An attractive way to teach programming

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Abstract

In Argentina, the incorporation of ICTs (Information and Communication Technologies) to the classrooms is manifested in many different ways. In most of the cases, it is present when teaching of tools and products which are mainly oriented to Offimatics and Internet access. Although these tools are extremely necessary in today's world, they themselves are not sufficient to stimulate the interest of the students in ICTs. The schools that teach programming generally do so by means of traditional techniques, such as procedural languages, like Pascal or C, or event oriented visual languages, such as Visual Basic.

This article presents a proposal to bring the new technologies to the classroom in an untraditional way. It consists of using personal robots for the resolution of problems by means of the development of algorithms written in Python. The robots which would be used have sensors and a digital camera, by means of which they allow to manipulate and program dynamic trajectories, and work on the images captured by them. On the other hand, the use of Python [1] introduces free software philosophical concepts to students and teachers, an activity which the UNLP has been promoting for many years. [2][3][4]

This proposal is based on the RobotEducation[5] initiative presented in the event "Latinamerican Academic Summit 2008" organized by Microsoft Research in the city of Panama. From this experience we will adapt the manuals and resources available to the particular characteristics of our region.

This article explains the process of adequation and adaptation of the required teaching resources, as well as the update of the curricula in the involved schools. We will describe the pilot school selection mechanisms and the training process undergone by the teachers in order to implement this project in the classrooms.

This is an innovative training proposal, in which complex knowledge such as problem resolution and programming are transmitted by means of simple tools and mechanisms which stimulate and promote the teaching process and the creativity of the students in the formulation of the activities to be performed with the robots.

How and what is taught in ICTs in our schools?

In 2006 the National Education Law[1] (Law 26.206) extended compulsory education to 13 years, including complete Middle Level. This level includes 7th year of the EPB (Basic Primary Education) and from 1st to 5th year of Secondary level. The ages of these students vary from 12 to 17 years old.

Among the curricular contents, concerning ICTs teaching, the new law includes as part of its aims and objectives to develop the necessary competences for the use of the new languages produced by ICTs. It also establishes in one of its articles that the access and domain of ICTs will be part of the essential curricular contents for inclusion in the knowledge society.

To talk about how and what is taught in informatics today in Argentina in Basic and Middle Level educational institutions, in private as well as public ones, we will begin with a brief summary on the incorporation and evolution of the teaching of this discipline throughout time.

The first incorporations of informatics teaching in education began in the 80´s, basically in Middle Level schools. At that time, the objective was focused on teaching programming, generally using Basic as a programming language. In further years, Informatics teaching began descending to the Basic Level, and Logo language appeared, which enables a more natural programming. This language, besides from containing simple sentences and a friendly syntax for the students, enabled them to program in a fun way, for they could make charts and drawings on display through

the computer screens.
Although both proposals were a good way of introducing informatics in schools, they had their weak points. Basically, there was much emphasis put into teaching language sentences and operations, rather than in the methodology, apart from consisting on highly demanding logic that required a level of abstraction and symbolization that exceeded the student´s congnitive posibilities .
Some years later, with the advent of machines with a higher capacity of storage and processing, new informatics tools were incorporated, such as graphics and offices software, and informatics teaching began to aim towards explanation of the use and function of these tools in particular. This focus is maintained today in many of the educational institutions in our countries.
Another approach which began some years ago and is being increasingly consolidated is to consider computer as a tool for studying and for enhacement of the topics seen in the classroom. Informatics tools are used, but from a different perspective to the previous approach. The tasks given by the teacher are reflected in some of these tools and the focus is centered not in the full explanation of the function and use of the application used, but on the development of the activity given by the teacher. It is beleived that learning about the informatics tool is acquired throughout time as the different tasks are carried out.
In this approach, the use of educational software is incorporated. It is a vision where the computer as a tool is used in all the disciplinary fields. The main difficulty to carry out this perspective, which is the reason why its evolution was delayed, was the lack of informatics knowledge by the teachers, and as a consecuence, their continuous refusal to use this new resource. Appart from being afraid of unknown issues, we can also add the additional time that the coordination among informatics teachers with the rest of the teacher staff demands to implement this approach.
At the present, as mentioned before, many educational institutions that count with computer cabinets suitable for imparting informatics to their students (because this is also a reality to consider), continue with the approach of functionality and office application teaching, adding teaching on the use of applications which may enable to handle Internet services, such as browsers and e-mail programs. Others apply or are tending to apply the last approach mentioned.
Regarding programming teaching, which in general corresponds to Middle Level education, they continue teaching Basic language but in its visual version: Visual Basic. Whichever the program used, the way of teaching the programming techniques are in most cases, the traditional ones. They begin with the language syntax and program traditional algorithms, such as mathematical calculations, etc. In those institutions where they work with visual languages, they work more intuitively, “drawing” interfaces and adding the necessary events for their interaction, but these are the least cases.
Teaching topics such as informatics networks, operative systems, profound knowledge of computer functionality, etc. are seen specifically in technical schools.

The IPRE experience

IPRE, Institute for Personal Robots in Education, is an institute which is specialized on the development, application and use of personal robots in education. It aims to make Computer Science teaching more fun and effective [6].
IPRE, along with educational institutions such as Georgia Tech and Bryn Mawr College of undergraduate level, carried out the initiative of using personal robots for basic teaching in programming, specifically in the subject of Computer Science 1 (CS1). The use of robots as a didactic tool to initiate students in programming was an innovating and motivating idea. It emerged as an alternative solution to the problem detected in the USA in the Computer Science careers, where a 20% enrollment low was registered in those careers and also a drop in the 1st year of almost a 60% [7]. This data was provided by the US National Science Foundation where the period 2002 to 2004 was taken into account.
This situation can be significantly contrasted with the labor offer existing for IT proffesionals that, according to the Bureau of Labor Statistics, will increase in more than 1,2 millons jobs in the next decade.
This situation, framing the North-American reality, can be applied to the Argentine reality, where in the current year the study of technological careers has been encouraged from the government, with study grants and by promoting initiatives for the area development.
To organize the CS1 courses, groups of aproximately 20 students were formed. Each student counted with a robot

which was connected through a bluetooth way to a PC. The new users could command the robots from their PC or notebook, by writing instructions that were inmediately interpretated by them without the need to learn the traditional cycle of translation and compilation [8].
From an educational perspective, the most imporant characteristic of these robots is that the students could learn the basic concepts of programming in an intuitive and fun way, exploring instructions and language sentences to handle them, move them, give them orders and reproduce sounds as well as maniputale pictures. This encouraged them to create programs with more complex algorithms and to be able to experiment the results in an interactive way and through direct observation on the robot.
Using robots, artistic (painting/ dancing), social (theatre play and ballet) and game activities were organized, which enabled the students to work with their creativity in a collaborative way in the development of programs.
Robots simplified programming learning and progam debugging. They made visible and tangible those abstract aspects which are inherent to Computer Science, where instruction execution is inside the computer´s memory, behind the computer screen.

The necessary technical requirements

The computer environment used for the robots is called Myro, which stands for My Robotics. Myro is a shared source project aimed at making it easy for beginners to learn about computer science by programming robots. This is a project of the Institute for Personal Robots in Education, a joint initiative between the Georgia Institute of Technology, Bryn Mawr College, and Microsoft Research.
It is a library of functions written in Python for robot movement, sensor readings, multimedia and image processing, automatic web publishing, communication via instant messaging, music and tone generation, and text-to-speech translation.
Myro is a cross-platform tool that works on Macintosh, Linux, and Windows operating systems y Python is a high-level interpreted scripting language which belongs to Free Software that itself exhibits many of their pedagogical goals.
The robots have the advantaje of not being very expensive, the pack with the bibliography costs $150,- comparable to a text book. They are also portable, small enough to carry in a backpack, wireless, controlled from computer, customable, interactive and easy to program [8].
The bibliography which comes with the robot is very complete and appropiate to be applied in the 1st year of the career. Among it, it includes Myro reference materials, extensive materials for instructors, practical activities and chapter web-based textbook called
Computer Science 1—An Introduction with Robots.
Their experience was invaluable and it generated an interest and important motivation to be able to adapt it and use it in our country with a younger audience: the children we will work with are between 13 and 15 years old. This community is used to using the PC only to play, surf through the Web and chat, which will imply a great challenge for us. We intend to expand their vision of Computer Science and give them a a fun approach to informatics, proposing more creative and educational activities such as problem resolution and programming.

Our proposal

IPRE experience was presented in the event “Latinamerican Academic Summit 2008” organized by Microsoft Research in Panamá city. In that presentation, emphasis was placed on the fact that “programming can be fun” and that studying computing is not only for those that have enrolled for studies in this field [2].
On that ocasión, Lic. Javier Díaz, Vice-Dean of the Informatics Faculty and Director of LINTI, made contact with Jay Summet, one of the teachers in charge of imparting the course in the Georgia Technological Institute. After this contact, Prof. Summer visited Argentina, where he gave a seminar for teachers that would be in charge of working with the children in our country [9].
The original proposal is based on the idea of “personal robots”. This means that each student has his own robot. Although the cost of each robot is not unreasonable, it is too high for the public schools of our region. This is why our experience will be carried out with two (2) robots by group, for which we will have to adapt the contents and

activities to be done in groups. The available material includes a text book with is handed in with the robot purchase and is available on the Web. This book is very well written and describes very well the necessary guides and concepts for the course, but it is in English. For this reason, the first activity carried out was the translation and adaptation to our language. This task was not only beneficial for our teachers and students, but also for the IPRE that has spanish speaking students and this version will also be available for them.
Besides the translation, we had to adapt the activity guides so that they could be carried out in groups. For this reason, we added activities that can be done without the robot, such as program formulation that use the Myro graphic libraries [10].
As mentiones before, the ages of the children we will be working with are different, and this demands a reformulation of most of the activities.

Pilot Experiences

Initially, we will begin working with two schools in the Province of Buenos Aires. The ESB Nº 3 from the town of Arturo Seguí and the ESB 5 from San Andrés de Giles. In the first case, the project will be coordinated in the school by the teacher Dora Guevara, and in the ESB 5, it will be carried out by the teachers María del Carmen Marengo and Adriana Dolores Miravalles. Both projects have been subsidized by the Scientific Research Comission from the Province of Buenos Aires [11] and in both cases has been called: "Program Learning with robot experience". Both schools are linked to each other and to LINTI researchers[3], UNLP, who assist teachers and students in any situation and are the ones who impart training sessions for teachers and encounters with the students.
Since none of the schools have teachers with experience in programming, we have organized a series of workshops to work with the teachers that will be in charge of the students, as well as other teachers who have the intention of implementing this initiative forward on.
Teachers count with the translated and adapted material and we expect that during the year, they will make suggestions and guides to improve it.
Before begining the first training, we carried out a survey which enabled us to know not only the level of programming skills of the teachers, but also the degree of commitment to the project. It is essential for the teachers that interact directly with the children to be absolutely convinced of the project objective for the implementation to be successful.
From a total of teachers surveyed, 83% mentioned it was easy to work with the robot, 66% mentioned that is was hard for them to use and get used to Myro and Python environment, but 100% said that the material they had was enough to carry out this experience, and that they consider that the use of this technology is a very useful pedagogical tool which can improve the process of learning programming. We must recall that these teachers didn´t have previous knowledge on programming, which means these are very satisfactory results.
Although in this first stage it will be worked as an extra curicular workshop, the integration of these activities in the curriculum is planned.

Conclusions

This is a very interesting proposal which enables to approach a new vision on the use of ICTs at school
The pilot experiences are just being started and have caused great expectation not only in the schools which participate, but also in the general media.
Even if in our country there aren´t uniform policies on what should and what shouldn´t be taught in the area of ICTs, we beleive that this type of experience may open a line of discussion to incorporate this approach to Middle school.

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[2] We must recall that the CS1 course is for all the Institute students, whether they study Computer Science or not.

[3] In particular, we would like to mention the LINTI researchers Sofía Martin and Fernando Lopez, who have commited with the Project and contribued by preparing activities and guides which were used in the workshops.