Junior University Workshops for Children

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Abstract. Culture and education should be for all, and this is even more felt in a period of crisis where private resources diminish. In particular, involving children in academia is a way of raising awareness of children, their families and schools about academia and the facilities it can offer them. This paper is a modest contribution to this idea. It reports on a series of workshops launched at the Free University of Bozen-Bolzano, for children and their families. Workshops were organized under the new brand of Junior Uni. The paper reports in more details the experience of the workshops with robots organized at the Faculty of Computer Science by the authors of the paper. It concludes assessing the pro and contra of the initiative, and explains the planned new initiatives.

Keywords: robotics; collaborative learning; user centered design

1 Introduction

“From the earliest age possible, ALL children should have the chance to be in touch with academic thinking, to engage with scientists, artists, practitioners, researchers, students and research institutions.”

The Ankara Declaration [1] was signed in November 2011 by universities participating in the SiS-Catalyst and EUCU.NET Joint Conference 2011. The concepts it states have been inspiring many initiatives aimed at involving children and academics for more than ten years, that is, long before they have been formally stated as above. A popular name for such an initiative is “Children University”.

More than 200 places around Europe are now offering science related lectures, workshops or demonstrations to children. Such events usually take place at university premises, involve academics and children aged 7 to 14, and somehow imitate academic life. Each institution has developed own approaches, and has chosen preferred target groups in the local population. An association of European Children universities, called EUCU.NET [2], has been established, aimed at the development of better quality initiatives through networking.

As for Italy, the idea of a children university has not been widely explored, a few notable exceptions being in Bologna and Ferrara. The Free University of Bozen-Bolzano, located in the North-East of Italy, in an area where most people speak

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German, borrowed its experience from successful examples of "Children Universities" in German-speaking countries. Direct contacts with German professors, and especially with Prof. Dr. Gisela Lück from the University of Bielefeld [4], stimulated an initiative in this direction in Bolzano.

A steering group, with representatives from all faculties, was launched in 2010, aimed at arranging a series of events during 2011. Financial support was initially granted by a non-profit body, Uni-Stiftung, and a name that would be comprehensible by both Italian and German speakers was chosen: "Junior Uni". Twenty-six events were arranged during Spring 2011, and another series of twenty-five events was held in the Fall 2011.

Five faculties of the Free University of Bozen-Bolzano proposed workshops, dealing with various subjects being taught in each programme and faculty. As an example, professors of Political Sciences, Law and Finance from the Faculty of Economics arranged workshops concerning their research subjects, and gathered 10-15 children aged 9-12 at each workshop. At the same time, the Faculty of Computer Science offered workshops concerning Robotics, in two different series. The Spring series was conceived for children aged 9-12, while the Fall series was for preschool children, aged 5 to 6.

Common to all faculties was the availability of academics and students, working together to prepare a workshop. A workshop typically lasted between one and two hours: during a workshop, children actively participated and played, giving suggestions on how to improve the initiative; sometimes a guest was present as well (for example, the City Mayor came to the workshop on politics). Enrollment in workshops was left to family decision, out of children curiosity, without specific agreements with schools, or youth organizations. Initiatives were scheduled over several months, without a specific time pattern: each participating faculty chose their own time frames, depending on staff and location availability.

The next section describes related works in the field of robotics for children and the following two sections describe the contents of the Spring and Fall series of the workshops on Robotics at the Faculty of Computer Science. The workshops were planned as contextual inquiries following the user centered design [3]. The paper concludes with a short discussion on lessons learned, and plans for the future of such an experience.

2 Related Work

The idea of using robots to introduce children early on to scientific thinking, improve technological skills, and build up positive attitudes towards science and technology is not new.

The first robots that were used for education purposes did not consist of real hardware, but were made of software, such as the turtle in the programming language Logo [8] or Karel, the robot [9].

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Today, we can choose between different types of robots that differ in programmability and price classes such as the Lego Mindstorms robots [6] (about 200€[1]) to the Aldebaran Robotics Nao H25 [11] (about €12000[2]).

The purpose of using robots in education also varies from introducing children to science [10] to strengthen the self-confidence of girls in dealing with technology [11] or to befriend sick kids in a hospital [13]. Our initiative aims at introducing children to the foundational ideas of artificial intelligence and, more in general, at raising awareness of the existence of our university in the local context.

3 Workshop Design for 9-to-12-year-olds

In the planning stage, a steering group of academics and students was formed inside the Faculty of Computer Science, and started discussing what kind of activities might be arranged in workshops for 9-to-12-year-olds. The group decided to organize and attend a course on the use of robots in primary education, taught by an experienced educational organization, Scuola di Robotica [5]. The course employed Lego Mindstorms [6] robots. Two educational kits of robots were purchased by the university.

After the course, the steering group organized brainstorming meetings. The main goals of the workshops were set. The main objective became to make the children, the teacher, and the students reason together about what is an artificial intelligence, that is, a robot, a machine like a car, and humans. The other main objective of the workshop was to gradually introduce the basics of programming by playing with robots. The group prepared a "script", describing what would be the format of the workshop and the type of activities to be organized for achieving such goals. It was decided that all activities should take the form of games, the teacher would be the expert moderator and the students the assistants in the workshop.

Both the moderator and the assistants were collecting observations concerning the behavior of children during the workshop and at the end of it, in order to track their response to the games and in order to assess whether the goals were met.

The script was tested in pilots with two children in order to check the games and their timing. For instance, the pilot suggested that the workshop should last around 45 minutes, up to one hour.

Table 1 provides the schema of a workshop for 9-to-12-year-olds. The groups of children consisted of 12-15 participants per workshop. It should be noticed that, in some workshops, the order of games was changed, depending on the average age, background knowledge in Lego robots, and the main interest of the participants.

Table 1. Format of workshop activities for 9-to-12-year-olds.

Phases	Activity	Duration
Prelude	Introduction: the teacher introduces him/herself and the students, the children are invited to play the "who I am" game, i.e., a fake	

[1] http://www.amazon.com/LEGO-4544091-Mindstorms-NXT-2-0/dp/B001USHRYI

[2] http://www.robotshop.com/aldebaran-robotics-nao-academic-robot-v3plus-7.html

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pp. 125-133

Phases	Activity	Duration
	robot is passed from hand to hand as if it were a microphone, and the kid speaks to the car and introduces himself/herself. Then each kid gets a badge with his/her name.	
	The children are divided in two groups, each group is challenged to write on a whiteboard “what is a robot”.	
	The teacher collects the various definitions and reads and comments them aloud. The interesting points of the definitions are highlighted by the teacher and children alike. Then the teacher shows images of real robots and fake robots, e.g. from movies and cartoons.	
	The teacher shows a robot and explains its main components: wheels, light sensor, microphone, loudspeaker.	
	The teacher draws on the whiteboard: (1) the primitives of the iconic language[3] for the activities, e.g., turn the wheels once; (2) the if-then programming command.	15 minutes
Intermezzo	Game 1: the robot initially stands still. If the microphone perceives some noise (like a clap), it moves a bit forward and stops again. Each group of children tries to make the robot move, and reason about it with the teacher. Each group writes the program behind the observed behavior of the robot using the iconic language. Programs are discussed or tested.	
	Game 2: the robot is programmed as in Game 1, just that it moves faster when the noise is louder. The robot – put on a table – shall reach the end of the table and fall down (the teacher of course catches the robot). The groups compete shouting to the robot as loud as they can (whose robot is the fastest?), while a student times the robots. The teacher adds to the primitives to be used a graphical representation of a loop, and then each group writes the program causing this behavior. The programs are discussed or tested, and all the groups are congratulated in the end.	
	Game 3: the robot is programmed as in Game 2, just that it uses the light sensor to detect if the end of the table has been reached, and it stops in that case. The groups compete again and write/adapt the programs. The programs are discussed or tested.	20 minutes
Finale	We demonstrate an “intelligent” behavior of the robot: the robot is programmed so that it follows a line on the floor (the code is not shown). We briefly discuss how this could be implemented.	
	We show a funny type of robot that moves like a worm. The children have to guess what animal the robot resembles and are challenged to guess how to program its movements.	
	As farewell, each child receives a small prize.	10 minutes

In the Prelude, the teacher invites groups of children to reason about the foundational ideas of artificial intelligence, and creates an informal atmosphere for “breaking the ice” and knowing each other. During the Intermezzo, the teacher first describes an activity, verbally, and the student shows the robot performing it. In the 2nd game, the

3 The language is a simplified version of the Lego Mindstorm language created for the purposes of the workshop.

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pp. 125-133

teams of children compete in order to make the robot fall fastest, and in the 3rd game, they have to make the robot reach the end of the table fastest. The teacher leads the discussion on why the robot moves fastest, then explains the used programming components to program the robot for the game's activity. Afterwards, the groups of children write their programs on their whiteboard within a (not rigidly) fixed amount of time. The students replicate the program written by the children and show what the robots do. This type of feedback helps the children understand how the program they created gets executed by means of the robot. During the Finale, a student takes the lead, showing the "intelligent" line follower and the funny inchworm robot.

As for programming, Game 1 requires concatenation and "if-then" commands. Game 2 introduces the notion of bounded iteration. Finally, Game 3 requires concatenation, if-then and bounded iteration.

Timings foreseen in Table 1 generally underestimated the duration of the Intermezzo phase. Game 1 did not present difficulties and children easily devised the correct programs. Game 2 was more challenging, and students assisted the children on how to use bounded iteration. Game 3 proved to be too difficult for many children, and was solved with minor assistance only by older children, who had some experience with Lego Mindstorms robots. If all groups were stuck on Game 3 even with the assistance of the students, after a fixed amount of time, the teacher explained the solution, and the students executed it, then discussing it with the children.

Game 2, and the competition within it, was a huge success with all the children: children immediately understood that the noisiest team would win, and devised strategies for making as much noise as possible, and as close to the sensor as possible. The intention of the competition was also that of enforcing the play atmosphere of the workshop's games (sic): hearing a teacher asking them to "be the noisiest" engaged even more the children into the workshop's games.

4 Workshop Design for Preschoolers

A second round of workshops was arranged during the Fall period, building upon the experience of the Spring workshops, and targeting preschoolers. Our programming activities were beyond the reach of such young children, so the main goal was to show and discuss an "intelligent", programmed behavior as opposed to the "mechanical", radio-controlled behavior of many popular toys. The games were designed again to last approximately 45 minutes, and were mostly based on visual experiences (watching movies), sound and tactile experiences ("push the button and the robot will go").

Table 2 shows the modified script for the preschool games. These were designed in order to be run without the assistance of students, since those who were available in the Spring were unavailable in the Fall period, and there was no opportunity to train others. A second teacher was however present as assistant, in order to help the teacher playing the expert moderator with all the practical issues.

Preschoolers' groups per workshop were smaller, consisting of circa 5-8 children per workshop, and parents were invited to stay in the same room to reassure children

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given the totally new environment. Due to the presence of friends and brothers, who wished to join, the actual age of participants ranged from 4 to 7 years.

Table 2. Format of workshop activities for pre-schoolers

Phases	Activity	Duration
Prelude	Introduction: the teacher introduces him/herself and the students, the children get a badge with their name. The teacher shows some videos of robots that are similar to animals, such as a fish[4], snake[5], dinosaur[6], seagull[7], etc. The teacher shows a robot and explains its main components: wheels, light sensor, microphone, loudspeaker.	10 minutes
Intermezzo	Game 1: the robot initially stands still. If the microphone perceives some noise (like a clap), it moves a bit forward and stops again. Each child in turn presses the "go" button to start the program, while another child makes the noise. Game 2: the robot is programmed as in the game 1, just that it moves faster when the noise is louder. The robot – put on a table – shall reach the end of the table and fall down (the teacher of course catches the robot). The groups compete shouting to the robot as loud as they can (whose robot is the fastest?). All are congratulated. Game 3: the robot is programmed as in the game 2, just that it uses the light sensor to detect if the end of the table has been reached, and it stops in that case. The children are emotionally involved: would the robot fall down and get "hurt"? Will it stop and be safe?	20 minutes
Finale	We demonstrate an "intelligent" behavior of the robot: the robot is programmed so that it follows a line on the floor (the code is not shown), that is, a "road" among dwarfs, wolf, Grandma's home, etc. This is contrasted with a radio-controlled car, a toy that children are familiar with. We show a funny type of robot that moves like a worm. Children have to guess what animal it resembles. As farewell, each child receives a small prize.	10 minutes

Figure 1 shows a group of preschoolers in the Finale activity, closely watching the robot following the white line and helping the robot in case it went off track. This image was taken during the EURobotics Week [7], since one of the workshops was scheduled in such a time frame. In the end, the children "befriended" the robots, and it was hard to convince some of them that the game was over, and that the robots (as well as the teachers) needed some rest to recharge their batteries.

4 http://www.youtube.com/watch?v=eO9oseiCTdk
5 http://www.youtube.com/watch?v=cJuNe50uuzk
6 http://www.youtube.com/watch?v=jqR8vDLp_9w
7 http://www.youtube.com/watch?v=Fg_JcKSHUtQ

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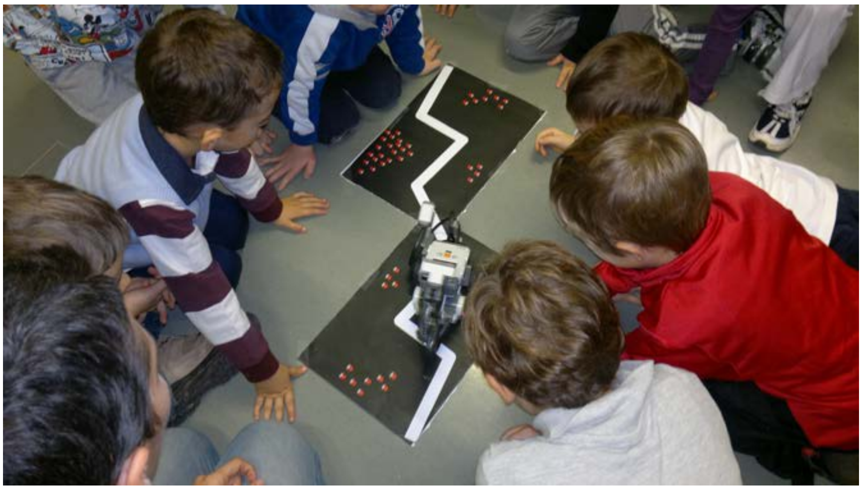

Fig. 1. Preschoolers in the Finale activity.

5 Discussion and future work

The workshops on Robotics, like similar activities undertaken by other faculties, indirectly involved also families of participating children. Parents, brothers and sisters, and sometimes grandparents, were invited to a final event mimicking a Diploma ceremony. This informal get-together gave a second post-experiment opportunity to gather qualitative observations about such an experience. Many among the older children expressed a change in attitude with respect to higher education, and started considering possible future careers on topics that before were completely outside of their interests, according to their relatives. Widening the horizon of the young generations, in a mainly rural area as that of Bolzano, is part of our broader aims, and the workshops seem to have gone into this direction.

For what concerns specifically the experience with robots, we have always been surrounded by enthusiasm and curiosity. The groups of older children consisted of 12-15 participants per workshop. They sometimes showed some popular misconceptions about what robots are and what they can do, but quickly grasped the main issues, e.g., that a robot is "an intelligent agent directed by sensors", and showed no major difficulty in understanding the basics of programming.

As for preschoolers, the presence of friends and brothers, who wished to join, made it difficult to manage the group activity as foreseen by the script, since it proved to be too difficult or too easy for someone. The small group made it anyway possible to let all children participate and act – everyone in turn pressed the "go" button, operated the robots, etc.

The experience is now going to be repeated during 2012, concentrating most workshops in spring, and moving workshops also to schools or kindergartens where teachers have asked for our presence. This shall widen the possibility to participate in

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the workshops, reaching children that would otherwise never be taken to the university, because of distance, or due to family constraints.

So far, robotic workshops have made children and their families aware of the university "for all", as well as of the fact that university teachers and students are "normal people" that know how to have/be fun, and that computer programming may be fun for everyone, not just for nerds. This change in the perception of computer science in the territory will hopefully have a positive impact on the future generations, up to an extent that at present we cannot forecast.

6 Conclusions

This paper describes an experience, planned with the user centered design, which took place inside "Junior Uni", during 2011, at the Free University of Bozen-Bolzano. The paper focuses on the workshops on Robotics run at the Faculty of Computer Science.

Eight workshops for and with children were arranged inside the university premises, four of them devoted to children aged 9-12, and four devoted to preschoolers. Research staff and students from the Faculty of Computer Science ran this experience, and involved children in activities focused on robots. All children were challenged to think about fundamental ideas of artificial intelligence, e.g., what distinguishes a robot from a remote controlled car, and older children were introduced to the basic commands of programming and challenged to solve concrete problems by programming their robots. The experience was successful according to the qualitative observations we gathered during and after the workshops, e.g., children were eager to express their ideas about what an artificial intelligent agent could be, as well as to run their own programs and play with the robots. Several parents reported that they were happy to know what the university was like and to meet professors in person. Similar larger-scale initiatives with quantitative data gathered via questionnaires are planned for the next fall.

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