Everyone to Robotics: an educational robotics project in Argentina

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Abstract. Under the new Argentina Education Federal Law and the digital development plan, the province of San Luis began to intensify technology education in the classroom based on digital technologies essentially. From this extensive work in technology education, it was considered essential to achieve significant learning adding digital development incorporating concrete material. In this direction, it expanded its educational digital project inserting robotics in the classroom. This new project aims to introduce this innovative resource in transverse way, proposing a specific working method and a content platform that accompanying teachers of all subjects in its implementation. Below are the features of the project and findings after two years of its implementation.

1 Context: Federal Law of Education.

Education in Argentina is governed by the National Education Law No. 26,206 that defines a common set of knowledge called Core Learning Priorities (NAP in Spanish), settling a common basis for education throughout the country.

The NAP defines knowledge as products of learning processes and it's oriented to build a teaching agenda. Under this option, the agreement of the national curriculum can be expressed in different content selections the Jurisdictions made, including topics of specific interest in their schools and communities. This scheme leaves a political and practical for the provincial and teachers make the decisions that are inherent in their professional role.

Thus the administration of educational institutions (management and organization of primary way) is in the hands of the Provinces (States) and the CABA.

In this framework the province of San Luis is actively implementing various initiatives to achieve alternative approaches to the NAP with a large digital footprint.

2 Description of San Luis as a province.

San Luis is a province in Argentina located in the Cuyo region. It has a population of 450,000 inhabitants and an area of 760,000 km2.

It is estimated that the provincial education system has a total of about 120,895 student's initial, primary, secondary and college/university.

13.3% (16,078 children) of the total enrollment belongs to baseline, 44.7% (54,071 children) are attending the primary level, 36.2% (43,805 students) the secondary level and 5.8% (young 7021) do so in superior careers.

The system has 8085 teachers, primary and secondary, 60.9% (4926 teachers) do their work guiding children's initial and primary levels, the remaining 39.1% (3,159 teachers) teach students at the secondary level.

The province has 451 educational institutions. 379 are state-run, privately run 60 and 12 are under devolved management. Peculiarities of the 113 schools are unique personal and to them must be added the 122 educational establishments with rural characteristics.

3 San Luis Digital

The province of San Luis has carried out a digital development plan, San Luis Digital, which has among its objectives to generalize the use of information technology and communication as a key tool to reduce the digital divide, helping to improve the development and quality of life for all province's residents.

This plan had its first stage in 1998 through the development of a telecommunications interconnection oriented government network throughout the entire province. This was achieved over a fiber optic and radio links which currently interconnects over 1200 posts, evenly on the four corners of the province, this is making the communication system with greater coverage en Latin America.

Since 2008, this plan was extended to civil society through Wi-Fi wireless connectivity, free of charge, with a total of 644 Wi-Fi antennas installed in 74 locations, planning to install 100 additional antennas during 2013.

Simultaneously, the provincial government launched a plan for the purchase of computer equipment: computers, modems and antennas to add, in the shortest possible time, as many people connected to the Internet.

This investment generated the Internet penetration rate, defined as the ability to access the network measured every 100 inhabitants, reaching more than 90% of the population. Today the Internet link is 2,900 megabits per second and more than 85% of households have at least one computer.

This plan is executed by the University of La Punta (ULP) with each of the Ministries of the Government to ensure services according to their competences. The ULP is a provincial university, economic resources from the provincial government[1].

[1] For more information see:
Digital Infrastructure of San Luis:
http://www.ulp.edu.ar/comunicacion/libros_ulp/infraestructura/files/libro.pdf

The development of a digital province:
http://www.ulp.edu.ar/comunicacion/libros_ulp/desarrollo/files/libro.pdf

4 All the Kids on the Net

This initiative is part of San Luis Digital plan and it is an experience that applies the model one to one aiming to improve the quality of education, providing a laptop to every child in primary school and teachers, with the goal of improving school performance. Currently, this initiative involves all primary schools in the province of San Luis.

Objectives:

- Improve the quality of education in primary schools.
- Improve the level of learning of elementary level students based on the content of language, math and science, which it is specified by the Ministry of Education of San Luis.
- Expand the use of ICT in schools, to digitally literate through useful knowledge, that impact in the daily school activities.

The Government has delivered more than 70,000 computers to students and over 2,000 to teachers of primary school in the Province. The plan has trained 95% of teachers in literacy for the future which added Internet access not only at school but also in homes, configuring a setting for educational improvement and implementing new initiatives[2].

5 Everyone to Robotics

As part of the Digital Agenda developed by the province of San Luis where all primary level students have their computer and all schools and localities have internet access for free, Everyone to Robotics project is carrying out.

It is an educational project for primary students with concrete material introducing robotics technology as a teaching resource in the classroom, and activities based on the Core Learning Priorities (NAP) established by the Ministry of Education's Office which does not isolate this technology the everyday life in all disciplines.

Stories of San Luis Digital
http://www.ulp.edu.ar/comunicacion/libros_ulp/historiassld/files/libro.pdf

[2] For more information see:
All the Kids on the Net (2009 & 2010)
http://www.ulp.edu.ar/comunicacion/libros_ulp/chicos/files/libro.pdf
http://www.ulp.edu.ar/comunicacion/libros_ulp/chicos2/files/libro.pdf

Digital Natives with Disabilities
http://www.ulp.edu.ar/comunicacion/libros_ulp/chicos3/files/libro.pdf

6 Project Framework

Speaking of technology, robotics and artificial intelligence is no longer a futuristic projection, it is tipping increasingly on issues and problems of the present. Many leading educational institutions share this view, and understanding that they are training their students for a rapidly changing world, they want to incorporate into their project activities related to the theme.

Now, introducing concrete technology material is not simply buying robots. It is necessary to carry out a comprehensive project that does not isolate the technology of everyday life in all disciplines, in the same way those technological devices across all the tasks we do in our lives. With this vision, the University of La Punta is implementing the project Everyone to Robotics in primary schools.

From constructivist theories has begun to focus the use of technology in the classroom to internal aspects of the student, to the cognitive processes involved in the learning interaction with technology, beyond use pragmatic thereof (Papert, 1990, 1991 - Alimisis, 2007). It is considered that the learning process is related to an active exploration and personal knowledge construction. The development of a device to solve specific real-life problem requires the formulation of hypotheses that will then contrasted in the design and programming of the device (Barak M., 2009). Moreover, there is increasingly greater prominence to theories that emphasize the use of tools of mediation, teamwork, the study of relationships between individuals, significant assigning roles and others, such as activity theory, or distributed cognition.

Thus, the project contemplates implemented these new educational trends, giving teachers and students a set of highly motivational, cross-use, significant, contemplating the world and future of children.

7 Proposed Methodology

The inclusion of these new resources for classroom's teachers represents a complex challenge, since not only they are new in education, but almost none of them have the used of similar elements in the course of their daily lives. Therefore, it is essential to accompany them in the first steps of the process to once again do not feel they have to implement projects away from their learning needs, in offices designed by scientists and officials outside the reality of the classroom (Buckingham, 2008).

On one hand, the project proposes a methodology classwork with three moments allowing the construction processes with the content, giving educational content to assemble, beyond the obvious playful aspects of the use of these materials.

Furthermore, the development of these devices becomes impossible automated individually. You need teamwork, beyond the need that arises for economic reasons in the purchase of equipment. And it is very important to order with different roles this group work so that each participant has a specific and concrete work within the activity, each role in developing a set of specific skills. The proposed roles are linked to the organization of work materials, the construction process, and the representation of the

computer from the teacher and their peers, developing written reports and other activity.

Both now work in the classroom as organization teams had its inspiration in the "Infoescuela" Lego in Peru (Iturrizaga, 2006) and experimental science project "Hands-on" in France (Charpak, 2006)

8 Organization of the classroom activity moments

In the first stage (frame of reference) introduces a problem situation of daily life, which provides a framework for building students subsequently performed. In it, from videos, photos, stories, news or other stories, there is a problem related to the engine situation to be develop. From this material, and with the mediation of the teacher, the student gives meaning to the activity they're doing. Furthermore, in all cases there is a deep bond between the nuclei of priority learning (NAP) of the grade and issues of status raised.

After entering the frame and presented the problem, students will build in the second stage (construction) a device that allows solving in part or all of what they have seen in the first stage. This device is among many others, and as the group and the teacher feels more comfortable with the material, may be replaced by one of his own creation.

Finally, upon completion of construction, each group will present their results (analysis) showing the operation of the game or doing some use.

9 Towards a true team work

To get students becoming involved in various cognitive challenges presented by this work, we propose to divide them into groups of two or three. Each of the team members will rotate suggesting a role in each activity, so that everyone has a chance to overcome the problems posed by each member of the team.

Moreover, it is noteworthy that, although each of the students has a particular responsibility, this does not mean they should be isolated from teammates. Precisely such liability is related to an objective, and it is very important to involve their colleagues in achieving it.

Suggested roles for each of the members are:

1. Constructor: it is responsible for the assembly of the device to a successful conclusion. Requests collaborative peers for preassembled certain structures analyzes carefully the plane to interpret for construction and fine motor exercises.
2. Responsible for materials: organize the components of the kits, preparing the parts you need the builder and works with pre-assembled structures. Exercise analyzing construction drawings and fine motor skills. Finally, to complete the construction and disarmed it, arranges the pieces in the box for return, verifying that has not dropped any of the pieces on the workshops tables.

3. Team Leader is the team representative between the teacher and peers. It completes the activity report and presents it at the time of analysis. Faced with a need of the teacher is the one who calls and communicates the difficulties. Also, if they must perform some programming, it is responsible for putting it together on the computer and downloads it to the device controller board.

In the event that the team is considering only two students, the builder is also responsible for the materials, counting from and with the help of his partner.

10 Robotics kit features used in the project

With respect to the specific material used in the project, we selected a national educational robotics kit, provided by Robotgroup Company. Its name is "technology box" and is comprised of:

- Various parts of acrylic, mdf and aluminum, with a construction system developed by the company itself. The connection between the parts is performed by using bolts and nuts.
- Controller DuinoBot. DuinoBot is a flexible and powerful platform arduino compatible for developing and prototyping electronic programming AVR microcontroller.
- Sensors: sensors present in the kit are designed for the needs presented by the various proposals are armed in the platform. These are: LDR, CNY70, sound, push button and infrared receiver.
- Actuators: the controller has a buzzer and various integrated LEDs, and includes LEDs to connect to other ports. With respect to the engines, two DC motors provides 200rpm.

11 Implementation of robotics project

For the implementation of this project, first the ULP trains teachers and then maintains personal contact, virtually or in person, offering new trainings, collaboration in the first classes, counseling for different activities, via emails , IP phones, experience sharing forums web platform based on Moodle.

Moreover, in order to work on the project in hand the ULP character lent to each of the educational institutions of technological boxes with corresponding assembly kits.

The methodology of classroom work is under a workshop modality activities and all of them are available in a Web platform; www.todosalarobotica.ulp.edu.ar in which there are more than 100 activities, discriminated by cycles and areas of knowledge and all prepared with content based on the NAP, which have a teacher guide, activity framework, a guide to analysis and construction steps.
Her we can see the growth of the project:

Year	Students	Schools	Kits Delivered	Trained Teachers
2011	5517	22	210	37
2012	11767	217	1114	496
2013	4121	53	265	63

With these steps we will complete the entire primary education system Province:

- Students 21405
- Kits 1589
- Schools 292
- Teachers directly involved 596

12 Conclusions and Future Work

In these two and half years of project implementation, the results were very positive. Students have shown from the beginning a great motivation of working with this material and doing it together in the form of a workshop. At the same time, teachers and school officials have realized this, and they have begun working with a very good initial predisposition toward the use of these resources.

It has generated a positive spillover effect into the new institutions for the advice and comments received from other institutions where it has been launched. In addition, schools that already have two years of work in robotics have not only maintained the activity, but adding the teachers have increased in all areas, conducting trainings own school, inviting the community to participate in activities parents and siblings, and performing in events related to science as the science fair or Roboliga (Argentina Robotics Olympiad). That is, the motivation could be the result of novelty is not lost, which indicates that it is inherent to the material and the proposed activities.

The set of proposed activities on the platform has grown, not only from the work of the teaching staff accompanying the project, but also activities suggested by the teachers themselves. In this case, the activities for the lower cycle (1st-3rd grade) are most teacher participation in its development have had so far.

The participation of teachers in the forums is high, not only for querying, but also to showcase their work and make proposals.

However, many of these positive aspects are measured from our own eyes, without a formal evaluation of the project. For this reason we are making an agreement with the University of Buenos Aires for the development of an external evaluation in all aspects of the project.

Finally, in 2014 we plan a new project in our middle schools, focusing on issues closer to the hard sciences, extending the use of this equipment for data acquisition for experiments in physics and chemistry and a new methodology adequate job of middle school students.

13 References

1. Alimisis, D., M. Moro, J. Arlegui, A. Pina, S. Frangou, and K. Papanikolaou. "Robotics & Constructivism in Education: the TERECoP project." In EuroLogo, 40:19-24, 2007.
2. Barak, M., and Y. Zadok. "Robotics projects and learning concepts in science, technology and problem solving." International Journal of Technology and Design Education 19, no. 3 (2009): 289-307.
3. Buckingham, David. Beyond technology: children's learning in the age of digital culture. Buenos Aires: Spring, 2008.
4. Charpak, Georges. Kids and science: the adventure of the hand in the dough. Buenos Aires: Routledge, 2006.
5. Iturrizaga, I. M. "Study of Educational Impact of the LEGO Dacta INFOESCUELA-MED-materials." Final Report, retrieved June 30 (2000): 2006.
6. Papert, S. & Harel, I., 1991. Situating constructionism. Constructionism, pp.1-11.
7. Papert, S. & Turkle, S., 1990. Epistemological pluralism: Styles and Voices Within the computer culture. Signs, 16 (1), págs.128-157.