

# Creating New Teaching Techniques with ITCs following the Montessori Method for Uneducable Young Students

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**Abstract.** Nowadays, it is important to help students' critical and independent thinking skills development by promoting the capacity to resolve problems on an individual or group basis. Cognitive development is the term used by experts to describe the learning process, mind expansion and the capacity to resolve problems happening inside students' minds when working on their own or with-in groups while interacting with their peers. In this paper we present the design and development of a system for the students to work at schools as well as at home following the "Montessori" method using technologically enhanced learning sensory. We have implemented the Montessori suggested patters by designing and developing a system, also having the capacity to monitor and measure students' evaluation and actual grading. The proposition is directed towards the first cycle of primary education, where basic skills are acquired.

## 1 Introduction

Nowadays a great number of educational games for students exist aiming at developing their personal skills such as [1]. The students can play these games individually as they work through the action and reaction process even for students less than 6 years old. These educational applications do exist for digital tablets. In Spain for example, there is a wide use of the educational software Pipo [2]. Games can complement a more conventional master class (for example a traditional method) to enhance a student's associated cognitive levels. For example, we may consider the traditional educative Montessori Method developed by María Montessori (1850-1952) in 1912. At that time, the schools consisted of one teacher who had to work with a great number of students from different educational levels simultaneously, and the uneducable students had to be sent to special centers those days [3]. While working on one of these schools, the author observed that the uneducable students of the specific institution were playing with the crumbs of food, as there were no other objects in the room. *"She saw that they didn't eat them but they manipulated them and she realize that they need objects to manipulate. This is because the human being has the necessity of activity, of reality, of developing their intelligence and personality"*[4].

So we may find a situation that can facilitate the development of educational patterns for the specific didactical method. During our research, we did not find educational platforms or software applications for home use, allowing teachers to track successful methodologies that improve uneducable students' learning process. However, we have found a lot of games focused on the action and reaction stimuli engaging the students' senses and attention while playing. Surprisingly, babies and very young students seem to have been programmed to learn to play in such environments (regardless if they tend to be educated or not). In addition, actions that adults see like gaming, in reality, they can work to stimulate the uneducable students' learning process. There are also several easy to use measurements we may consider to utilize for these experiences to become more efficient in order to improve students' cognitive development.

In this paper we present a system's design and development that allows teachers and parents to perform and control educational work using didactics methods at school as well as at home. In addition, the validation of this system with such pedagogical features has been performed using current technological devices and systems everyone uses.

## 2 System Features and Attributes

The proposed methodology anchored in the Montessori Method was developed by taking into account the *cognitive structures* and the *social development*; the main features are [3]:

- Teachers must perform their work without obstacles inside the classrooms. The students are active participants in the learning process.
- The environment and the Montessori Method promote the internal individual discipline.
- Personal learning and group learning are adapted to the individual student's learning style.
- Students of different ages are grouped together.
- Students are motivated to teach, collaborate and help each other.
- The students choose their own work according to their individual interest and skills, as to formulate their own concepts based on autodidact material.
- Each student chooses his/her own step in the learning process and path as well as the learning speed.
- The student discovers his own errors through the material feedback.
- Repeating one specific learning activity leading the student at receiving a successful positive feedback and feeling reinforces the learning process.
- Each student can work where s/he feels comfortable, where s/he moves freely and talks secretly without disturbing his/her partners. Group work is optional.

The educational patterns that can be determined for these ages [4], emphasize basic values in collaborative work and the necessity for the students to interact and work together based on the use via action and reaction of their senses and stimuli within the environment, accessed from the school as well as from home interacting

with each other using a platform. Therefore, we present a set of selected patterns for these educational levels following the features of the aforementioned methodology, in order to cover the uneducable students' new needs. In addition, we accompany each pattern with the device to help each student's performance. These attributes function as behavioral patterns and are the following:

- **Motivation:** This pattern performs motivation-stimulating activities for the uneducable student; it activates students' senses, their individual integration and mobility [5] [6]. To carry out this pattern, there is a need for audio and video systems to improve student's interaction with his/her environment. This pattern must also include sensory-based actions so to stimulate reactions; while using ICTs, those senses are: *Sight (color, size, position and movement), Hearing, Touch, Smell and Taste.*
- **Collaboration:** This pattern compliments motivation necessities towards collaboration among the students and their peers, so they can learn to help each other.
- **Selection:** The uneducable student chooses his/her own work according to the individualized purposes and skills.
- **Temporization:** the student establishes studying times inside the selected projects and structures in his/her own time by performing this activity.
- **Feedback:** The student learns by trial and error. This pattern controls the mistakes performed by the student during the learning process. When the system detects an error, it uses this information to plan activities to reinforce student's learning, based on the specific error.
- **Repetition:** The student repeats the activity to reach a successful action and therefore feeling.
- **Daily activities:** This model organizes activities related to the self- and environmental care. These social skills are needed inside the system; thus, the student automatically acquires the necessary basic competences.

The system was developed using HTML5, which ensures its portability among the different operative systems, and guarantees its maintenance.

### 3 Personal Assistant Design and Development

The uneducable student of an infantile course must perform a set of exercises aiding at developing sensorial learning and peer-to-peer collaboration and learning. To support this, we have planned a scenario where the students need to work collaboratively taking into account the developed patterns anchored in the Montessori Method. When the student enters the systems, s/he finds a graphic user interface, which is friendly, comfortable and attractive; it is also enhanced with a "*Personal Assistant*" to support the student with his/her individual interaction with the system. This is a virtual character with capacities depending on the specific device connected to the system allowing the student to easily interact, as in Figure 1.

Once the student initiates the application, the system selects the programmed activities controlled by the teacher or the parents. After that, the student selects the



Fig. 1. Examples of Personal Assistants.

activities from a specific category anchored in the official curriculum for infantile education [7]. The process is straightforward and easy to handle; the student only clicks on the corresponding icon and then on the virtual character to start performing the activity. Instantly, the virtual character starts interacting with the student by providing personalized activities step by step performed in a way so to complete the targets of the learning activity. As an example, this student decides to perform the activity related to geometric forms on his own as personal work as well as interacting with his peers as collaborative work, as in Figure 2.



Fig. 2. Educative game selection.

The collaborative work is conducted by the interchange of “tokens” that appears on the screen on an individual and group basis so to fill in all the gaps in the table presented on the screen. If the student does not know which token to send to which one of his peers, the virtual character helps him with this task, as in Figure 3. This performed exercise takes into consideration the satisfactory presentation and business logics for user interface design. This is completely oriented to reach and evaluate the goals targeted for each of the previous presented attributes.

The design of the educational game can be personalized according to the age of the student, and his requirements. The tutor (teachers and parents) has to select an activity from a set of games available to them according to the student needs, to ensure by this the correct application of the educational games.

### 3 Conclusions and Future Work

During our research about educative applications and systems, we discovered great

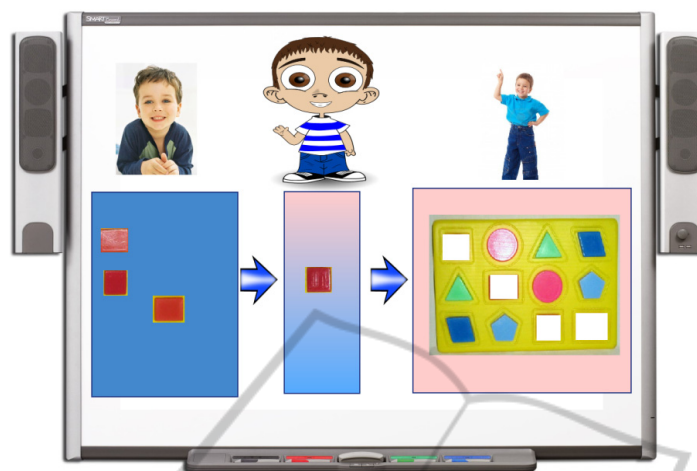


Fig. 3. Educative game selection.

discrepancies regarding educative methodologies that could fit the uneducable students' needs. Based on this vision, we conducted extensive research for appropriate methodologies to fit these needs; apparently, we found that the Montessori method, which is related to sensorial learning and is widely recommended by teachers at schools to fit our purpose. As a result, we started searching for patterns that cover the specific actions these students need to perform and their relation with technological hardware devices. For now we want to focus on students with special needs of just one type: Children with problematic and not friendly behavior with other children similar to their ages.

During the system design and development, we have noticed the simplicity related to user interface design and development specifically for these ages, as the students press over objects with their finger within a virtualized solution developed using HTML5. Currently 7 students in the CEP Juan XXIII educational centre of Huesca are using this system, and until now the intervention was successful and widely accepted by the teachers and parents. The evaluation of this test will be presented in our future research work.

For the system implementation we are studying to apply Model-Based User Interface development environment to give the system the possibility to be independent to work over any type of platform and using any type of interactive device.

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