EXPIRIENCES WITH EDUCATIONAL ROBOTIC

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Abstract. Educational Robotics has come to prominence in recent years because it allows to articulate a more playful and interactive teaching. It works the abstract in concrete basis, and this way stands as a new methodology of teaching and learning. Therefore, this article seeks to present educational initiatives that use robotics in elementary schools, located in western Santa Catarina and northern Rio Grande do Sul. For that, we used the Lego Mindstorms NXT robotic kit. As result, it was found that the technology enables the insertion, integration, interaction, discussion and cooperation between students, teachers and employees, which somehow permeates individual and collective development, providing opportunities for improvements in the educational processes.

Keywords: Educational Robotics. Constructionism. Robotic. Automation. Lego Mindstorms NXT.

1 INTRODUCTION

Education leads us to a series of situations, practices and policies that bind the area itself [2]. In this perspective, it is possible to highlight the importance of transformational technologies that offer educational processes, serving as support for the proposals developed, contributing to changes in the social and cultural dynamics of individuals.

In this sense, [3, 4, 5] is stated that it is up to the task of the educators to plan and introduce such technologies in school life.

The computer is not only to perform human tasks such as to add, process and teach, but also to require the development of cognitive and meta-cognitive skills of each individual through learning situations that enable a better understanding of the world in which we live in[6].

The author states that technologies have a transformative approach, since: They alter the structure of interests of each individual; Change the thinking of each individual; Alter the nature of the community.

Corroborating this proposal, [7] he states that technology should promote the development of basic skills and cognitive abilities of their users, explore learning in an interactive and playful way, allowing people to new educational processes, new experiences, new discoveries and new ways of learning. Thus, the robot is attractive as a means [8], "invites teachers and students to teach / learn / discover / invent in collective processes, capable of connecting abstraction and concrete world."

Through them, you can explore the area of robotics in an educational manner, coming to join efforts to make school life more challenging, creative and focused on the processes of teaching and learning. The use of robotics in the classroom, according to [9], provides that "teachers escape the blackboard and that lessons become more dynamic thereby arousing the curiosity of students," setting up what could be called technological literacy.

In Brazil, projects conducted by the Educational Robotics, are yet isolated initiatives. There is still a look that directs efforts to robots that can support the school setting as a means to include the Computer within other disciplines such as Mathematics, Physics, Biology, Portuguese and others [5]. From their research on the use of educational robotics, [8] it pointed out that: "Countries such as the Netherlands and Germany have already robotics [...] 100% of public schools. England, Italy, Spain, Canada and the United States go in the same direction. Some Latin American countries have adopted their first strategies nationwide. This is the case, for example of Mexico and Peru."

[10] claim that the university is a place of production significant social and technological initiatives that are carried out in this case study on Robotics in Education, in order to: Knowing closely the social reality of the public attended in order to modify it; Provide the qualification of the citizen; democratize access to knowledge gained to improve the quality of life of citizens; Encourage scientific research; Promoting citizenship and democratic values to the different social actors who are involved directly and indirectly in the shares.

Thus Robotics Education opens unexplored possibilities for the field of education and to the field of research, transforming educational settings.

So, this paper aims to present considerations of Robotics, Robotics Education, present the Lego Mindstorms NXT robotic kit, and show initiatives in education level and extent applied with students of the initial series.

Finally, the text helps to diversify the work done by the teacher, and this will have available a means versatile, able to cause a modification of traditional culture and organization of the school, contributing the learning of their students.

2 ROBOTICS

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Robotics is a branch of technology that includes mechanics, electricity, electronics and computing, which deals with systems composed of mechanical parts and machines: automatic and controlled by integrated circuits, making mechanical motorized, controlled manually or automatically by electrical circuits [11].

The term robotics was created by science fiction writer Isaac Asimov in his novel "I, Robot", 1948 [11]. The word “robot” was first used in 1921, a play that was titled RUR - Russum's Universal Robots, Czechoslovakia, written by Karel Capek. In Czech, the word “robota” means work and was used in the sense of a robot machine to replace human labor.

The difference between a computer and a robot is districted by its power to interact with the world. The computer does not start without human operation. Thus, robot is considered an intelligent mechanism that works autonomously [11].

From the 80, the Robotics is advancing at great speed and, among numerous projects, ASIMO, initiated in 1986 by the Honda Motor Company, to get highlighted. Contrary to what it may seem, his name was not created in homage to the science fiction writer Isaac Asimov, but is derived from Advanced Step in Innovative Mobility. Just like ASIMO, the Qrio, Sony, and Robonaut robot created by NASA to assist astronauts on the International Space Station performing extra vehicular activities, are also quite relevant. The three are cited as humanoid robots designed to interact with humans [12, 13].

Besides these, [14] presents the home robot NAO, which can recognize the face of a person and interact in conversation. RI-MAN and RIBA II are other examples of robots that provide assistance to a person’s body.

Something that caught our attention is that “the Internet has proved valuable in providing access to similar lines of research, sharing open source materials and facilitated exchange of opinions and resources, which benefits the improvement of technologies.” [14, 15].

Thus, the next section presents considerations regarding one of the areas that benefit most from the Robotics, in this case, Education.

3 EDUCATIONAL ROBOTIC

The technologies are important tools for studying and research in the learning process, as they provide conditions to both teachers and students working from themes, projects and extracurricular activities. [16] states that the computer is a medium that develops attention, perception and creativity.

Corroborating this idea [17] states that the computer is like “a machine [...] that allows to test ideas or hypotheses, leading to the creation of a world abstract and symbolic that at the same time allows you to enter different forms of operation and interaction between people.”

This is a device that is increasingly diverse in functions, contributing significantly to an increase in productivity, cost reduction and optimization of product quality and services.

For this reason that the school should support projects where the computer presents real situations to students in order to make your learning fun and engaging, the example cited is Educational Robotics.

The Robotics Education and teaching, named, “[...] encourages creativity students due to its dynamic nature, interactive and even playful besides serving as a motivator to stimulate students' interest in traditional teaching.” [18].

It is characterized as an environment in which students can "program" and "build" your robot. "The ease of installation and programming of robots, articulated piece sets and intuitive programming interfaces can be identified as factors that [...] put in a field of robotics accessible to educational purposes." [19].

The advantages of Educational Robotics are very significant. Among the benefits are: interdisciplinary, the expansion of content already worked in the classroom and, what is more important, the learning achieved through group work, since the study phase. Principles of teamwork and cooperation, which are required in professional practice, skills are developed in students from the Robotics projects [20].

In this way, we use the cognitive model of the Theory of Multiple Intelligences (MI), proposed by Gardner [21] which describes for the coexistence of multiple intelligences. Thus, relating the theory of IM with Educational Robotics have:

- linguistic intelligence - students can express themselves through words as a robotic experiment passed or that was developed;
- logical-mathematical intelligence - students can reason about how to solve the problem by means of the robot and how to program it;
- spatial intelligence - the student can understand how the pieces fit the robot to assemble the robotic structure (visual perception);
- kinesthetic intelligence - the student can, by means of somatic sensations obtained through sensors, articulate his/her robot to obtain elements for analysis;
- musical intelligence - the student can, through rhythms and melodies, listening posts, sounds and music via robot;
- inter-personal intelligence - work as a team with the involvement of the group, assembling, programming and the use of the robot;
- intra-personal intelligence - the ability to act adaptively meets the challenge presented;
- naturalist intelligence - the ability of interaction between the student and the environment, in this case, using recyclable artifacts.

Projects addressing the theme of Educational Robotics develop in several segments, geared mostly to high school and vocational education. [21] states that there are few projects articulated with the elementary school. The author states that there are few institutions in fundamental level that include content related to technology education into their curricula. Among the projects using robotics as learning environment IN Brazil:

- Technological Education - it's a project that allows experience knowledge in areas such as Physics, Biology, Mathematics and Language, through the assembly and programming of robotic kits. The project is carried out in primary and secondary schools in Feira de Santana, Bahia [23];
- Educational Robotics in High School - its experiments are performed between the disciplines of Geography, Mathematics and Programming by robots. Project developed in Blumenau - Santa Catarina [24];
- Educational Robotics in UCA - the project aims to analyze "technical activity as symbolic and creativity from the field of possibilities of modeling and programming in the context of design prototypes UCA." [25]. The project took place in Porto Alegre (Rio Grande do Sul) with public and private schools from elementary and high school.

At the level of the technological resources available in the market to work with robots, there are free solutions and cost as the Arduino, the GoGoBoard the xBot, among others. Already in level sets (kits) and manufactured commercial, there is the Lego Mindstorms NXT, the Fischertechnik, Parallax, among others.

[20] points out that the basic difference between commercial complexes in relation to free ones, are: number of parts (gears, motors, etc.). In this aspect of low cost kits contain a limitation on the number of its parts; Collection of alternative materials. In this aspect both kits cost as commercial or manufacturing allow the customization of parts; Technical knowledge of electronic and mechanical modelling. In this aspect kits that require low cost to learn a specific programming in accordance with the kit purchased.

Based on the questions listed by [20], in the next section, we present some considerations about the commercial kit Lego Mindstorms NXT. The kit was chosen because it contains a simple programming interface and iconic, many examples available on the website http://www.nxtprograms.com plus numerous parts such as gears, motors and sensors support [26].

4. PROPOSALS DEVELOPED WITH CHILDHOOD EDUCATION AND ELEMENTARY SCHOOL

As the authors [28], the school is one of the most important social institutions, because it is the link that mediates the interaction between the individual and society, allowing that the child can take ownership of values and social models, with direct repercussions on their autonomy.

Therefore, the technology is part of this link, as it allows them to adopt actions that facilitate the educational process. In this sense, the Educational Robotics in schools aims to provide students with the awakening of logical reasoning, creativity, autonomy in learning, understanding concepts and improve coexistence group, treating cooperation, planning activities and tasks [29].

Thus, in Section III set out examples in Brazil's level of technological use of robotics in the classroom. Obviously, corroborating [8] the area is still shy and lacking in trained professionals at both technological as teaching. However, it is at this time showing initiatives experienced by researchers in level of education and outreach. The proposals are summarized here from the work: [30, 31, 32].

In both projects we used as instruments to direct observation of school and classroom intervention, a second time.

The observation has the advantage of identifying the facts directly, without any intermediary, as indicated by [33], it is a simple methodology and systematic. Thus, the first step involved the analysis of impactual technologies, especially robotics in schools.

Therefore, there was an informal contact with representatives of schools, these included teachers and principals in order to realize their positions through technologies. This contact allows us to understand how the robot can interfere with the educational process, since, according to statements summarized, “[...] it is a mechanism to aid the teacher, it enhances the process of child development, is

attractive, is a motivating tool that arouses interest, changes the dynamics of teaching and learning, motor elaborates on the student, a different way to share their knowledge with students and can open many doors for these children who are starting school life."

The next step in the study provided the Lego Mindstorms NXT robotic kit in order to analyse and understand their use, operation and programming. The robot was chosen because it is a line of Lego toys released by the company, focused on technology education, and for being a technology widely used in the process of teaching and learning in schools.

[27] posits that humans learn best when they are engaged in building something that he can show to other people and that is meaningful to him. These computing environments, especially Robotics, contribute to this way of thinking constructionist, because students engage and interact with the development of projects.

The study on the Mindstorms Lego NXT kit is considered with step observation of classes in schools - presented in the sequence, where the idea is: a) to investigate the teaching practice, directly observing how the activities are developed, explored and its relevance to students; b) analyse the relationship between student and teacher in the classroom.

From the analysis of reality and the school plan for each school, went to trial activities in technological level. For this, we used the flowchart first proposed by [30]. In this case, the flowchart is composed: Name - name of the experiment; Objective(s) - highlight the educational purposes; Discipline(s) - experiment (s) intended; Materials used - detailed description of physical materials for the experiment; Description of the stages - description of the step by step to the realization of the activity.

From the structure of the experimental projects using the Lego Mindstorms NXT robotic kit, went up to the stage of intervention in school. The intervention process has the intention to facilitate the "problematic at collective practices of training and enhancing the production of a new think / do education." [34].

The intervention included the formation of teachers and other legal representatives of schools, through workshops, so that they can meet the robotic kit and check usability. After that, it went to the training and validation of the project with the students.

Finally, the initiatives have great concern for the educational processes of human development. Following considerations and presenting peculiarities of each initiative indicated with the results obtained.

4.1 Iniciative Kerber

The initiative [30] was applied in Ambial Project, Escola de de Educação Básica São Lourenço, in the municipality of Iporã do Oeste-SC. The project aims to promote the inclusion of pedagogical actions socio-environmental, mitigating the problem of hunger, education and sustainability of the students.

[30] applied his work against the shift of student activities. As the study areas, highlight Sciences, Mathematics and History. Among the experiments developed and applied:

• Interactive Game - the idea of the game is to interact with the Lego Mindstorms NXT robot. In the game there is a specific symbol that appears in the central controller. Thus, the student is invited to interact selecting between the buttons contained in the controller in order to ascertain where the symbol is showing up randomly;
• Commanding the vehicle by remote control - vehicle was developed, similar to the transport of the pieces of Lego Mindstorms, which moves around on two wheels, which are located in front of the application and the lower end of which was affixed a wheel lowest, responsible for the direction of the vehicle;
• Distance in centimeters from one point to another in a straight line - it's an application which calculates the distance in centimeters from one point to another in a given line segment, displaying them in real time on the display of the central controller;
• Hieroglyphics - with parts and programming Lego together in the shape of a vehicle, it is the representation of some symbols (hieroglyphics), so that students can understand this writing in a fun and interactive way, using the History and Mathematics to encourage logical reasoning;
• Calculation of area and volume - application which calculates the area and volume of objects that the students will choose, displaying them in real time on the display controller;
• Representation of the solar system - development of a framework for a rotary level, with the parts and programming Lego set, which makes movements similar to the solar system. The proposed design allows three variations on an experimental level. The first would be the Earth revolving around the Sun, and the second would be the planets rotating around the Sun, the Moon would be the third turning on the Earth.

4.2 Initiative Tosini and Holz

The initiative [31] was applied at the Escola Estadual Catharina Seger, located in the municipality of Palma Sola-SC, with students in the class multi-seriate the first and second years.

The initiative [31] considered the use of Bluetooth technology in parallel to the use of Lego Mindstorms NXT robotic kit.

The Bluetooth allows communication via radio signals from high frequency between computers, smartphones, cell phones, mice, keyboards, headsets, printers and other devices.

To make this possible, it took two robotic kits. The first, called the master is the device that creates the connection, while the other, called the slave performs the action.

The project was carried out taking into account the areas of:
• Mathematics - with understanding the geometric shapes, basic arithmetic operations of addition and subtraction, colors;
• Sciences - healthy eating habits through educational activities that inform and motivate individual choices.

At the trial there was a special student with a mild mental retardation. The child that contained aggressive behavior with the teacher and classmates, the experiments performed satisfactorily and felt motivated to help their classmates. At work there was not a closer study on the use of technology in special education.

4.3 Initiative Zarpelon, Tortelli and Bieniek

The initiative extension was applied to three schools, two located in the municipality of Erechim-RS (Escola Estadual de Ensino Médio Irany Jaime Farina and Escola Municipal de Educação Infantil Dom João Aloisio Hoffmann) and the other in Passo Fundo-RS (Escola Municipal de Ensino Fundamental Georgina Rosado). Participated in the project students from kindergarten and first grade of elementary school.

In the phase of experimentation, was developed a board game. [15] believes that a play can develop play behavior, anticipating the behavior of the child, adult and old. "[...] The game is working well, the duty, the ideal life." That is, pervades the individual's independence.

In the case of the project, the game involves environmental issues, since it is one of the crosscutting themes of education and research focused in schools. The goal is to develop logical thinking through differentiation of geometric figures, as well as its dimensions, color differentiation, the interaction with the world technological and environmental awareness, all these issues will appear in the course of the board. It should be noted that the board game involving environmental issues is just one of the indications to be used in the process.

From the results obtained it can be seen that the enormous interest on the part of students and teachers, who also supported the project, the integration of robotics in the school learning environment. Students showed greater attention, concentration and pledged to develop the proposed activities on the board.

5. CONCLUSIONS

From the results obtained with the Lego Mindstorms technology, the researchers realized the advantage of the kit in the learning of both students and teachers; it provides creating imaginative concrete structures, ranging from humanoid replicas of animals, vehicles, among others.

In contrast to this, it is clear also that the robotic kit is still expensive in Brazil and that it can be a complicating factor, since public schools depend on state and local budgets.

In order to meet the social reality of the public attended, schools attended were visited, to see how the students are in the classroom, what activities are developed by teachers, the main difficulties faced by students in their learning process, if there are initiatives in schools with the use of technologies. It was found that, lacking training processes that encourage the use of computers in school, particularly robots, with "small" (personal lines of teachers consulted).

[30] highlights the need for an overhaul of the school curriculum, teacher training and school representatives so that they can work properly interdisciplinarity that technology can provide.

The initiative also influenced the relationship between the groups, allowing greater communication between students and teachers, which in a way, was distant.

Now [31, 32] highlight the involvement of staff (students and teachers) in the process of experimentation. They also indicate that the curriculum reform and the training of teachers, raised by [30], as necessary, relevant and urgent in school.

When asked about how they imagined a robot for some robot were only those with humanoid forms, or had other idea would be a robot. And when asked about the proposed activities, the students would like other activities that were proposed [30, 31, 32].

Therefore, the university has the main role to change the reality pointed out by researchers, either with incorporating technological, scientific, educational process, professional skills in order to create a more just society that promotes the development of individuals who make it part.

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