Russian. In this regard, it is worth noting the works translated by Yoshihito Isogawa [14] and Laurence Valk [15].

These works are a user manual for beginners, but LEGO MINDSTORMS has a deep understanding of the designer's mechanics, which allows you to more deeply understand the principles of working with the EV3 set, and examples of mechanical nodes are most interesting in the formation of technical aspects of students.

In the publication [16] Sarah Wilner-giver presented a unique and interesting way to introduce robotics into the educational space as a STEM exercise that encourages students to look for non-standard ways to solve physical problems. This technology is actively used in the training of students of American universities. STEAM reveals a universal educational methodology aimed at forming students ' interest in science and engineering.

"All over the world there has been an increased interest in robotics, as well as in related areas, first of all - in the technology of creation (production), programming languages, mathematics and physics. The global trend also affected Russia. According to the site" interesting robotics", many circles, sections, studios and schools have appeared, the main focus of which is educational robotics. In addition, over the past two years, there has been a sharp leap in the coverage of the country with educational modules.

Currently, the most popular is competitive (sports) robotics. However, not all students can participate in it, so you need to use creative robotics for them, without making students fail. Combines these two types and educational robotics - "robotics for everyone, not selected." Educational robotics is the propaedeutics of Engineering Education " [17].

Robotics in education is a new interdisciplinary direction of teaching schoolchildren, which combines knowledge of physics, biology, technology, mathematics, computer science, drawing and allows you to involve students of different ages in the process of scientific and technical creativity.

Figure 2" interdisciplinarity of robotics with other Sciences " shows the relationship of educational robotics with other educational disciplines.

"Educational robotics is aimed at developing scientific and technical creativity and increasing the prestige of engineering professions among young people, developing young people's skills in working with technology and practical solution of urgent engineering and technical tasks." The practice of robotics in education helps to form students ' Polytechnic competencies, which allows them to solve household problems, and also contributes to the successful acquisition of Polytechnic knowledge and professional skills.

"Describing educational robotics as an integrative course for a secondary school, one can single out the purposeful, meaningful, active, educational, developmental aspects of its teaching," says T. V. Nikitina[19].

"Target aspect: educational robotics is considered as a means of implementing the GEF of general education, design activities in classes on educational robotics contribute to the effective formation of the entire complex of universal educational activities (cognitive, regulatory, personal, communicative) in schoolchildren" [19].

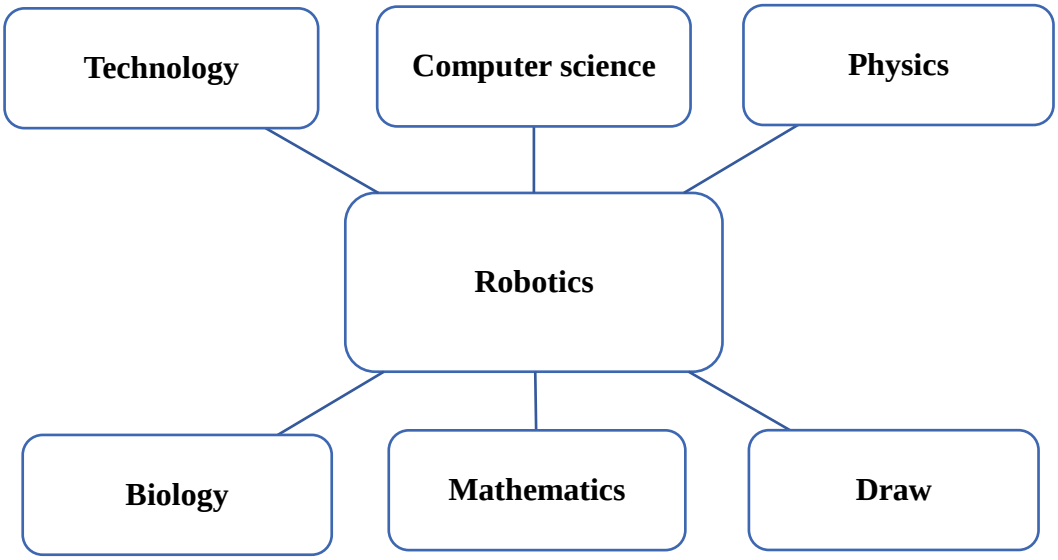

Figure 2: Interdisciplinary Relationship of Robotics with Other Sciences

"Substantive aspect: in the process of studying robotics in education, the teacher has the opportunity to effectively implement interdisciplinary connections in the main school subjects "computer science", "physics", "mathematics". One cannot fail to note the interdisciplinary connection of educational robotics with biology. The biological mechanisms of sensory and motor functions of living organisms are prototypes of the sensory and motor systems of the robot. If we consider a robot as a means of teaching some subject, then it is better to include elements of educational robotics in classes on Computer Science, Technology, Physics and the surrounding world (elementary school). The projects of robots proposed by LegoMindstorms include " machines and mechanisms. Graphic representation and modeling "(mechanisms of technological machines, Assembly of models of technological machines from designer parts according to sketches and drawings) and" electrotechnical works " (devices with elements of automation, Electric Drive, simple electronic devices).

In elementary grades, robotics can be used in lessons around the world. Working with robotic models, young students recreate life situations and objects of the surrounding world close to reality, and, therefore, better assimilate the results in this subject area. In computer science lessons, the robot acts as a real executor of the algorithm developed by students.

In physics lessons, a robot experiment can be used when a demo or laboratory installation is assembled from the parts of a robot designer, i.e. the constructor is used as a measurement system with processing and fixing the results. At the same time, the equipment of the physics and robotics equipment cabinet can be combined " [19].

"The activity aspect is associated with the assimilation of the types of activities characteristic of the disciplines of the Natural Science cycle within the framework of the educational robotics course: systematic observation, hypothesis presentation, prediction, collection and interpretation of data, analysis of results, formulation of conclusions and others.

The leading method in teaching robotics in the education of students is the method of projects aimed at independent activities of students: individual, pair, group, which students perform at regular intervals" [19].

"The educational aspect of robotics in education is associated with the career guidance function of the course (models of engineering activities are presented in the lessons), as well as cultural studies (education in robotics as"the most important forms of socio-cultural experience of mankind"). It depends on the "depth" of mastering the course. We believe that the study of educational robotics at the basic level has an important cultural significance, because students should not only have basic knowledge of classical subjects, but also be able to navigate new realities, which are the trend of widespread use of robots and controlled embedded systems.

"The developing aspect of educational robotics-the synthesis of Assembly and programming in one course allows you to solve tasks:

- development of mental and cognitive processes of students (perception, thinking and speech, memory, imagination);
- development of thought forms (analysis, synthesis, comparison, etc.);
- development of personal qualities (behavior and actions);
-development of intellectual characteristics, organizational and volitional qualities, creative potential, etc."

"The issues of educational robotics are discussed at numerous seminars, conferences and forums in different regions of Kazakhstan. However, there is no "educational robotics" section in the comprehensive school curriculum and in many schools Robotics is taught in the form of circles and electives" [20].

"Educational robotics is a relatively new learning technology that allows you to involve children in the process of engineering creativity from primary school age. Educational robotics can be widely used in the organization of both the educational process and extracurricular activities. Educational robotics can be used in Computer Science, Biology, Physics, Technology classes and other subjects in a limited form (demonstrations, observations), as well as when studying individual topics in the subject.

We also note that robotics, due to its unique synthetic nature, is a powerful tool for the development of unique skills and abilities of a child in various fields of technical creativity and, accordingly, can serve as a tool for career guidance of young people in the field of engineering and Technical Education" [6].

"In engineering and technical education, the main direction of personality-oriented training is educational robotics, which provides students with a unique opportunity to master the basics of programming and assembly, creating existing mechanical and electrified models of robots, as well as acquire initial engineering and technical knowledge, skills and abilities in the field of design, modeling and programming.

Each activity for a child is a creative process. The child can work individually, as well as in a group. Individual work allows the child to assert himself, increase self-esteem and self-confidence. Work in groups allows you to develop communication skills, the ability to cooperate, the ability to distribute tasks to each member of the group to build a common complex model.

In addition, the teaching of robotics in modern schools should be built on the basis of teaching at different ages, which contributes to the creation of a favorable pedagogical environment for achieving qualitative results that meet a wide range of needs of students" [21].

"The need and problem of introducing educational robotics into the basic educational process is becoming more and more obvious. At the same time, the introduction of a new discipline" Robotics " has not yet been announced. Therefore, this course can be included as an integrated block in the Natural Science cycle of Technology, Computer Science, Mathematics, Physics, Biology, Chemistry. Two types of integrative relationship of educational robotics with the listed academic disciplines can be distinguished: 1) elements of subject knowledge necessary for the study of robotics; 2) elements of interdisciplinary knowledge necessary for the study of robotics" [22].

"The creation and repair of algorithms for a robot is the task of the computer science course. In addition, the programming of the devices (Motors and sensors) on which the robot is equipped also affects the field of physics. When creating programs, it is necessary to understand the essence of the operation of the sensor (the physical laws on which its work is based), take into account sensor measurement errors, etc.physics has always taken a leading position as the scientific basis of technology, since it lies at the heart of all the most important areas of technical progress. For educational robotics, the most important sections of physical science are mechanics and electronics. Mathematics as a means of scientific knowledge in educational robotics allows you to solve problems with angles, degrees, coefficients and proportions. In general, physical and mathematical knowledge allows you to calculate the trajectory of a robot, measure and calculate the values of physical quantities. So, together with computer science, mathematics allows you to create very complex algorithms for a robot using variable quantities and mathematical calculations" [22].

Speaking about the place of robotics in the curriculum, it should be borne in mind that robotics does not and does not take all the training time. Therefore, the place of robotics in the course of classes is determined by practical, control activities, reserve time in the framework of Technology, Computer Science, Mathematics, and optional hours in extracurricular time and in the framework of circles.

"Educational robotics as a direction of educational and cognitive activity has a high cognitive interest among students. The study of robotics at school is carried out using educational constructors: Lego WeDo, Lego Mindstorms NXT, Lego Mindstorms EV3, Tetrix, Matrix, Fischertechnic, Arduino, Roborobo, Bioloid and others. Of course, the game is an effective method and form of organizing learning that allows students to learn without noticing the learning process" [22].

"As for Grades 7-9, both the circle of subjects and the possibilities of the element base of educational robotics are expanding here. If we take a global approach to educational robotics, it can be seen that this discipline is successfully integrated into all natural science disciplines, the main of which is the implementation of interdisciplinary connections. In fact, robotics is the only area that can be successfully integrated with any mathematical or natural science discipline" [23].

It should be noted that the "federal state educational standard "regulates the teaching of the basics of robotics within the framework of the discipline"Technology". The study of the subject area" technology " should ensure: the development of innovative creative activities of students in the process of solving applied educational tasks; the active use of knowledge gained in the study of other academic disciplines and established universal educational activities; improving the skills of performing educational and research and design activities.

The subject results of the study of the subject area" technology " should reflect:

1) to understand the role of technology and technologies for the progressive development of society; to form a holistic understanding of the essence of the Technosphere, technological culture and labor culture;

2) mastering the methods of educational and research and design activities, solving creative tasks, modeling, Assembly and aesthetic design of products".

"Educational robotics as an integrative course has significant potential in school learning, meeting the requirements of modern production, contributing to the deepening and systematization of students' knowledge in basic school subjects, allowing them to choose a future profession. With the help of multilateral interdisciplinary connections of educational robotics with the main school disciplines, the tasks of teaching, developing and educating students are solved at a qualitatively new level, the foundation of an integrated approach to solving complex problems of reality is laid " [22].

Educational robotics has a great didactic potential. Robotics can be successfully integrated with disciplines such as physics, computer science, technology. In the practice of introducing robotics into other disciplines, there must be appropriate methodological support for Applied programs and courses for implementation. Entering project activities in different areas ensures the integration of robotics and many school subjects. Projects should ensure that students are selected according to their personal interests. The subject of projects should ensure that students have the knowledge and skills acquired in courses of other natural sciences, therefore, the formation of project activity skills is an important task of pedagogical practice, taking into account the age characteristics of students.

Educational robotics has been widely used in integrated learning in the direction of STEM-Education (S-science, T - technology, E-engineering, M-mathematics), where educational robotics is a powerful tool for conducting research in related sciences (computer science education, creative and engineering design, as well as traditional science and mathematical education, physics) and at the same time a teaching tool. Configurable functional interfaces are used as a means of cognition, thanks to which students, using specific programming languages (graphic or text), observe the behavior of material models and actively involve them in solving specific problems.

The world experience of teaching robotics in primary school is more than 15 years. During this time, a lot of research has been carried out in the field of robotics teaching methodology. Many studies are associated with the introduction of robotics courses related to robotic development platforms. The most popular of them are courses for LEGO platforms.

Another part of the researchers focused on the development of robots using improvised material, a virtual environment for the development of robots and their integrated use.

"The use of a new scientific and methodological basis, developed information technologies made it possible to include the method of project activity in the framework of the most demanded educational technologies, without the systematic use of which it is impossible to implement the central principles of modern education:"teaching children to read" [8]. When working with children, it is necessary to take into account their age characteristics.

Starting from the 4th grade, we work with older teenage children. In many cases, the educational interests of children are becoming more focused and stable, associated with the still conscious choice of the future profession. Taking into account the age and resources used, project work should be organized in a certain way. The development of the student is the most important component of the pedagogical process in educational activities and the assimilation of scientific knowledge acts as the main goal and the main result of the activity. Helping students to fully show their abilities, develop initiative, independence, creative potential is one of the main tasks of a modern school.

Consider the age characteristics of 4th grade students who participated in a pedagogical experiment.

The eldest stressed that adolescence is a very complex, but at the same time very important and fruitful stage of human development. As L. S. Vygodsky notes," it is at this life stage that the structure of activity is formed, which is able to take action for itself, without pursuing the achievement of any distant goal."

1. "Age in general. In the spiritual formation of a teenager's personality, this quality gives him unlimited freedom. The teenager does not restrain even the norms of behavior. Therefore, it is necessary to talk about adventurous behavior as the result of a still insufficient understanding of the deep meaning of social human relations.

2. The most important age phenomenon is that the interests of a teenager are not available. Unusual searches reflect the self-consciousness of a teenager. At the same time, adolescents do not set themselves a special cognitive goal, but indirectly they constantly go to the assimilation of reality in various manifestations. It acts as a kind of emotional form of the subject that adolescents can identify with.

3.The leading motive of behavior is the need to take a worthy place, which is experienced by all adolescents.

4. All actions of a teenager are associated with the search for an individual in the unknown. For this, the teenager uses and, if necessary, creates a certain situation and feels himself, his abilities and capabilities.

5. The creative imagination of a teenager acts in the form of an arbitrary fantasy. Such fantasies are an area where it is easy to combine things that are not really compatible.

6. The creative process for a teenager is not the creation of models based on preliminary documentation. The teenager wants to think, analyze, summarize in the process of creative activity.

The listed features of the adult adolescent period make it possible to form the requirements for the organization of the educational process, aimed at developing the creative potential of students in general.

"There is one eternal school problem that can be solved in the course of project activities. It's about the problem of learning motivation. Teachers who work with teenagers are well aware of how difficult it is sometimes to support the desire to learn, even from capable students. This problem- a decrease in learning motivation in adolescence - has a number of reasons. In adolescents, the need for communication with peers, self - realization, the formation of the image of the future comes to the fore-this is the main content of the motivational sphere of adolescents. During this period, the desire to study successfully fades into the background.

At the same time, adolescents are more pronounced than primary school students, showing differences in learning and cognitive motives. For example, a student with outstanding abilities and an interest in one subject of study can fully start studying in other subjects. The cognitive motive, as a rule, is realized in hobbies and other extracurricular activities. If the learning motive is often based on the child's desire to meet the requirements of adults (and in adolescents this desire is significantly reduced), then the cognitive motive is not so susceptible to these effects, since it feeds on a deep internal impulse. Project activity allows the student to realize his cognitive motive directly in the educational work, since it gives him maximum freedom to choose not only the main topic of the project, but also the ways of its implementation. Working on a project, you can gain new knowledge and experience in the field of interest and immediately apply them in practice. In this case, learning becomes a process of consciously active search, assimilation and application of new knowledge (which is usually characteristic of active learning technologies). It is the growth of knowledge, skills and abilities that project activities are organized and in the future students can easily switch to other types of educational and extracurricular activities.

Often, adolescents are dominated by the needs for communication with peers, self-realization, the formation of a future image, including a professional personality. If the teacher allows the student to show maximum independence without leaving "on his own", work on the project will allow the teenager to build new relationships and take his place in the class hierarchy; know the boundaries of his capabilities, see the growth of competence in various fields of knowledge, gain new experience; Form clear ideas about the future profession, about his adult life.

"The biggest problem with teenage students is their weak point. Teenagers quickly lose interest, especially if the work seems difficult and the result does not inspire. Analysis and self-esteem cause minor difficulties, because at this age reflexive abilities are still at the stage of formation. In general, with dosed help, unhindered control and an inspiring example, 8th grade students successfully complete even large, complex projects.

When organizing project activities at school, it is possible to solve not only educational, but also educational tasks. Design activities, especially when performed individually. The project allows you to take into account the characteristics of each student. Working on a project helps to develop the missing skills and abilities. At the same time, mistakes and mistakes on the way to the result will be noticeable only to the author himself and his supervisor, and a successful presentation of the project will allow you to show yourself from the most advantageous side. It increases self-esteem and status in the class, helps to cope with anxiety, gives the experience of success" [5].

"In the main school, it is possible to use all the advantages of Group project work. Group work allows you to take into account the individual characteristics of each student, divide labor and distribute roles, and the result achieved will be much higher than in each group. During the group organization of work, the necessary communicative competence is formed. In addition, in such an organization, collective responsibility is formed and mutual assistance is provided both on the part of classmates and on the part of the teacher" [26].

To conduct a pedagogical experiment, the category of students of the 8th grade was chosen, since robotics lessons require certain knowledge in Physics, Computer Science, which is taught at school from the 7th grade. The number of projects they implement is reduced, but they are more complex and voluminous.

Project activities of students of the 4th grade are organized in the form of classes for 1 hour 1 time per week during the academic year, and the course "fundamentals of robotics" in the system of additional education in the form of Circle work according to the schedule. Classes are conducted by both teachers of the main school and teachers of additional education.

Thus, work on the project allows you to realize many of the personal needs of adolescents. This allows the student to apply not only his academic knowledge, but also his daily experience, to show himself as a special person, to show his strengths. All this fully meets the needs and interests of adolescents, so teachers should always take into account the age characteristics of students when performing projects.

The course" fundamentals of robotics " can be implemented in the system of additional education in the form of Circle work in accordance with the schedule of additional education classes of the school. When conducting classes on the course "fundamentals of robotics" in the system of additional education, it is necessary to adjust the number of hours devoted to the study of a particular module of Education. The program is aimed at identifying, developing and supporting talented students, forming and developing students ' creative abilities in the field of robotics.

Guided by the principles of the formation of the foundations of students ' project activity, Robotics makes it possible to organize project activities that contribute to the qualitative development of technical literacy and technical competence of students.

"Measurement of the formation of the foundations of students' project activities is associated with the problem of choosing criteria for evaluating indicators and the levels of their formation.

The criteria are determined by the educational tasks and represent a list of various types of activities that the student carries out in the course of work and must master perfectly as a result of work" [29].

"The criteria are determined by the educational tasks and represent a list of various types of activities that the student performs in the course of work and should master as a result of work.

Descriptors describe the student's achievement levels according to each criterion (sequentially showing all the student's steps on the way to the best result) and are evaluated with a certain set of points: the higher the achievement, the higher the score on this criterion.

Basic requirements for evaluation criteria used in design activities:

- they must show students the achievements and shortcomings of their project work;

- they should show the teacher the pedagogical effectiveness of the project method of teaching and the level of their own pedagogical skills. Criterion-based assessment in project activities as a teaching method is closely related to the problem of its effectiveness: the criteria for evaluating projects are determined by the requirements for the educational project as a pedagogical method; the basis of these requirements are didactic goals and methodological tasks.

The didactic goals of project activity are universal competencies, general educational skills, design skills. This is:

- universal competence-thinking, activity, communicative, informational;

- general educational skills-intellectual, organizational, communication skills;

- design skills are problematization, goal setting, planning, implementation of the plan, self-analysis and reflection.

The criteria are the types of activities that the student carries out in the course of work and that he must master well as a result, and which can be evaluated. In the course of design activities, the student must master a number of specific design skills, public skills and subject knowledge, as well as the formation of universal competencies. Therefore, projects are evaluated according to the following criteria:

List of project evaluation criteria

- Goal setting and justification of the project problem.
- Plan ways to achieve it.
- Variety of sources of information, the feasibility of their use.
- Compliance of the selected work methods with the purpose and content of the project.
- Analysis of the work progress, conclusions and prospects.
- Personal interest of the author, creative approach to work.
- Compliance with the requirements for the design of the written part.
- Quality of presentation.
- The quality of the project product.

From the names of the criteria, you can see what the student needs to learn while working on the project. The content of each criterion is disclosed using descriptors. Descriptors are the levels of achievement of a student according to each criterion, they sequentially describe all the steps to achieve the best result and are evaluated by a certain number of points: the higher the

achievement, the higher the score on this criterion. Using the dimensions and descriptors in them, the student clearly sees what should be the perfect work, what steps to achieve this result. He will be able to independently evaluate his work, complete it on time"[30].

Undoubtedly, robotics can be attributed to the most promising areas in the field of Information Technology. This is not surprising, because the development of such modern industries as automotive, Microelectronics, machine tool making is currently impossible without the use of robotic systems. It is no coincidence that robotics has become one of the priorities of Skolkovo. In turn, the development of such industries requires the training of many specialists in the field of robotics. This will undoubtedly set new challenges for the modern education system. It is necessary to approach the complex to solve this problem.

However, this problem is very difficult to solve within the framework of the traditional complex of physical and mathematical disciplines. The most suitable subject in this regard is computer science. Teaching robotics to children within the framework of this discipline can be based on the use of special designers, which include a programmable device. The most common at the moment is The Lego constructor group, which allows you to reach all age groups of students, from elementary school students to high school students.

This circumstance is very important, as it allows you to maintain the continuity and periodicity of the educational process. The conditional teaching of robotics within the framework of the school computer science course can be divided into three stages: elementary school, high school and high school. For teaching robotics in elementary school, you can use the Lego WeDo Constructor, which consists of standard Lego parts, as well as a set of sensors and drives connected to USB.

NXT fits perfectly into the constructivist approach to learning. First, the robot is a" social essence " in the sense of Papert (Harel and paper 1991). NXT comes directly from work experience and works. NXT is the latest evolution of paper work, starting with the logo and continuing with Dacta. NXT is modular and optional. This leads to development from the bottom up. Starting with the basic bricks, which define the basic standard for all other elements of the Lego set, you can create complex architectures, combining simple, already built parts.

NXT also fits very well with TERECop's philosophy, which is that you first have to look at the robot as a "learning object", study it to understand how it works and how it is handled, but then use the robot as a "learning tool" to learn academic subjects. In this sense, one of the advantages of NXT is that students quickly reach the first step, seeing the robot as a "learning object". With NXT, it's easy to learn how to create and program a robot. In this way, students can move very quickly to the second step, where they see the robot as a "learning tool", which must be used accordingly.

The modularity of NXT makes it very flexible and extensible. From a hardware point of view, in addition to the sensor and engines provided by LEGO, there are several third-part sensors and actuators that expand the possibilities of the experiment. For example, companies such as Hitechnic (http://www.hitechnic.com/). and mental sensors (http://www.mindsensors.com/) NXT produces several sensors that can be read and registered directly, while other companies such as

Vernier (www.vernier.com/nxt/) produce NXT adapters to connect sensors for scientific experiments.

When organizing a robotics club, it is necessary to take into account the following factors: firstly, it is necessary to have a plan for robotics education; secondly, it is necessary to choose the theory and practice of robotics based on the age characteristics and abilities of students gathered in the circle; strictly observe the safety rules of equipment in practice classes of students; practical projects created according to the selected plan should be provided with mechanical parts and radio parts.

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