Project for a Robotics Exploration Laboratory

Location (Region, Country)

Omar Dengo Foundation
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San José, Costa Rica
URL:Website: http://www.fod.ac.cr/

Target beneficiaries/groups:

This project is addressed to boys and girls in primary schools of the public system in Costa Rica. The priority target are schools in rural areas and impoverished population areas.

Since 1998 this project has promoted the participation and the interest of the students in topics related to robotics and the current examples or applications in the country. The learning principles have been defined around two basic inquiries: Why things happen the way they do? and How things work?

Areas of Activities:

The pedagogical reference frame in which the project takes place calls for children from different grades and ages to gather together in their spare time after classes and learn to design, create, build and program with robotics.
The learning environment will emphasize on in the following:
To promote an inclination for sciences and technologies through study and investigation.
To promote work oriented to learning through projects.
To maintain an atmosphere of exchange of ideas and socializing that favors the interaction between the students and the resolution of problems.
To encourage a continuous evaluation of what is done and how it is done resulting in an internal feedback for the interchange and the improvement of the methods.
To encourage the students to develop external productions with their colleagues; these constructions are enhance physically and intellectually by the joint participation in the construction.
Work in the laboratories is done using mostly LEGO® materials and programming on PC's, the materials include sensors and actuators controlled with a specialized programming language

Development Needs Addressed:

The project seeks to create in the boys and girls a different culture towards the way of learning and looking up at the science and technology.
The project enlists the children as the main actors and originators of learning projects in a learning environment that fosters their interests and curiosities not solved in the standard classroom.
Thus the children get involved in planning processes, design, construction, programming and development of projects, making use of technological resources for robotics.

The context of the Robotics Exploration Laboratories favors in the children an approach towards problem solving, design and creativity, teamwork, decision making and values.

Background Information:

Organization and Partners Involved:

The project for Robotics Exploration Laboratories in Costa Rica is carried out by the National Program for Educational Informatics on schools and high-schools (Programa Nacional de Informática Educativa de I y II ciclo -PRONIE I Y II ciclo-) coordinated by the Omar Dengo Foundation and the Ministry of Public Education.

Project Description

The project seeks the creation of a generation of boys and girls conversant with the recent developments of sciences and technology. According to this goal, the promotion of robotics, particularly pedagogical robotics, proposes the establishment of learning spaces in schools to support the comprehension of deeper concepts such as construction of mechanisms and motion control. An underlying objective in the laboratories is to coalesce a recreational ambience with interdisciplinary learning, thus helping in the development of competencies such as problem solving, communication, creativity, design and logic

Details:

The students carry out a process of sketching, producing, programming and socializing in order to complete their projects. This process sets them in the role of an engineer or a researcher that has to work out a solution for a given idea or problem or establish the validity of a theory to be show to the community.
The children in the public schools attend the robotics exploration laboratories for 8 weeks, in sessions of 4 to 5 hours a day, two days in a week. This exposure ensures a continuity in the learning process, more profit for the students and deeper understanding of the topics studied.
The groups are set up of 20 boys and girls with ages between 6 and 12 years old. Work is most often done in couples or in sub-groups of 4 to 5 students. The learning process is guided by a tutor trained in the topics to be discussed in the laboratory
The learning process begins with an introduction to the individual pieces, the basic principles of construction and programming, this is done along with a study of key mechanisms and basic concepts of design.
The tutor with the children agree on the main topic driving the design and development of the project. This agreement allows to analyze different subjects or situations potentially rich offered by the surroundings and that can be recreated. Once agreed on the main topic, the group gets involved in an investigation stage that pushes them to research and scrutinize potential designs.
The projects are sub-group creations that attempt to recreate or reproduce industrial or technological processes, work sites or events involving machines, electronics or mechanical objects from various sources. Finally these creations are shared and assessed by the group as a whole and shown to the rest of the school and the community.

Summary of Activities:

The project Robotics Exploration Laboratories started as a pilot program in October 1998 on 7 public schools. In the year 2001 the project was enlarged with 8 additional schools totaling 15 schools with 16 installed laboratories. Each school was provided with:

- One tutor with an average of 100 hours of training per year and the permanent assistance and follow-up provided by the staff from the Robotics Area at the Omar Dengo Foundation.
- Five computers, 8 kits for robotic exploration, manuals, didactic materials and complementary materials to support the construction. Some laboratories have digital cameras.

Every school gathers 5 groups of 20 students every year. They attend to the laboratory 7 hours a week during 8 weeks.

The pedagogical strategy of the laboratories is such that the 20 children that attend the laboratories organize themselves with the help of the tutor and define the theme that will be covered in the final project.

The final project programmed in the laboratories has a duration of 5 to 6 weeks. During this time the students will:

- investigate on the selected topic
- organize visits
- go on tour to manufacturing facilities or places where they can find good examples of the topic under study
- decide on the appropriate ways to exhibit the project (e.g.: constructions, environment, mechanism behavior, etc…)
- organize themselves to distribute the tasks that every subgroup will perform
- unite all the different parts and set up a formal presentation as a whole to be shown to the students of the school, the families and the community.

Some of the themes that have been discussed on the projects are: sugar cane processing, pasteurization and processing of the milk, automation of manufacturing processes of medical products, modernizing of ancient machines, ways of transportation, cities and places, processing of coffee bean, generation of electricity (hydroelectric and eolic processes), refining of petroleum, automatic cooking of french fries, simulation of processes of packaging and stocking of banana, candy factories, meat plants, etc…

Main Outcomes

The project has been through several processes of systematization and evaluation. The following has been noted on the boys and girls that have participated of the laboratories:

- They elaborate projects that involve programming and construction with robotics based on simulations of industrial and technological processes, or the recreation of events that occur on their surroundings.
- They make usage of specialized vocabulary and construct meanings on the different terms. In this matter, they talk fluently on the functions and uses for the different parts or materials involved in their creations.
- They face the problem situations with natural demeanor and commitment to find a solution. Their knowledge allows them to explain and support the research of a solution to the problems of construction and programming that they come to face.
- They have risen their self-esteem and improved the ways to relate to a team and make decisions in teams.
- They show more respect and have more tolerance to work in teams with subjects with different ages.
- They show more curiosity towards -how things work?- and display better knowledge on the topics that have been discussed on the project.
- They show a clear grasp on concepts related to construction of structures, stability, soundness usage of gear trains and mechanisms in motion.
- They display fluency on basic concepts of programming, such as: knowledge of the programming tool that they use, programming of loops, multitask and the usage of sensors, lights and sirens in their projects.
- They build better strategies for the resolution of problems in situations involving construction and programming, as well as presentation and argumentation of projects to other children and any observer.
- They show better capacity for analysis and criticism upon the evaluation of their creations and their partners.

- They log the significant aspects linked to their learning and the difficulties found on the way.

Benefits (Direct and Indirect), Impacts, and Lessons Learned

A community of specialists, persons with recognized skills in mechanics, industry and manufacturing has been progressively integrating to the schools that have Robotics Exploration Laboratories. They either visit the workshops or receive the students in their manufacturing facilities.
In an activity of outreach to the national community, the boys and girls that have attended to Robotics Exploration Laboratories prepared a workshop for less favored children that do not have this possibility. The workshop took place on October 2002 during the 1st Robotics Festival, 35 children that previously attended the laboratories acted as mediators for 112 visiting children from schools that do not have this option.

The boys and girls from the Robotics Exploration Laboratories often display their work with grand success in national and regional scientific fairs and the children congress.

The boys and girls from the laboratories have held many interviews at schools and in the Omar Dengo Foundation. As well as demonstrations and conferences with envoys from national organizations and universities and international organizations like UNESCO, BID, MICIT, CONICIT, regarding what they learned and how they learnt it.

As for the teachers and tutors that oversee the laboratories:

- They have improved their procedures of mediation and pedagogical intervention, driven by the proposals put to work at the laboratories and by their own interest to be more effective in the learning process of the children.
- They become very interested and committed to the development of the pedagogical robotics at world scale. They become actively involved in the training processes proposed directly by the Omar Dengo Foundation and through the Internet.
- They learn from the kids: they learn from their programming techniques and their procedures for problem solving. They value the project as an alternative for curriculum integration.
- They have changed their conceptions of what robotics is, based on the experience they have lived through the project.
- They detect the need to extend their knowledge in different areas, such as physics, programming, children sociology, mechanics. They also recognize the importance of self education and education in technology skills.

Type of ICT Used:

The Robotics Exploration Laboratories project has shown that the boys and girls between 6 and 12 years old can develop projects using the same technological tools that are actually used to teach robotics in educational contexts. While they develop their projects, they think as engineers, they create and design as artists, they organize, plan and assign tasks as researchers, they share, negotiate and make decisions that construct values in them. Values such as tolerance, respect for the others and the diversity of ideas, learn to value themselves and the others. At the same time, they get a clear picture of the basic concepts of sciences, physics, mechanics, engineering and robotics.

Role of ICT in addressing Development Needs and Delivering Benefits:

Future Activities

We expect that the children currently involved in the project will become facilitators in the near future for the learning of other groups of children in their learning centers. We expect them to have a deeper interest for the sciences, the mathematics and engineering. We expect as well that they will be able to recognize easily, contexts in which they can generalize the knowledge acquired in the laboratory.
In the years to come, we expect these generations to become young adults that lead the country and become key players in the technological development of the science of the state and the region.

Additional Comments

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