Robots at School.
The Eurobotice project

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Abstract. *The pedagogical usefulness of robotics in Science and Technology education is being proved in different contexts and approaches.*

In this communication we will present a Comenius 1 school education project named Eurobotice where it is intended to combine the study of the basics of robotics and of its applications with space science and space exploration.

The Eurobotice project involves around 300 students, ages 12 to 14 on average, from 10 schools of eight EU' countries.

Teams of school students are established and work cooperatively in order to solve a number of challenges under the theme of space exploration. The space topic will be researched discussed and explored and several robots or robotic' artefacts are build and programmed in other to fulfil a number of task in a final robotic competition at the facilities of the European Space Agency in Holland.

Keywords. Robotics, Science Education, School, Hands-on experiments, Comenius 1 projects.

1. Introduction

Hands-on experimental activities have long time proved to be one of the most effective ways to drive the students to a successful learning of science and technology [1,2].

Robotics is a topic rather challenging and appealing to our young students.

On the other hand robotics and automation is also very and ever increasingly important in science and technology, in a vast number of industries and even in our every day life. Robotics will certainly have a major role in the current and future development of our economies and society.

2. Eurobotice - *Mission Mars*

At the 1st International Conference on "Hands on Science, Teaching and Learning Science in the XXI Century" we introduced the topic of the learning and use of robotics in school education [3]. This time we are going to report on a European cooperation project centred in this in-school' robotics topic.

The Eurobotice project is Socrates/Comenius School project involving 10 schools from 8 European countries (France, Portugal, Austria, Belgium, Denmark, Norway, Sweden and UK) and promoted within the frames of the Hands-on Science European network.

The main objective of the project is to promote the learning and the dissemination of new technologies, with special focus in robotics, motivating and involving all the school members, as well as the whole community they are inserted in. In particular Eurobotice aims to improve the teaching of science and technology through the use of robotics and space research dealing with both subjects in an integrated and interdisciplinary way. Students from all countries find the challenges of space exploration stimulating. The project wishes also to encourage an exchange of ideas between members of the European Union and to promote the study of science, engineering and technology.

The activities of students teachers and schools will be driven towards the preparation of a final major activity. It is a robotics competition or festival on the theme of Robotics and the European Space Exploration research. In particular the main topic will be the exploration of Mars, a topic of great actuality. Students will design build and program a robot or a set of

robots built to perform a series of different but interrelated tasks. The robot teams will than, at the festival, be exhibited and run against other robot' team from other schools and countries.

For this competition there are two main preparatory activities that will take almost a full school year: the Robot Game and the Research Assignment.

Figure 1. The students present their work to the other teams the jury and visitors the results of their research work on space exploration.

During the development of their Research Assignment the students will understand more fully the significance to the real work of the scientific and technological research being conducted by scientists around the world in this specific science and technology subject. In the context of Eurobotice the subject is space exploration. In particular the students must to, by them selves, learn more about space, space exploration constraints and missions. They are asked to learn about the industries and research activities in their own country.

Reports shall be produced namely in the form of multimedia presentations and webpages or sites.

After this preparation phase (that in fact takes place throughout the all duration of the project' activities) the students enter the Robot Game phase. Here the students must design develop build and program a robot to solve a series of missions on a playing field. Specific rules are associated with each one of the different tasks presented. The different missions will take place in a specially designed playing field (figure 3.) that intends to simulate a Mars' ground. The eight chosen missions are named: Exit the Tetrahedron base; Launch the sample canister; Clear the solar panel; Connect the 180° and 90° habitation modules; Free the rover; Move ice cores to base; Move boulders into the launch circle; All terrain vehicle test.

The ensemble of missions intends to reproduce actual activities that need to be fulfilled in a space exploration program. Furthermore each activity focus on tackling the learning of a specific competency (programming, building,…) or knowledge (kinematics and dynamics, friction, mass and volume, resolution and accuracy,…).

Figure 2. The winning robot?... result of several months of intense highly motivated work.

The project was integrated into the normal curricular activities of different and diverse disciplines: foreign languages – used to assist in the exchange of information between participating European countries- namely english and french; ICT, of great importance in the processes of learning how to program the robots but also on how to exchange information between the different teams and schools from the different European countries involved, through email and internet; physics, in all that relates to mechanics but also optics and electricity for instance as support to the understanding selection and use of the different robotic sensors ; technology – on the construction of the robot's propulsion and manipulation systems; art and design – in what concerns the "look" of the built robots, and to enhance the presentation of the pupils' research reports to an international audience.

During the project students have to locate sources of information, select appropriate materials and organize it in a logical efficient and appealing way.

With these activities we will achieve to develop an awareness of the organisation of Europe's space industry and research, to encourage

students to consider a science or technology based career and increase the awareness of the links between theory and practice. The project was also used to facilitate and induce exchanges between students and teachers from diverse European countries increasing the sense of European citizenship.

Teachers learn how to work with colleges of schools from other European countries sharing experiences and best practices.

Individual schools learn how to benefit from European fellowships by developing links with other European schools and institutions

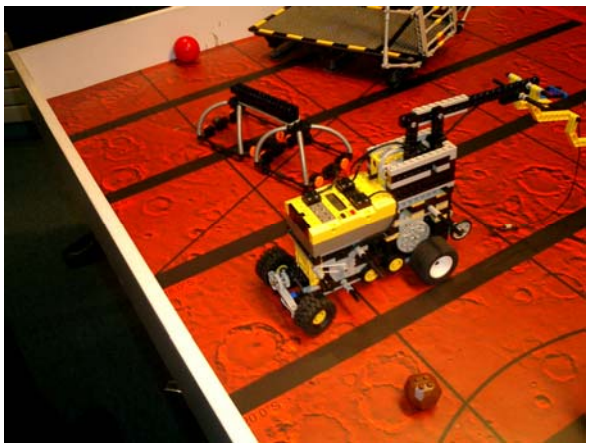

Figure 3. The Mission Mars' playing field.

At the end of the project the students are capable of:

- perform tasks methodically individually and in teams;
- to put in practice their theoretical knowledge concerning the programming of their robots;
- use the theoretical knowledge obtained in the solution of practical problems;
- increase their aptitudes and competencies of use of the technologies of information and Internet, elaboration of critical and logical reasoning, the ability to validate and to use all the obtained information towards a goal.

At the end of the project the students' teams and the schools will produce and exchenage a DVD with the conclusions of their work, their multimedia presentations, films and pictures of the accomplished work and the participation in the competitions. These products will be used in demonstrations to motivate other students to the study of robotics and other areas considered traditionally difficult as physics and mathematics.

More information concerning these projects can be found in the websites created by the project students: http://robos.no.sapo.pt and www.eb23-joaomeira.rcts.pt/indexeurobotice.htm.

3. Conclusion

In-class hands-on experimental activities have a very positive impact in the large majority of the students involved.

Space exploration and robotics are appealing and challenging topics that students from early ages work with in an enthusiastic and committed but very responsible way.

The students, their teachers and schools gain a series of new competencies and knowledge invaluable in their educational development. The most important outcome of this type of projects is the self-confidence and responsibility our students developed and well as an excellent posture towards science and technology.

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