Artículo de investigación

Robotics as a basis for Informatization of education in a children's health camp

ИНФОРМАТИЗАЦИЯ ОБРАЗОВАНИЯ В СИСТЕМЕ ОТДЫХА И ОЗДОРОВЛЕНИЯ ДЕТЕЙ КАК СПОСОБ РАЗВИТИЯ РОБОТОТЕХНИКИ

La robótica como base para la informatización de la educación en un campamento de salud infantil

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Abstract

At present, informatization of education is gradually gaining increased applicability in the process of education development. Due to the accelerated rate of science and technologies development, versatile specialists implementing new types of technologies, flexible to tendencies and up-to-date information, who come to their own conclusions and qualified to absorb new skills are appeared to be in-demand in modern society. Educational robotics is a developing field of national domestic education which provides a solid foundation for systems thinking, integration of computer science, mathematics, and natural sciences into engineering creativity. Informatization of education gained through the

Аннотация

В настоящее время в процессе развития системы образования становится актуальной проблема информатизации образования. В связи с высокими темпами развития науки и техники, в современном обществе возникает острая потребность в специалистах, способных работать с новыми видами технологий, быстро ориентироваться в обстановке и изучении актуального материала, обладающих вариативностью, способных мыслить самостоятельно и быстро усваивать новые знания.

Образовательная робототехника является развивающимся направлением развития отечественного образования,

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fulfillment of intellectual and creative children' potential revealed by means of robotics and resulted in motivation, individualization, social engagement. The present issue is considered from the point of view of extracurricular activities established with due regard to theoretical and methodological background of information technologies accomplishment in the global educational field and experimentally determined advantages of robotics development in children' health care and recreation system. The present survey embodies observation, practical results, analysis aimed at the development of creative activity, inventive skills. It allows us empirically prove the effectiveness of the implementation of robotics classes in the form of hobby clubs in children' health care and recreation system. The data obtained reflect receptive audience of youngsters being interested in robotics-related classes which has become an integral part of children' health care and recreation system. The children were excited while visiting the robotics-related classes throughout the children's recreation camp shift. During classes they tried their best in learning and put their knowledge into practice, as a consequence, different, types of robots have been developed. Robotics-related classes as an integral part of children' health care and recreation system facilitate inventive and creative skills development.

Keywords children's recreation camp; extracurricular activities; information technologies; informatization of education; robotics.

закладывающий прочные основы системного мышления, интеграции информатики, математики, естественных наук с развитием инженерного творчества. Информатизация образования через раскрытие интеллектуального и творческого потенциала детей с использованием возможностей робототехники. обеспечивающей мотивацию, индивидуализацию, социализацию. Теоретико-методологическая база применения информационных технологий в мировом образовательном пространстве и доказательства опытно-экспериментальным путем преимущества развития робототехники в системе отдыха и оздоровления детей позволяет рассмотреть данную проблему во внеучебной деятельности. Основу исследования составляют методы наблюдения, упражнения, анализа, направленные на развитие творческой активности, изобретательских навыков, экспериментальные методы позволяют нам эмпирическим путем доказать эффективность внедрения в систему отдыха и оздоровления детей занятий по робототехнике на уровне хобби-клубов. На основе полученных данных можно сделать вывод о том, что робототехника вызвала огромный интерес у подрастающего поколения в системе отдыха и оздоровления детей. Ребята были заинтересованы посещением хобби-клуба по робототехнике на протяжении всей лагерной смены, пытались как можно больше узнать и применить полученные знания на практике, что характеризовалось созданием новых интересных и, довольно, сложных видов роботов. Занятия по робототехнике в системе отдыха и оздоровления детей дает положительный результат, способствует развитию творческих и изобретательских навыков

Ключевые слова: робототехника; система отдыха и оздоровления детей; внеучебная деятельность; детский оздоровительный лагерь; информационные технологии; творчество; информатизация образования; инновации.

Resumen:

En la actualidad, la informatización de la educación está ganando gradualmente una mayor aplicabilidad en el proceso de desarrollo de la educación. Debido a la velocidad acelerada del desarrollo de la ciencia y las tecnologías, los especialistas versátiles que implementan nuevos tipos de tecnologías, flexibles a las tendencias e información actualizada, que llegan a sus propias conclusiones y están calificados para absorber nuevas habilidades, parecen estar en demanda en la sociedad moderna. La robótica educativa es un campo en desarrollo de la educación doméstica nacional que proporciona una base sólida para el pensamiento de sistemas, la integración de la informática, las matemáticas y las ciencias naturales en la

creatividad de ingeniería. La informatización de la educación obtenida a través del cumplimiento del potencial intelectual y creativo de los niños se reveló mediante la robótica y resultó en motivación, individualización, compromiso social. El tema actual se considera desde el punto de vista de las actividades extracurriculares establecidas teniendo en cuenta los antecedentes teóricos y metodológicos del logro de las tecnologías de la información en el campo educativo global y las ventajas determinadas experimentalmente del desarrollo robótico en el sistema de recreación y cuidado de la salud de los niños. La presente encuesta incluye observación, resultados prácticos, análisis dirigidos al desarrollo de la actividad creativa, habilidades inventivas. Nos permite probar empíricamente la efectividad de la implementación de clases de robótica en forma de clubes de pasatiempos en el sistema de cuidado de la salud y recreación de los niños. Los datos obtenidos reflejan una audiencia receptiva de jóvenes interesados en clases relacionadas con la robótica, que se ha convertido en una parte integral del sistema de cuidado de la salud y recreación de los niños. Los niños estaban emocionados mientras visitaban las clases relacionadas con la robótica en todo el turno de campamento de recreación para niños. Durante las clases, hicieron todo lo posible por aprender y pusieron en práctica sus conocimientos. Como consecuencia, se han desarrollado diferentes tipos de robots. Las clases relacionadas con la robótica como parte integral del sistema de recreación y cuidado de la salud de los niños facilitan el desarrollo de habilidades inventivas y creativas.

Palabras clave: campamento de recreación infantil; actividades extracurriculares; tecnologías de la información; informatización de la educación; robótica.

Introduction

Changing information, digital, social, cultural, economic spheres implied the necessity to reform the education system established in Russia in terms of underlying the importance of implementation information technologies into the educational field. One of the priorities of modern domestic education system as well as of foreign educational systems is the incorporation of robotics into the educational process and extracurricular activities.

The present paper studies the process of introducing robotics-related classes into children' health care and recreation system in the form of workshops, immersing a child in an information-digital environment.

Information environment influence a person throughout one's life, thus learning –related issue is highly important, since the environment determines development. Any of the sciences is unconditionally woven with the concept of environment. In the most general sense, "environment" is taken as "surroundings", referred to natural processes of interaction of human society and organisms [8].

The existed before problems of universities' fitting with computers and high-quality access to telecommunications facilities are partially resolved. Nowadays, the most crucial problems are related to the improvement of specialist trainings and effectiveness by implementation of information technologies, identifying the education system requirement in informatization, establishment of excellent online resources. Nevertheless, the issues related to lecturer's competency, student motivation and informatization of large-scale fields of activities provided in modern educational institutions are matters of current interest [14].

Almost all the ongoing reforms and amendments, concerning, in particular, higher education systems all over the world, one way or another, determine the need for improving the information component of the trainings designed for high-level competent specialists. Major part of scientific programs, both in Russia and abroad is concerned with information, means of its storage, processing and presentation, as well as studies and government with updated approaches to training and education.

Information technologies contribute to the improvement of the educational level in the field of innovative projects management [1]. Let us consider the implementation of robotics in children' health care and recreation system. Robotics is an applied science that develops automated technical systems and itself is the most important technical basis for the intensification of production [2]. The number of sources with available information and educational materials on educational robotics, which need to be adjusted to the Russian educational system, is being increased and accessible in Internet and library information system.

The research hypothesis of the study states that the implementation of robotics-related classes in

children' health care and recreation system will boost the creative activity of children and inventive skills.

To prove this hypothesis, the following goals were set:

- motivation of children participation in robotics-related workshops from the first days living in a camp;
- determination of the level of readiness for participation in robotics-related classes;
- development of skills for designing and modeling through robotics-related classes.

The following methods were used to accomplish the goals:

- The method of theoretical analysis and synthesis;
- empirical research methods: observation, conversation, review of children practices;
- methods of quantitative and qualitative data processing.

At present, robotics can be considered as a technical field related to the development and robots usage, as well as elaboration of computer systems for controlling robots, sensory feedback and information processing. Robots and robotic systems are designed to perform micro and macro work operations, including substitution a person and performing a hard, tedious, and dangerous work [3].

Robotics is a fairly new and continuously developing scientific field, designed to introduce new outcomes and areas of human activity, as well as develop automation of present-day production process, aimed at dramatically increasing its efficiency. Integration of scientific findings of a number of related fundamental and technical disciplines in a single scientific and technical field - robotics – was fuelled by application of automatic programmable devices (robots) while exploration of space and ocean, then, consequently in production area from 60th of 20th century-present, as well as by rapid progress in the development and engagement of robots within the recent years. The idea of creating robots - mechanical devices, similar to human being or other living beings appearance, belongs to people from ancient times. Reference can be made as follows: in legends and myths, people sought to create an image of man-made creatures endowed with physical skills and dexterity, capable of flying, living under the ground and water, acting independently, obeying a person and doing the hardest and the most hazardous work. In Homer's Iliad (6th century BC), it is said that the lame-footed blacksmith Hephaestus, the god of fire and the patron of blacksmithing, hammered the people executing his orders out of a piece of gold. These ideas have come down to our times and are embodied in robotics.

Robotics theory is based on the following disciplines: electronics, mechanics, computer science, radio engineering and electrical engineering. Robotics is divided into construction, industrial, domestic, aviation and extreme types of robotics.

Robots are used in:

- Industrial sphere- performs motor and control functions during the production process, a handling robot, i.e. an automatic device consisting of a manipulator and a reprogrammable control device that generates the control actions defining the required movements of the actuators of the manipulator;
- in the military – robots play different roles: intelligence officers, infantry, sappers, etc. Many military robots in the army seem to be "supermovers", it capable of destroying entire units, can execute the most dangerous work on the front lines;
- in emergency situations - in the event of an emergency, robots participate in emergency and rescue and other urgent work aimed at saving lives and preserving human health, as well as at reducing damage to the environment and material losses, etc. [4,5].

The main tasks for operating robots are the following:

- position planning;
- movement planning;
- planning of strength and moments;
- analysis of dynamic accuracy;
- identification of the kinematic and dynamic characteristics of the robot.

The prioritized functions of a robot:

1. manipulation and moving: using objects, the robot must perform its work and move;
2. determination of the ambient environment state: the robot must have senses that allow it to "see", "touch", "feel" weight, "recognize" objects, etc.;
3. comprehension and decision making makes it possible to plan the sequence of operations

necessary to achieve the goal set by a person, as well as to exercise appropriate control, etc. [6].

Integrated implementation of these four functions allows us to develop a robot.

Nowadays, robotics-related classes are priority information technologies. In keeping with the times and society demands in universal educational space the information competence is being top ranked. Children and adolescents should be flexible, modern, ready to develop and implement innovations in life. Also, they should not only get an education, but also reach a certain level of competence in order to meet the social expectations of the government towards specialists requested to creatively solve complex professional tasks.

The main goal of introducing robotics into education is to form an individual who is ready to set educational goals on its own, design ways to solve them, evaluate the results, work with all sources of information [8].

Modern education system is being developed. A large number of teachers and parents all over the world strive to make children interested in science, learning and development of extraordinary ways of development and thinking what the modern world encourages during the period of intensive and innovative technologies development. The established ways of materials introduction need updating. Students and pupils want to be teached in lively, interesting, interactive way. Scientists and practice-oriented specialists are working on these issues, because the learning process is constantly being improved, and all participants in this process are becoming an integral part of the educational system with rapidly developing information technologies.

Experience of teaching practice implemented abroad in children's recreation camps shows that robotics-related classes are becoming widely popular. In 2014, several studies related to this topic were conducted in the children's recreation camps: the camp "Rainbow" (Montenegro), in 2015 – the camp "Star club" (Bulgaria), in 2016 - camp "Belarus" (Crimea). Children are interested in robotics, try themselves in a new field of design and modeling, along with that they improve the education system [14].

As part of supplementary education in the children' health care and recreation system, the following goals can be set and solved:

- learning software engineering;
- development of logical thinking;
- development of creative abilities;
- formation of imaginative and technical thinking;
- formation of creative approaches of solving non-standard tasks;
- the formation of the ability to apply knowledge from various fields of science;
- obtaining skills of experimental work [5].

These tasks make it possible to diversify the huge range of possibilities that the educational sphere currently suggests for the comprehensive, harmonious, mobile and competitive development of all sides of the modern personality. Thus, accordingly, there is the increasing role of extracurricular activities, capable of enhancing cognitive and intellectual processes in project activities [7.9].

Nowadays, educational robotics in both foreign and Russian education is mastered by students in school, as well as during passing elective courses through educational sets: Lego WeDo, Lego Mindstorms NXT, Lego Mindstorms EV3, Fischertechnic, Arduino, Roborobo, Bioloid, etc. At the same time, Lego Mindstorms NXT is the most common construction kit, since it allows solving a wide range of tasks for schoolchildren from 8 years old.
In Russia, there are educational institutions and systems of supplementary education, such as Moscow School No. 548 - the most unique school in Russia adopting European technologies, where a robotics training course has been introduced, to which particular attention is paid. Furthermore, in the premises of State University Federal State Budgetary Educational Institution of Higher Education named K.A. Timiryazev's Center for Technological Support of Education (CTPO) has been established, where private groups, both from different schools of the city of Moscow, and university students will be able to investigate the modern equipment and technologies of robotics, 3D modeling and nanotechnology, implement their projects and introduce them participating in competitions, contests at the state level. The main task of activities is the theoretical study and innovative effective practical implementation of robotics by students in the future [9,10,11].

The main tool for teaching children in the system of rest and recreation for children is mainly designers, such as Lego, Fischertechnic and Vex. They are quite popular in Europe and are becoming more common in Russia, thanks to the

wide functionality and many specific details that allow you to create not only entertainment and educational projects, but also prototypes of real complex devices [12].

Along with this, educational robotics is a didactic model of robotic science. Elements of this model are not scientific and engineering-technical knowledge in the field of robotics and can be used to organize propedeutic education of children and adolescents in the basics of engineering activity in order to attract their interest in engineering and technical specialties, which today plays a huge role in the robotics industry.

Literature Review

In many countries of the world (USA, Germany, Japan, China, etc.) there is a significant interest in the educational component of this scientific and technical direction. In the paper "Rethinking Learning in the Digital Epoch - Implications for Teacher Education" of the International Conference "Society of Information Technologies and Teacher Education" Washington, DC, United States of America: Association for the Advancement of Computer Engineering in Education (AACE) by the authors Voogt J., Lai KW , Knezek G., Christensen R., Forkosh Baruch, A., Grinshkun V., Grigoryev S., Shonfeld M., Smits A., Henrikson D., Henderson M., Uvarov A., Philips M., Webb M. , Niederhauser D., Mishra P., Leahy M., Butler D., Strijker A analyzes education in rethinking the education of the modern generation digital technologies [13].

In the paper by A. Bhaumik "The best twenty-four projects with Arduino", the work of leading researchers is presented in detail, which allows depicting the socio-economic picture of how robots transform our world and will continue to do so. [4] This work is presented along with influences and ideas from futurists such as Asimov, Moravec, Lem, Winge and, of course, Kurzweil.

The paper by K. Markland provided information on the creation and programming of intelligent robots using the designer Lego Mindstorns EV3, where it is possible to make a prototype of their own small-scale intelligent robot that uses specialized software and hardware to accomplish the mission [12].

A. Gadzikowski proposes in his study "Robotics for young children: stem measures and simple coding" to present to the elementary school students the construction and programming of robots through playful, appropriate development of the event. This convenient and affordable book gives teachers great ideas for engaging younger students through 100 exciting practical classes in computer science and engineering [5]. Modern studies by foreign authors, for example, Castellano G., are conducted from the standpoint of recognizing robots as social partners in educating children. Children perceive robots more useful when the robot responds to emotions by showing empathic behavior [6]. For this reason, the current research directions of Leite, I., Castellano, G., Pereira are associated with the development of empathetic models of robots, game interaction between the robot and the child, as well as the assessment of affective learning [14].

Methods

Experimental work has been carried out in various countries for 4 years. In 2014 in the children's camp "Rainbow" p. Montenegro, with the support of the Coordination Center for Social Support for Youth, in 2015 in the camp "Star club" in Bulgaria, in 2016 in the camp "Belorussia" p. Crimea with the support of "Tsentrzdravkurort". Age category of children and adolescents 8-16 years. The study was conducted at the level of the robotics hobby club using the designer Fischertechnic, Lego and Vex. Children studied the basics of modeling and design, collected both simple models and complex ones.

At the first stage, a group of 100 children was involved and the survey on willingness of robots engagement into work. The first stage of survey was conducted aimed to fin out whether the children were engaged in robotics before, then they passed through the verification test, which consisted of 15 tasks, where participants chose the correct answer, (the options were presented in the form of pictures), entered the details of the robot or another designer added a missing answer to the proposal, also, the task was presented in the form of a crossword puzzle, consisting of 8 questions, tasks were performed by each individual, after which the completed work was checked by the leaders of the hobby club, consisting of 3 people.

Results

After the survey, the following results were obtained, see Figure 1.

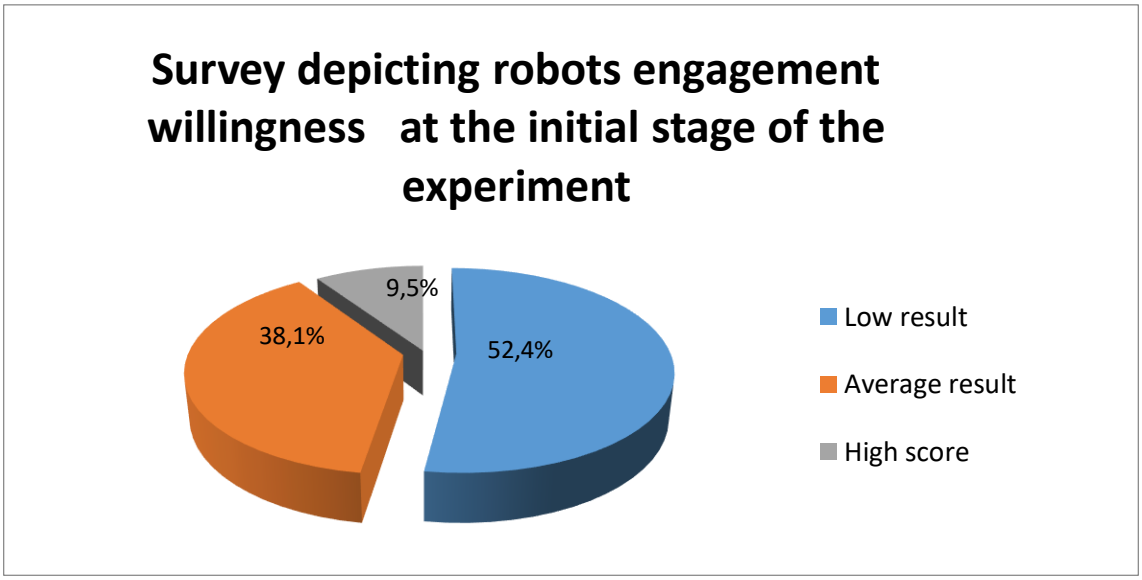

Figure 1. Results of research on willingness to work with robots at the initial stage of the experiment, (%)

Based on the research, it turned out that 52.4% have a low result, medium - 38.1%, high - 9.5%. Criteria for evaluating the performed diagnostics: correctly performed tasks (1-6 questions) - low result, average result - (7-12 questions), high result - (13-15 questions).

Then, each participant from the groups chose a model of the robot that he would like to assemble during the period of the circle, from three types of constructor.

This children's work on assembling robots was carried out with the help of leaders of a circle of 3 people, training videos and instructions, and documentaries on robotics were also shown. [15] This allowed the children to demonstrate the breadth and significance of the use of robots in people's everyday life, their structure “stuffing”. Developed new products and ready-made models introduced into our life were shown, which made it possible to expand the horizons of children. Instructors talked about the advantages of robots today and demonstrated their work.

At the end of the camp shift, a photo exhibition of the best assembled models of robots took place, during which each participant in the camp shift voted. Thus, a situation of success was created for the children, which was reinforced by new knowledge and practical skills. The guys received a certain reward for the best assembled robot and memorable prizes. Photos of the best works were published in the local newspaper and posted on the site of the camp organizers www.kcspm.ru, www. centrzdravkurort.ru, so that not only children, but also their parents can see the work of their children.

Also at the end of the work of the hobby club was re-diagnostics of knowledge and skills of children in the field of robotics. To do this, the guys were first offered to assemble a robot, then they were given a task, which also consisted of 15 points, where participants chose the correct answer, (the option was in the form of pictures), entered in the table the component details of the complicated robot assembled of the constructor used, the missing answer was added to the sentence; also, the task was presented as a game on a computer, consisting of 10 questions, tasks were performed by each individual. The completed work was checked by the leaders of the hobby club. The results of the diagnostics are presented in Fig.2

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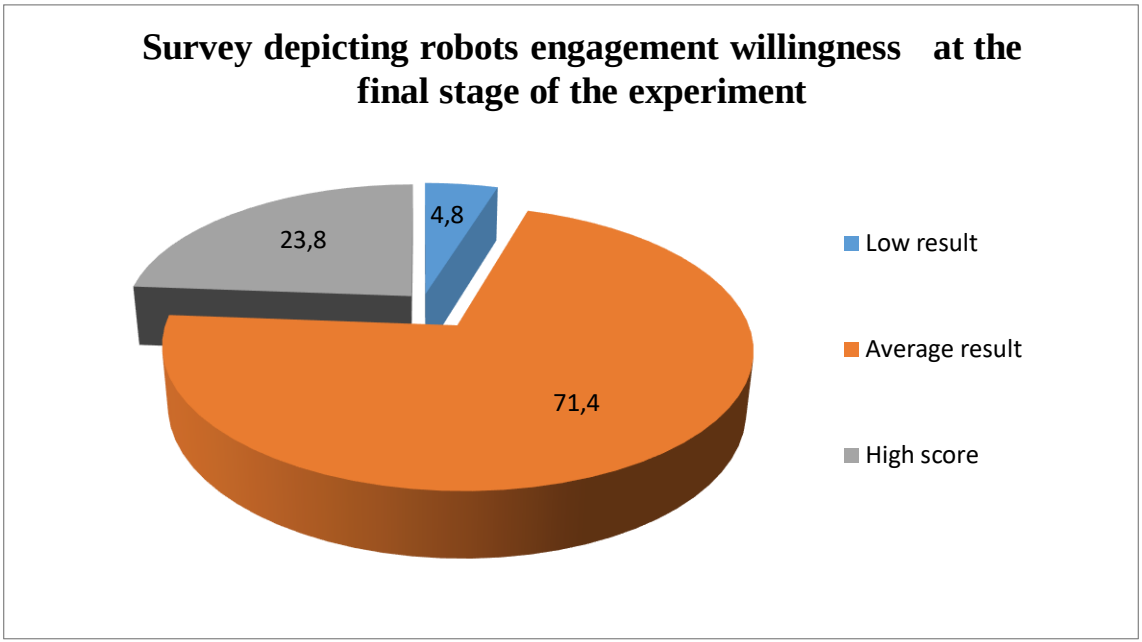

Figure 2. Results of Research depicting robots engagement willingness at the final stage of the experiment (%)

Based on the test, it turned out that low result is 4.8%, average result 71.4% -, and the highest result was already 23.8%. Criteria for research evaluation: well- performed tasks (1-6 questions) - low result, average result - (7-12 questions), high result - (13-15 questions).

Based on the data obtained, we can conclude that robotics aroused great interest among the younger generation, the children were interested throughout the camp shift, tried to learn and apply their knowledge in practice, which was characterized by the creation of interesting and rather, complex types of robots, and some guys collected several models of robots have been demonstrated in the photo exhibition. The survey conducted at the beginning of the shift and at the end, allows us to trace the positive dynamics in working with robotics. The majority of children showed willingness to be involved in robotics, which develops innovative thinking, teaches critical thinking, improves the skills of designing, modeling and design. Robotics-related classes will be profitable in the pursue of developing mobility, adaptation and introduction of innovations in modern life.

Discussion

Thus, the tasks set at the beginning of the study have been completed: the children were motivated to practice in robotics from the first days of their stay in the camp; survey on children's willingness to participate in robotics-related classes was carried out at the beginning and at the end of the camp shift; in the course of lessons children developed designing and modeling skills by means of robotics demonstrated during practice. The hypothesis of the study was proved: the introduction of robotics –related classes in children' health care and recreation system has contributed to creative activity and inventive skills of children.

Conclusion

Robotics is a developing field in Russian education. Robotics develops extraordinary thinking, teaches critical thinking, improves design, modeling and design skills. Robotics-related classes will allow developing mobility, adaptation and introduction of innovations in modern life activity. Consequently, it is necessary to implement robotics in extracurricular activities, in particular, in children' health care and recreation system, where a creative atmosphere contributes to the development of inventiveness, helps to determine exciting type of activities in the future.

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