

A strategy of an Introduction of Educational Robotics in the School System

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During about 10 years the University of Concepcion, Chile, has done trainings in the area of educational robotics, which is a part of the curriculum in the formation of master's degree in Educational Computer Science. In spite of these efforts, the educational Robotics wasn't developed in the Centers.

In search of new strategies that allow us to promote the use of this tool, we created an Educational Robotics unit (<http://www.roboeduc.udec.cl>), which depends on the Center of Technology for Teaching. This unit proposed, in a period of three years, to develop a strategic plan which would allow the strengthening of Educational Robotics as a pedagogic tool. For this, we developed three lines of work, on the one hand, the creation of a NET of Educational Robotics, based on a Web arcade that allows us to carry out permanent transference to the centers and simultaneously allows the centers to achieve interchanges of experiences. On the other hand, we generated lines of investigation that are sustained in the work that institutions of the NET carry out, and finally we developed materials that allows us to satisfy the needs detected in the NET.

The product of this strategy of approximation to the centers, currently, is that eighteen establishments are employed by the NET, three of them with a distant modality, with students from pre-school until the last years of secondary school in all the areas of the curriculum, which once a year get together to present their works in front of the community and interchange their experiences in the use of the Robotics. Parallely, we have been carrying out a series of investigations that have allowed us to detect the usefulness and the utility of Educational Robotics in the participating centers, also, to validate the systems of integration of the Educational Robotics into the Curriculum.

Finally, we have given the centers materials which have been developed by our Educational Robotics Unit and the materials available on the Internet.

Key words: Educational Robotics; Learning by TIC.

1. Introduction

In recent years, unidirectional traditional pedagogy has been modified by the incorporation of new tools of information to which pupils have access, and one of the most important, both in the quantitative and in the qualitative way, is the use of the TIC. This fact has made us think again about the roles and functions that have traditionally been were assigned, both to the centers and to teachers and students (Marcelo, 2001).

One of the methods of introducing TIC into the curriculum has been via Educational Robotics. By analyzing international experience regarding this, we have realized that there are many forms of insertion of Educational Robotics into the educational practices of the centers, including knowledge of the simplest concepts of the robotics, a kind of "robotics literacy", and even the most sophisticated uses of it. These developments not only refer to models or representations of machines, as commercial industries, but also in the education. In education, this tool promotes representations of knowledge which are the product of the interaction of the apprentice with the materials, especially when there is a problem to resolve in a collaborative way.

1.1. WHAT DO WE UNDERSTAND FOR ROBOT?

A robot is a machine; from the point of view of physics it transforms energy to achieve work, and its essence is constituted by a computer, an interface, acting devices and sensors in its most simple structure. This concept is changing, as its applications are more complex in different areas of human tasks.

1.2 THE ROBOTS IN THE EDUCATION

A simple robot, which is installed in a center, is a **System** that includes at least:

1.2.1. The idea and its representation based on a problem that will develop a model. This is what we call a **conceptual set**; for example, creating a model of a roadway for a policeman who has a radar in his/her hand (light sensor), obtaining a curve of speed / time of a vehicle that has a light bulb ignited in the roof, done by students of 10 ° of a Center.

1.2.2 A set of acting devices, sensors and electrical connections that, once connected, can interact.

1.2.3. The construction of the **model** (cardboard, modeling clay, sticks of model, cartons, tempera, etc.).

1.2.4. A **programming** based on software that provides easy access to the students: one of the frequently used is LOGO.

It is clear that to this conception of robots, of low cost implementation, we can give a major degree of technological sophistication, like in case of some commercial options as: Lego Mindstorms, Handy Cricket and the components Stamp, among others available on the market.

1.3 EDUCATIONAL ROBOTICS

Educational Robotics has also been called Pedagogic Robotics (Sanchez 2003) because of its emphasis on development mainly in the centers.

In this sense, Ruiz-Velasco (1996) says that " pedagogic robotics is the discipline that is in charge of conceiving of and developing educational robots in order that the students begin with the study of the Sciences (Mathematics, Physics, Electricity, Electronics, Computer science) and technology " (Sanchez 2003).

Nevertheless, we cannot fail to consider that robotics is also increasingly used way in student clubs, which has generated competitions among different clubs and fans of these activities, which include all sorts of young amateurs and even professionals in robotics.

We consider that the Educational Robotics team at the University of Concepcion is a pedagogic tool at a school level and it has primarily focused its attention on curriculum, which does not exclude the future possibility of developing other options.

We have considered the following suppositions of Educational Robotics:

- 1 It generates interesting and motivating **environments of learning**.
- 2 The role of the teacher becomes that of a **facilitator** and the role of the student becomes active.
- 3 It promotes **transversal curricular**, where different knowledges act to find the solution of a problem at hand. It is not strange that a project of robotics resort to mathematical, and physics solutions and other sciences / disciplines; which gives a value of integration / totality and approximation to the reality in which the student is working.
- 4 It allows the establishment of **relations and representations**.

According to Alvaro Galvis (2000), an environment of learning is a necessary condition for the generation of knowledge, but it is not enough. Didactics, as the interaction of the student with the materials during the process of learning, is one that allows them to learn. "An environment of learning can be very rich, but if the apprentice does not do activities that take advantage of his/her potential, it is worthless ".

2. EDUCATIONAL ROBOTICS AS A TOOL OF SUPPORT

2.1 THE DIFFERENCE BETWEEN MEAN AND PURPOSE

Educational Robotics, from a pygotskian point of view, can be understood as a way of acting in, of understanding and learning about the reality. In this way, it is constituted as a method and offers available action to educational systems. The methods implementing this method are characterized by being active – participative and cooperative.

It is necessary to indicate that robotics in some opportunities constitutes a purpose. This could be the case for the students of technology, where the object of study is the robotics. Technical, Industrial and related schools have as a purpose the development in students of some methods of work that, often, include the robotics for its particular purposes.

The Educational Robotics Team of the University of Concepcion will have as one of its purposes the construction of knowledge regarding the use of Educational Robotics in educational systems. This production/elaboration places an emphasis on the development of pedagogic work; therefore, its main action is focused on the learning processes of the students, by means of a process of constructing and learning. Because of this, the duty of the teacher is that of a facilitator. This look towards process develops a space for creation and solution to already known problems.

2.2 A NET OF EDUCATIONAL ROBÓTICA

For approximately 10 years, the University of Concepcion has been working on the use of robotics in educational environments, both at the teaching and at the direct support level in the Centers that are working on the topic. As a way of consolidating this work, in November, 2004 we organized, together with 10 educational centers, the first Educational Robotics Fair, in which the educational centers presented their achievements on the topic. At the same time, as a part of the event, the University organized in parallel a series of chats by different specialists on the topic at a national level. As a way of consolidating the path of the University in this area, a work team was created that hopes to be projected as a group of excellence in Educational Robotics, for which we have proposed a work plan that has as one of its main tasks shaping Educational Robotics' Net, which aspires to develop three lines of work:

(1) Helping the centers (2) systematizing the development of the University and, (3) being a source of investigation in the area.

2.3 PRINCIPLES

On the one hand, for the majority of the Centers, Educational Robotics is understood and used as a tool of support for teaching. The exception is some centers of technical education, in which Robotics is a part of the curriculum and, therefore, a purpose in itself. On the other hand, the University, by definition, is in charge to carrying out teaching, extension and investigation. Due to the aforementioned fact, the group of Educational Robotics is essentially composed of educators and its orientation is focused on pedagogy, together with the principles that guide the participation of the University in this Net; as a result of which we have designed and started the implementation of three lines of action.

Direct work with the Centers

We give support to the Centers which are members of the Net according to the specific needs of each one of them and depending on the capacity of attention that the University group has, simultaneously the Centers put at the disposition of the members of the Net their experiences with regard to the topic, specifying the difficulties encountered and the planned solutions, the wisdom and pedagogic achievements that the experience has given them, etc. This has as a purpose the fomentation of the work in pairs as a line of learning.

Systematizing of information

Both the University and the Centers compile and generate information related to the topic; it will be a policy of the net to share in a most wide and transparent possible way this information, having as the only restriction a strict respect for the author's copyright of the above mentioned information.

Investigation

The Net and its associated Centers are sources of information for the accomplishment of investigations in the area. Therefore the University invites the Centers to take part freely to the Centers, in investigations with or without intervention and respecting fully the code of ethics.

2.4 OBJECTIVES

On the one hand, the main objective of the Net is to promote Educational Robotics as a pedagogic tool, in the Centers, contributing both spaces for information and specialty advising. On the other hand, the University will be benefited by having a space in which they will be able to plan empirical and theoretical development in the discipline, which will contribute for the construction of knowledge.

In the Centers

To implement Educational Robotics within the curriculum of the Center and to promote the fulfillment of pedagogic objectives

In the University

To develop theoretical and empirical knowledge linked with the model of Educational Robotics created by University of Concepcion, as a way of promoting its educational function in the discipline, allowing it to carry out investigation on the forefront and allowing the extension as a direct agent of the knowledge that it spreads.

2.5 TASKS

Aim of Centers

The Centers elaborate a work project for the year, which is supported and collaborated by academics of the University, simultaneously, for those who don't have Interfaces; the University provides them with a minimum of 2 interfaces according to availability. These interfaces are created by the team of Educational Robotics of the University.

Systematizing of information

The University is developing an Educational Robotics arcade that would have three thematic objectives, which would be meant to be a support for the educational establishments and a channel of diffusion of developments in the area:

1 Material of support for the Centers, such as specified sheets and guides for pedagogic activities, which will facilitate a better use of resources and development of activities in the Centers

There would also be spaces of formation for the teachers who want to incorporate Educational Robotics in their daily jobs.

2 Publication of experiences of the centers The Centers, which are members of the Net, will have a space in the portal to share their most successful experiences. There will be an Educational Robotics forum where the academics of the University who are working on the topic and the teachers of the Centers will be able to interchange information, experiences, sources of information, etc.

3 Scientific publications The scientific productivity will be publicized across the arcade. There will be links to available contents on the Internet. This, with the purpose of sharing, together with scientific productivity, has a goal of putting within reach of the Centers the available knowledge on Educational Robotics.

Investigation

The academic team, in collaboration with the establishments, carries out investigations that attempt to solve the problems that are presented in the development of Educational Robotics, as well as the lack of knowledge in this area. The results of the above mentioned investigations will be published by the usual channels (in congresses and on paper) and, simultaneously, put at the disposal of the teachers of the Centers by the "arcade of the Net".

2.6 GOALS

We have goals in the short and medium length that, as a principal product, search to strengthen Educational Robotics in the area of influence of the University and, besides, to contribute to the knowledge and publication of the discipline, and also to insert it as a line of stable investigation within the University. We will try to achieve the mentioned via a series of partial goals.

Goals for the work with the Centers

In 2005, we have been working with eighteen Centers, primary and secondary ones, in which you can find a great diversity of experiences on the topic, including establishments that came to the Net because it seemed to them interesting, but without any experience in the area, and also Centers that have been developing in the meantime, and they possess teachers with formal formation in Educational Robotics at the level of a master's degree.

What we intend to achieve in the short term is that the Centers incorporated into the Net use in a systematic way Educational Robotics as a pedagogic tool.

Besides, we expect to increase the number of establishments that take part in the net, when this becomes possible.

Goals of diffusion of knowledge

We want to develop an arcade as a main source of transference of knowledge, which has as main points of thematic development:

1 Glossary of Educational Robotics' terms

2 Technical specifications for support for teachers

3 Guides of learning for work with Educational Robotics in contents of the Curriculum and different degrees

4 Pedagogic experiences of the establishments belonging to the Net

5 Theoretical and practical material developed by the University in the area of the Educational Robotics

6 Links to sites related that offer classification for contents and quality

Goals of Investigation

We want to consolidate Educational Robotics (Gatica, Ripoll, 2004) as a line of investigation, for which we have designed a work plan which would last three years (2005 - 2007), which intends to know and include the phenomenon of the Educational Robotics as educational tool. For this reason, we are developing, during 2005, two initial investigations, one that tries to describe the insertion of Educational Robotics into the educational centers and other one, which is being developed together with the Pontificia Universidad Católica de Valparaíso. This investigation intends to test an offer of science education supported by technology, specifically in the area of physics and chemistry, which considers a pedagogic model and the use of the virtual laboratories, robots and sensors.

3. INDEX

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