

UP SCHOOL: Introduction of Pervasive Learning Technologies to Enhance Classic Educational Models

Paolo Garau, Ludovico Boratto, Salvatore Carta, and Gianni Fenu

Abstract—With the continuous development of new technologies that have been naturally integrated in the daily activities of children, it becomes necessary to include them in the educational programs, in order to enhance the children's learning with tools they are already familiar with. In this paper, we present a case study realized by UP SCHOOL, a new Italian Primary School that introduces a novel educational model, designed around the children to favor their learning. In particular, we will focus on the learning technologies employed in this project, on the motivation that led to their inclusion in UP SCHOOL, and on how they have been designed and adapted for the use by young children in a learning environment.

Index Terms—Computer aided instruction, Computer science education, Educational technology, Electronic learning.

I. INTRODUCTION

IN 2001, Marc Prensky defined the new generation of children as “digital natives” and highlighted that the educational system is not up-to-date with the needs of the modern students [1]. Moreover, several studies, such as [2], highlighted that an improvement in the level of learning is directly linked to the capability of the students to make experiences.

In their every day's lives, children use tools and technologies, like computers, smartphones, and tablets. Therefore, one the hand, children continuously make experiences by interacting with the new technologies, while on the other hand, in most cases the organization of the education in schools does not involve any of these technologies.

In order to cover this gap, in this paper we present a novel Primary School concept of education realized by the internal research team of UP SCHOOL¹, whose objective was to

realize the school around children. The educational model chosen for UP SCHOOL involves a reorganization of the space and of the teaching methodologies, starting from a flexible and polyvalent environment, in which groups of children get together based on their interests and competences, supported by innovative technologies during the learning process.

In the literature, the introduction of learning technologies in education environments has been analyzed from several perspectives. The studies conducted thanks to the introduction of the “Microsoft Innovative Schools Program” [3] confirmed that the introduction of the ICT is essential in order to enhance the learning of students. Oghan and Johnson recently highlighted that the introduction of learning technologies has to be adapted to the cultural context in which these technologies are employed [4]. Therefore, some studies have analyzed the impact that these technologies had in Russian schools [5], and on the difference that characterize Europe and Asia [6]. The introduction of game-based learning approaches that also involve technologies have been presented [7,8]. In [9, 10, 11, 12], it has been highlighted how the design of the environment in which the educational activities are done is an essential aspect for an effective learning.

With respect to state-of-the-art educational models that involve the use of technologies, UP SCHOOL does not only introduce new technologies as learning tools, but these technologies are integrated in a physical space and educational program specifically designed to exploit them, and enhance the learning of young children and their experience at school. This is the first time in which both the design of the environment and of the introduced technological aspects have been combined. Moreover, the cultural context has been highlighted as a characterizing aspect to decide which technologies should be introduced, and in Italy no other school adapted the whole Ministerial Education Program to the learning technologies.

The educational project presented in this paper has been actually realized in a kindergarten and primary school called UP SCHOOL, located in Via Trento 50, in the city of Cagliari (Italy). In September 2015, UP SCHOOL started its first year in which this educational model started working.

In this paper, we are going to focus on the learning technologies employed, adapted, and installed in UP SCHOOL to favor the development of enhanced educational programs, but still based on standard Ministerial Education

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¹ <http://www.upschool.it/>

Programs. Indeed, the new technologies are a central component in the project, since they are employed as learning tools and they are integrated in the school activities. Tools like 3D printers are employed to develop the first “baby fab-lab” where children can learn to make and build in team. Instead, a 3D projector located in a specific school’s room is dedicated to the teaching of science, while interactive tables and interactive projectors are employed during frontal lectures and group activities.

It is important to underline that the traditional tools employed during the learning are not replaced but integrated with new devices and technologies, with a controlled but spontaneous employment by the children. Indeed, thanks to the interaction with the technology, the same subjects can be taught with different tools and educative objectives, like the introduction of logic (e.g., “If you do this, this will happen”).

In order to allow the students to share the information and knowledge they gathered, it is necessary to give them tools that stimulate the research and discussion among them, also letting them employ tools that the modern society requires them to adopt. Moreover, lots of subjects might use the augmented reality to collect and exchange information, or to simulate actions that would be impossible in a traditional school environment. To make this sharing of information and discussion possible, the project integrates all the forms of technologies that have been indicated by Weiser et al. as the essential elements for pervasive computing, i.e., tabs, pads, and boards [13]. Indeed, pervasive technologies are designed to support humans during their daily activities. This is one of the main purposes of UP SCHOOL that, thanks to intelligent use of technologies, effectively integrates the learning process.

The scientific contributions of this paper are the following:

- we present the first Italian educational model in which the whole learning process is adapted to the new technologies;
- the technologies have been specifically chosen and adapted to be employed by young children;
- UP SCHOOL is the first school that uses an educational model in which the learning technologies are integrated in a whole environment designed around the children, which involves both physical (e.g., the furniture) and experiential (e.g., water- and nature-based activities, yoga, etc.) elements that enhance the educational process.

The rest of the paper is structured as follows: Section II illustrates the learning technologies installed in UP SCHOOL; in Section III we present a brief analysis of the impact that the presented technologies have had on parents and children during a first presentation of the school; Section IV presents conclusions and future work.

II. LEARNING TECHNOLOGIES

This section presents the learning technologies employed by UP SCHOOL in its educational project.

A. Tablets

Tablets represent the primary type of technology with which children interact. They are introduced to substitute classic books, since they weight less and they are very easy to consult.

Moreover, thanks to their easy touch interface, it is possible to tailor the education to the needs of each child. Indeed, with monitoring algorithms that work in background while a tablet is being used, we are able to evaluate how each child learns by analyzing different aspects. For example, we can understand how focused a child is while learning a new concept by analyzing the number of seconds used to read a page.

B. Interactive Table

An interactive table is a system that, thanks to a monitor and a multi-touch system, allows the students to see presentations, and interact with the device by searching and sharing the information they want.

As mentioned in the Introduction, each technology is introduced with a specific educational purpose in mind. Teaching disciplines like geography becomes more effective with this type of device with respect to traditional methods, since children can interact in real time with a virtual globe, to locate the countries they are learning about.

The interactive table installed in UP SCHOOL as been specifically adapted to be used by young children. Indeed, the legs of the table have been shortened, so that children with an age of 4+ can sit and lie down the table to interact with it.

An example of room in which the interactive table is installed is shown in Fig. 1. As it can be noticed, the whole room is designed to integrate different type of activities, and the interactive table is placed close to a classic one, so that it can be employed only for educational purposes and enhance them.



Fig. 1. Room with an interactive table.

C. Interactive Projector

The interactive projector (shown in Fig. 2) serves as a sort of blackboard, in which the teachers and students can interact during the lessons.

With respect to a classic blackboard, this projector allows teachers to base their lessons on existing slides, enriched during the lectures with pen-based interactions, allowing them to keep strong the concept of the writing by hand. Moreover, if allowed by older, students can interact with the board thanks to their tablets.

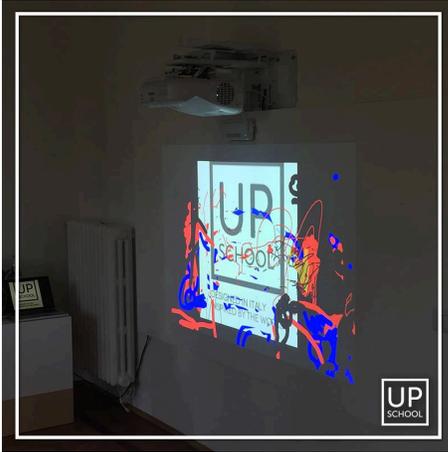


Fig. 2. Interactive Projector.

D. Interactive Floor

A special instrument to keep the attention of children is the interactive floor. This system is based on a horizontal projection of animated images in a floor. The interesting aspect of this technology is the capability to interactively respond to the gestures, by changing the projection as soon as a child “moves” a projected object. In this way, this instrument allows us to develop a number of educational applications useful to keep the child’s attention.

This is another type of technology that facilitates the introduction of the logic during the teaching, for example by showing them in real-time what happens when they rotate a geometric object.



Fig. 3. 3D projector.

E. 3D Projector

This system allows to project images in three dimensions. Fig. 3 shows its installation in UP SCHOOL. As the figure shows, it is formed by two normal projectors, specifically adapted for the purpose of having a three dimensional effect, by connecting them with a serial cable.

Thanks to this special type of projector, the teaching of science-related subjects is strongly enhanced. Indeed, children are allowed to inspect on the human body by seeing it from different perspectives, or analyze natural phenomena (e.g., the erupting of a volcano) by having the perception of what really happens.

F. 3D Printer

This type of printer allows children to learn by making something. Supervised by an expert teacher, they can create real models of what they are studying with her/him.

Thanks to the 3D printer, the capability of children to work in groups is highly stimulated, since the created model is the result of shared decisions and discussion among the children.

Not less important is the introduction of the concept of three dimensions, by participating actively from the modeling to the real creation.

III. FEEDBACK ON UP SCHOOL

UP SCHOOL’s educational model was presented, along with the structure of the school and the previously described learning technologies on July 23, 2015. Fig. 4 shows a picture taken during the presentation.

Parents have shown much interest in this new educational model, especially for the technological aspects that characterize it. Children have naturally interacted with the technologies previously presented; this highlighted the capability of this novel type of school to stimulate the interest toward these technologies and to be built around them.

IV. CONCLUSIONS AND FUTURE WORK

In this paper we presented UP SCHOOL that, on base of educational studies realized by its internal research team based



Fig. 4. UP SCHOOL’s presentation to parents and kids.

on its previous experience, starts to introduce a new educational model, in which the structure, the technologies, and the environment, are designed to enhance the experience of children and improve the classic concept of school.

In particular, we focused on the technologies employed in the project, by presenting them, along with the motivation that led to their installation in the school.

The first outcome of the project has been great, with both parents and children appreciating the project and its technological aspects, and with a first interesting response in terms of subscription to the first year of school.

In future, the research team of UP SCHOOL will study the impact of the presented technologies in the educational model. Indeed, we will analyze the Human-Computer Interaction of the children with the previously presented technologies, and we will also run data mining and statistical algorithms to extract information from the use of these technologies and enhance furthermore the educational model.

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