# Primary preschool experiences with computers in the classroom

Trella, M., Barros, B. & Conejo,R.
*Universidad de Málaga, Spain*
*{trella, bbarros, conejo} @ lcc.uma.es*

## Abstract

*The paper presents some experiences of learning with computer in a preschool setting. The framework MEDEA (a Spanish acronym of Methodology and Tools for the Development of Intelligent Environments of Teaching and Learning) is used to define the activities and construct the user models. The result is an environment that has been installed in the class as a new resource and has been used in the classroom combined with traditional learning tasks. The system has been successfully evaluated with children from different countries and cultures.*

## 1. Introduction

The present work focus on developing a computer-based support in classroom for 3-years old kids (first course of preschool). That is a preschool setting. Children assist to the school regularly but they do not have formal evaluation or obligations. Teachers have general guidelines that suggest types of activities and skills to be practiced individually by the kids. Additionally they can organize group activities in the classroom to promote sociability and to teach kids to communicate and share. In both cases, learners make their activities playing, interacting with the medium and with their colleagues in a continuous process of learning in which they understand the world.

Our approach is to use technology in the classroom for "learning with" computers [8] instead of "learning from computers", that means students use technology as a tool that can be applied to a variety of goals in the learning process [9]. Computer is another resource that helps to working and playing in the classroom along with other traditional resources (paper and pencil, backboard, games, etc.). In the case of intercultural schools, computer-based educational tools offer the possibility to define flexible contexts that help teachers to organize the activities in the classroom considering parameters such as language, pictures and procedures adaptable to child's needs and cultural settings. This requirements has been achieved using the MEDEA[11]. Using this framework, domain model, user model and activities can be defined in a flexible way. It also provides a log manager and profile monitor.

*Powman & Stephen* [7] introduced he concept of *guided interaction*. They described the ways in which children's interactions with computer and other forms of Information and Communication Technologies (ICT) can be supported in preschool settings. With this concept, they provide a tool for thinking about different modes in which learning can be supported to aid teachers to articulate, reflect on and find new approaches to work with ICT in pedagogy.

Focusing on other works related with children and technology, there are some interesting experiences with preschool and primary kids, observing different aspects of learning both individual or collaboratively. Some examples [ 3, 4, 12, 6] deal with digital libraries, reading through writing, graphics and story-telling. They implement learning strategies and observe how their use improves the results. Some of them also explore the possibilities of using new devices in the classroom (such as interactive blackboards, trackballs, video or PDA's).

Our proposal is to model and represent the child needs considering content, transversal and social aspects. The main goal is explore how to improve interaction and cognitive aspects of kids, using configurable and adaptable software and hardware not to disturb the learning process.

The schema of the paper is as follows: next section describes the context and motivation of the research; in section 3 the general architecture of the system and the schema of the user model are presented. Next section describes the experiences with the children in classroom, and, finally some conclusions are extracted.

## 2. Context and motivation

In a multicultural context, kids have difficulties to communicate and develop their skills. Sometimes they know more than they are showing, so the teacher does

not pose the adequate tasks to their maturity level. In this context, it is difficult for the instructor to organize and coordinate the activities in the classroom due to integration problems of the different cultures and knowledge levels of students.

The final outcome of our project is to have an environment that should be flexible, configurable and adaptable to different contexts, languages and maturity levels. This paper presents its first results.

We have considered the following constraints: (1) Play is the medium for learning [13] (2) The teacher has many students in the classroom (twenty, in our case) but all of them are not doing the same activity at the same time; they are doing different activities in subgroups with four or five kids; (3) A 3-year-old kid is not able to keep on doing the same activity for a long time (fifteen or twenty minutes maximum); (4) use of laptops is not appropriate because these young students are used to move and manipulate things in the classroom and a light computer is a good candidate to fall from the table [7]; (5) a conventional computer is better than a laptop but not the most adequate tool because 3-year-old kids have problems to manipulate the mouse [5]; and (6) Not all kids have the same maturity level although they have the same age. For instance, they might not have a good Spanish understanding, (the language used in the classroom), and/or they might use different materials and methods at home.

In preschool setting, the learning curricula is organized in several themes about the surrounding word of the children such as my home, my school, the market, the food, my body, etc. At the same time, they also practice different skills within these themes, such as language, mathematics, motor skill coordination, basic concepts (empty-full, more-less, big-small, near-far…), music, etc. Finally, they also learn transversal concepts that introduce them to social aspects, like health, environment, morality and, a very important aspect in our research, equality and interculturality. Children do not follow the domain theme by themselves as in the school or university. Teacher organizes different tasks, games and activities in a domain considering one or more skills and transversal aspects. This way of learning has guided the way in which the user model and the learning process have been designed (See section 3 and 4).

Furthermore, in this research, teachers manifested the importance of having full control of the instructional process at each stage of the learning process, and for each kid in their classroom. They indicate that they are not interested in having a program that automatically proposes activities to kids according to his/her profile. Teachers want to combine traditional activities in the classroom with computer activities.

Another requirement is a complete and updated profile of each kid. Teachers require evaluation data about the computer-based and the non-computer-based activities. The first is updated automatically by the system in the user model of each kid. For the latter, the system offers and interface to manually introduce the results of other activities.

## 3. General schema and user model

To achieve the goals proposed in this project, a set of learning activities have been designed and implemented in conjunction with a preschool teacher team. These activities have been deployed by using the MEDEA framework [11] a software tool that allows building web-based adaptive learning environments that are able to adapt the learning process to student needs.

MEDEA provides tools that allow 1) to introduce contents and configure their presentation according to the particular features of a student or a group of students and 2) to manage and monitor student activities. MEDEA can also decide, along the instruction process, the activity that better suits student needs but also allow teachers to do this work manually) MEDEA evaluates the tasks done by a student and uses this information to update the student model and draw conclusions about the more suitable learning path from a current instruction point.

In this sense, this framework is more than a content manager. It provides curriculum sequencing, selection of teaching tasks, student diagnosis techniques and student monitoring. It can also be used as an assistant that helps teachers in pedagogical decision making.

The user model has been designed taking into account the preschool curricular model peculiarity (see previous section). We have considered a multidimensional model that organizes the children knowledge in three axes: 1) *cognitive*; 2) *domain*; and 3) *transversal*. The first one is related to the skills acquired by children in different areas as language, mathematics or psychomotricity. In order to practice these skills in the classroom, they are contextualized in subjects that are familiar to the children and belong to their closer environment as school, family, his/her body, food, etc. These topics constitute the *domain* axis. Finally, the social aspects of the education are included in the *transversal* axis. These issues become relevant in early education stages where children learn concepts related to health, ecology, good manners; and cultural and social diversity.

The child knowledge level can be measured from any of the three perspectives. In this sense, we have designed activities in which items from the different axes are combined.

**Table 1. Some exercise types and their relationship with the axis of the user model**

| | | EXERCISE TYPES | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| AXIS | *COGNITIVE* | Inside-outside | Inside-outside | Inside-outside<br>Big-small |
| | *DOMAIN* | | Food<br>Fruits | Foods<br>Sizes |
| | *TRANSVERSAL* | Intercultural | Intercultural | Healthy foods |

## 4. Learning activities

The design principles for the activities are based on the preschool teaching style. All the topics in the cognitive and transversal axes are combined in the activities using the domain themes as the narrative thread.

The activities for this first experiences in real classroom has been developed around two basic concepts sited on the cognitive axis: *inside-outside* and *numbering*.

- *inside-outside*: the child must put several objects into (or take them out) an image that represents any kind of container (a box, a bag, a shopping cart,…)
- *numbering*: different groups of objects are presented and the child must link the number showed with those that contains the same amount of elements.

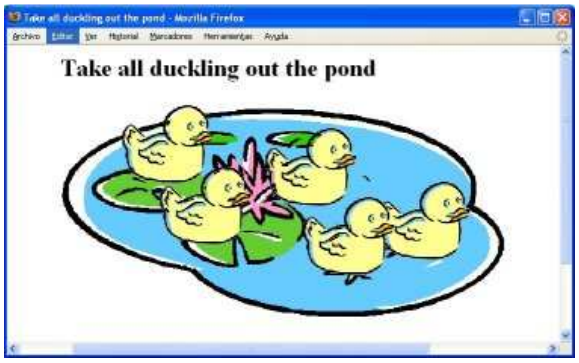


**Figure. 1a. Basic instance of *inside-outside* exercise.**

We have implemented a template for each activity that can be instantiated to produce different exercises. The templates define a set of *actions* that should be considered in the assessment process (see Table 2). Actions are classified as *correct* or *incorrect* depending on the template type, in such a manner the same action could be considered as correct for some exercises or incorrect for others.

Figure 1 shows examples of the *inside-outside* activity template. The first one, shown in Figure. 1a, asks children to take all ducks out the pond. This task only assesses the concept *inside-outside*. In the exercise shown in Figure. 1b, using the same activity, the teacher has added the concepts *food* and *fruits* from the domain axis. The children must select the fruits and put them into the shopping cart. A third instance (not shown) could be defined for concepts *healthy foods* (transversal) and *big-small* (cognitive) consisting in *taking out* from the container the *small healthy foods*.

**Table 2. List of actions and their evaluation for exercise 1.**

| ID | NAME ACTION | TYPE | SCORE |
|---|---|---|---|
| 1 | Take out the selected image from the container. | correct | +2 |
| 2 | Put the selected image into the container. | incorrect | -1 |
| 3 | Move an image in the zone outside the container. | null | 0 |
| 4 | Move an image in the in the zone inside the container. | incorrect | -1 |
| 5 | Click an empty screen zone | incorrect | -1 |
| 6 | Click a wrong image (without selecting it) | null | 0 |
| 7 | Click a right image (without selecting it) | null | 0 |
| 8 | Select the right image | null | 0 |
| 9 | Select the wrong image | null | 0 |


**Figure. 1b Instance of *inside-outside* exercise that assesses the additional concepts *food* and *fruits*.**

All of them have in common the learning of the *inside-outside* concept, located in the *cognitive* axis,

but in conjunction with it they measure the knowledge level of other concepts belonging to other axes.

The system helps teachers in children monitoring, knowledge level assessment and data analysis, allowing them to inspect and modify the student models. Table 2 shows the action list identified for the exercise in Figure 1a.

## 5. Evaluation in the classroom

MEDEA, framework has been developed using iterative prototyping and evaluated by formative evaluation [10]. This methodology helped to identify aspects of design and interface which could improve the system, such as functionalities, usability and/or performance Previous prototypes has been evaluated at university level, with courses about Logic and Computer Science [11]. In this section, the evaluation cycle for the primary school prototype is described.

The experiences have been carried out with three-year-old children attending a preschool located in a tourist area of the Malaga, (Spain) In the classroom there were children of five different nationalities.

The teaching process was organized around five themes (*domain model*): 1) My school, 2) My house, 3) Food, 4) Clothes and 5) Body and senses. There were a set of *cognitive skills* (in different areas like mathematics, language or music) that the children should acquire and that were practiced during the whole course. They were always associated to the subject that is being studied in each moment. In conjunction with them, the teacher introduces along the course different concepts related to social and health aspects (*transversal* axis).

The classroom was organized in five groups of five children each. A "computer corner" with a computer, a touch screen and wireless headphones was installed in the classroom. Although there are studies indicating that is possible that children use a mouse in a graphic environment [1,2], the same works indicates that a previous training is needed. This would make the evaluation longer. We used a touch screen that was installed leaning on the table, as a notebook. The computer box was hidden, kept out kid hands. This configuration offers the following advantages: (1) previous training sessions were not needed; (2) the working environment was similar to the conventional, because the screen was perceived as another tool for learning. This fact contributed to the initial purpose of defining an environment for *learning with computers* [8].

Initially, the system presented a page with the photos of all children. A child must press his/her photo

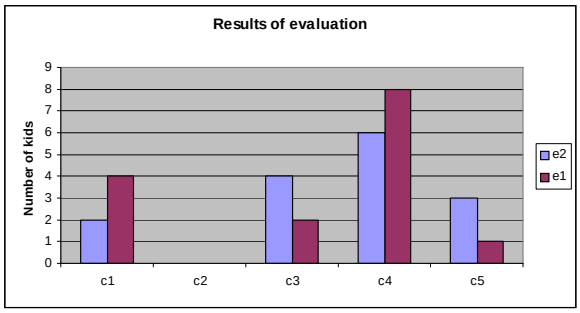


**Figure 3. Categories considering the sequence of actions during exercise 1 and 2**

to log in and automatically his/her student model was loaded and a page with several icons appeared one for each available activity. Teachers selected the type and order in which the activities were done. They assisted the kids during the exercise executions and controlled the navigation, avoiding normal attitudes in 3-years-old kids (distraction, reiteration of some actions, playing with the environment, etc.). After exercise completion, the system returned automatically to the first page.

The working method is similar to others not computer-based classroom activities. The teacher divided the children in groups and posed different activities to each one. Along a school day he/she worked with each child in the computer for a period of about ten minutes.

Two different exercises were done during a week with a classroom of twenty four children. All actions during the activities were registered in a log The exercises were evaluated according to the children actions, taking into account the value assigned by the teacher who also defined the minimum threshold to consider that the child has succeeded the activity. When the children is working the system automatically adds or subtracts the corresponding value. When s/he finishes the total value is annotated in the user model.

The conclusions of this evaluation cycle were obtained from the log generated by the system and the profile data of each user. In general, children were able to work with the system, and understand what the have to do. The environment really attracted them.

Students have been classified in several categories, according their sequence of actions during the exercises:

- C1. Children that do not understand the problem. They do not follow the logical sequence because they clicked randomly in all objects of the exercise.
- C2. Children with dysfunctions in their understanding. They mainly made incorrect actions,

for example, in the case of choosing the “red fruit” they never click on a red figure

- C3. Children that needed some time to explore the exercise and understand how the environment woks but, after some out-of-logical actions (three or four), they solved problem correctly
- C4. Children that apparently understood the problem but did not followed the logical sequence of actions during the solving process. They had a sequence of actions very heterogeneous. Teacher interpreted that those children were distracted during the exercise.
- C5. Children that directly solved the problem with a logical manner, mainly following the right sequence of actions.

This study concludes than the majority of children have understood the problem and done it correctly but, while they were solving it, they were distracted playing with other objects in the exercises. This is the usual behavior in 3-years-old kids. In most cases, children did not had misconceptions working with the system.

From these results, formative evaluation suggested some features to improve the next version:

1) Explore different possibilities to engage kids to the system, in order to focus them in the learning goals.

2) Implement a mechanism to define generative exercises using templates and a taxonomy of objects (images and sounds). That will allow a better assessment because children trend to memorize the procedures and images very quickly.

3) Define an automatic mechanism to detect the random clicking behavior during the exercise and perform some action (defined by the teacher) to correct it, such us stop the exercise for a while, present icons to indicate the incorrectness, etc.

4) Redefine exercises considering levels of difficulty in order to be able schedule exercises automatically using the facilities offered by MEDEA for planning and adaptation.

## 1. Conclusions

This paper presents the first experiences carried out in the classroom with a prototype defined in MEDEA framework for pre-school learning.

The system user model is organized in three axes that correspond with the cognitive model, the domain model and the transversal model. Exercises are modeled as activities configured with a list of actions (with correct or incorrect scores). User actions are evaluated automatically according to the three axes of the user model The prototype has been evaluated in a classroom with 3-4 years-old kids that used the system enthusiastically. This first evaluation provided a feedback to improve further versions.

## 2. References


[1.] Crook, C. 1992. Young children's skill in using a mouse to control a graphical computer interface. *Computers and Education.* 19, 3 (Oct. 1992), 199-207

[2.] Donker, A. and Reitsma, P. 2007. Young children's ability to use a computer mouse. *Comput. Educ.* 48, 4 (May. 2007), 602-617.

[3.]Druin, A., Revelle, G., Bederson, B. B., Hourcade, J. P., Farber, A., Lee, J. & Campbell, D. (2003). “A Collaborative Digital Library for Children” *Journal of Computer Assisted Learning*, 19, 239-248.

[4.] Hoppe, H. U., A. Lingnau, I. Machado, A. Paiva, R. Prada and F. Tewissen. (2000). Supporting collaborative activities in computer-integrated classrooms – the NIMIS approach. In *Proc CRIWG 2000*, Madeira, Portugal, 18 - 20 October 2000, IEEE CS Press.

[5.] Hourcade, J. P., Bederson, B. B., Druin, A., and Guimbretière, F. (2004) Differences in pointing task performance between preschool children and adults using mice. ACM *Trans. Comput.-Hum. Interact.* 11, 4 (Dec. 2004), 357-386.

[6.] Ovaska, S., Hietala, P. & , Kangassalo, M. (2003) Electronic whiteboard in kindergarten: opportunities and requirements. In Proc of the 2003 conference on Interaction design and children, July 01-03, 2003, Preston, England

[7.] Plowman, L., Stephen, C.(2007) “Guided interaction in pre-school settings”, *Journal of Computer Assisted Learning* **23**, 14, pp. 14-26.

[8.] Reeves, TC. (1998). *The impact of media and technology in schools*. Georgia: The Bertelsmann Foundation

[9.] Ringstaff, C & Kelley, L. (2002) The learning return of our educational technology investment: A review of finds from research. San Francisco, CA:WestEd.

[10.] Scriven, M. (1991) Evaluation Thesaurus, SAGE editors

[11.] Trella, M. (2006) *MEDEA: MEtodologías y herramientas para el Desarrollo de entornos inteligentes de Enseñanza y Aprendizaje; PhD Dissertation, UMA.*

[12.] Valkanova, Y. and Watts, M. (2007) 'Digital story telling in a science classroom: reflective self-learning (RSL) in action', Early Child Development and Care, 177:6, 793 – 807

[13.] Wood, E. & Attfield, J. (2005) *Play, Learning and The Early Childhood Curriculum*, Paul Chapman Publishig


.