

An Interactive Learning Environment for Edutainment

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Abstract: The development of new interactive technologies inevitably has an impact on education and entertainment. This paper describes a virtual learning environment to support and improve day-to-day teaching for short age children. We introduce a 3D playground where children find personalized aspects depending on their ages and tastes. The edutainment environment incorporates a series of difficulty levels depending on the age and skill of the players. There are currently four kinds of basic games available to users, namely, (a) a construction game, (b) a memory-like game, (c) a puzzle-like game, and, (d) a mathematics game. A personal pedagogical agent and a virtual book assist children at any time.

1. Introduction

Revolution is getting into classroom. New information technologies are providing new resources to support day-to-day teaching. Virtual learning environments are growing faster, both in number and capabilities. Computer games provide new characteristics that improve any learning process. Computer games supply meaningful learning, goals, success, challenge, cognitive artifact, and association through pleasure, attraction, and sensory stimuli [Sedighian and Sedighian, 1996]. These factors are even enhanced when using 3D environments and attractive visual interfaces. Though there are no substitutes for interaction at school or playing, a virtual environment is able to provide children with experiences otherwise impossible or hard to obtain.

Different learning environments for children have been proposed. Some of them rely on virtual reality as a collaborative platform, such as *NICE* (Narrative Immersive Constructionist/Collaborative Environments) [Roussos et al., 1997], *KidsRoom* [Bobick et al., 1999] or *Round Earth Project* [Johnson et al., 1999], we have relied on usual media means such as virtual worlds because of their flexibility and low cost. These features allow us to take our application to most schools.

Our research team is involved in the development of an interactive learning environment called *Virtual-Prismaker* [Gonzalez et al., 2001]. *Virtual-Prismaker* project's capital goal is to evaluate the educational potentiality of *Prismaker*tm game from two points of view: the physical game, and the virtual game. This latter is in development stage.

This project is being carried out in conjunction with the corporation that created the physical game and it tries fundamentally to analyze the game's utility inside educational environments. In order to achieve this goal a multidisciplinary team has been created, formed of computer engineers, psychologists, and pedagogues. Psychologists and pedagogues are designing activities for both the physical and the virtual game. These activities are grouped into three categories: language, mathematics and capabilities (attention, perception, corporal perception, spatial perception, temporal perception, etc).

At the same time, children and teachers from different primary schools are collaborating to validate how good this game may be for short age children. This validation will begin next academic year. Up to date, we have introduced this project to primary school teachers, who are collaborating in the final design of all activities.

Prismakertm [Prismaker, 2001] is a construction game that provides a reduced number of kinds of pieces to build with. Besides conventional possibilities, you can use logos to assign a meaning to these pieces, and, this way, it is possible to extend the educational features of the game. This game is intended for children 3 years old and over. Available activities meet educative needs for each age. The physical version of this game has received several prizes because of the educational features it incorporates.

2. Description of the Learning Environment

To play the games a virtual environment is needed. This virtual environment should be similar to the place where the child usually plays. This will introduce children in a friendly well-known environment. We all know about the differences in our own points of view when choosing the best color for our apartment walls or which furniture is nicer. This is one of the main reasons why we have created eight different virtual rooms available to children. We try to provide children with a number of choices enough to play in a place they feel comfortable. We use a variety of environments to get to a wider age range too. Notice that an older child will find some rooms too childish [Fig. 1a], while younger ones will find them appropriate, and vice versa.

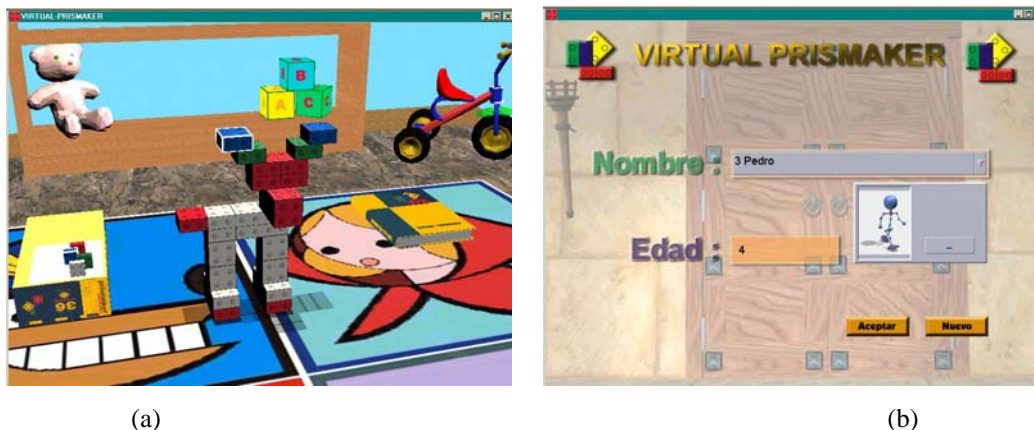


Figure 1: (a) One of the eight available virtual playgrounds. (b) Identifying window.

When our application is started an introductory video is shown. This video shows a stroll through a nice countryside. The video ends at the gates of a castle where playing rooms are supposed to be. Now it is time for the child to introduce his name and choose an identifying picture [Fig. 1b]. The teacher should introduce these input data, so the child just needs to know the picture that the teacher assigned him. This is useful for younger children who cannot read yet. These data is needed in order to keep track of which games have been played, which ones have been successfully realized and to allow children to play just the games matching their age. In our example, the child is called “Pedro” and he is four years old.

The book appears now, so the child can choose the virtual playground where activities will take place. There are eight different ones [Fig. 2]. Some of them are more childish, while some of them are designed for older children.

These virtual rooms are divided in three main working places: (1) a playing area, where all activities take place, (2) a storing area, where the child can save the current work to resume later on, (3) a book. The child uses the book to select the game to be played, the virtual playground to play in, or just to get help about the activity that he is currently playing.

Once the child has come into the room, the book will be shown again. The child now will be able to choose a subject to work in, and then choose a game from the selected subject. All the subjects and its games are generated dynamically from a database. The teacher, using a powerful game editor creates this database to match children learning needs.



Figure 2: Available virtual learning environments.

Most games at the stores are closed. You cannot modify the games to match day-to-day work inside the classroom. We have tried to avoid this in our solution, so educators are able to create contents to match what students need. We have developed our game so the teacher is able to customize the games using the editor. Thus, teacher will have the means to create his own games for the current subject.

Games are classified according the difficulty level they have. Each game is assigned to an age range and a subject. Children final goal is to complete all games in a difficulty level. A subject will be completed when all difficulty levels in this subject have been played successfully. The main advantage in our solution is that the teacher defines all relationships between ages, difficulty levels and games the way he wants. A powerful game editor and database manager has been developed to allow all these operations.

When a game is created you will be able to introduce all the information needed to run the game, including difficulty level and the information that will be shown in our virtual helping book. For a game to be shown in the book you will need to include it in at least one difficulty level, in a subject and for an age range. Thus, you can see it is the educator the one who defines the application game skeleton for their students. Teachers are able to share all the games created so teachers' productivity is improved.

There are four different kinds of games: (1) a construction game (2) memory, (3) puzzles or image sequences, (4) mathematics.

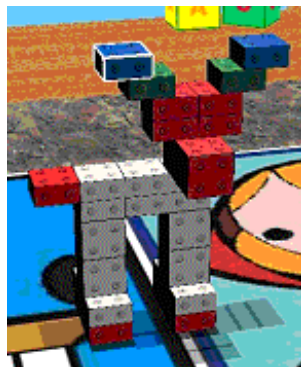


Figure 3: Construction game.

A construction game is available based upon physical game Prismatm. The basic construction block is a semi-cube available in four different colors (red, blue, green and white). These basic blocks can be combined to build different figures [Fig. 3]. Although blocks are the main pieces, there are wheels and small cylinders too. All different pieces are taken from a box on the left side of the playing ground. Shelves are available so any construction can be stored or resumed at any time. We are facing the constructions of a realistic construction game where graphic features are been implemented so children play in a credible virtual playground [Lopez et al., 2001].

Memory [Fig. 4a] is the traditional game where some pieces are laid upside down (hiding the image they have). Pieces are laid following a bi-dimensional grid. Players turn two pieces each time. The game objective is to find all hidden pairs. You don't need to define just pieces with the same images, but with the same meaning. For example, you could create a game to learn how to spell numbers. The number images should be assigned to an image where the correct spelling is written. The number of pairs is one of the parameters the teacher is able to define in game editor.

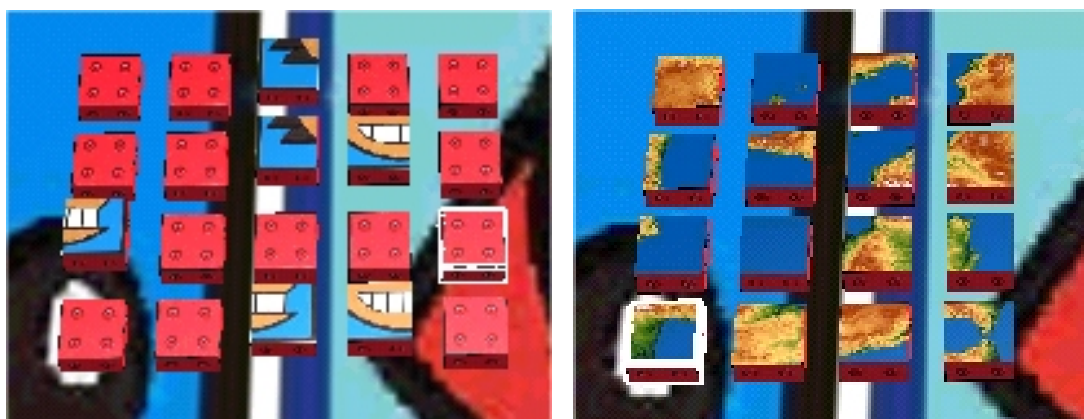


Figure 4: (a) Memory game. (b) Puzzle games.

Another possibility offered by Virtual-Prismaker is playing with puzzles. This kind of games allows creating a puzzle using any image we want. For example, teacher could create a puzzle using a map to complement a geography lesson [Fig. 4b]. Game editor should be used to do that. Using this editor teacher will be able to divide the image in as much cells as wanted, so difficulty level matches children age and capacities. You can build a puzzle game using single images from an image gallery. This modality allows creating alphabets, number series or story sequences. In story sequences children must find the right layout so the images in the playground tells the story in the right way. For instance, a game could be used to create a game for Little Red Riding Hood tale with five images: (1) Little Red Hood at home, (2) Little Red Hood stops to pick flowers and find wolf, (3) wolf eats Little Red Hood grandmother, (4) Little Red Hood arrives to grandmother's house, (5) Hunter kills wolf. The main benefit from story sequences is helping learning implicit schemes found when telling or listening stories.

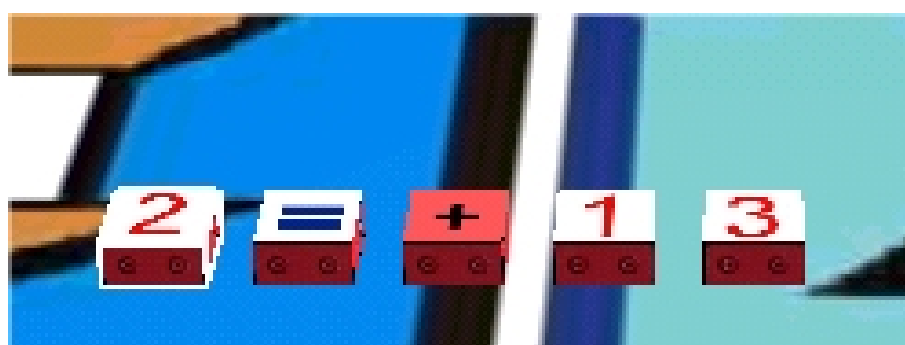


Figure 5: Mathematics game.

In mathematics game, the teacher is able to create simple mathematical expressions to help operations learning [Fig. 5]. Available operators are: add, subtract, multiplication, division and parenthesis. Created expressions will not be the same in each game execution. Teacher defines expression selecting both the number and the operators that will be needed, but not the result. Numbers are defined as an interval.

When the game is loaded in our application, automatically a number will be randomly generated for each interval. Then according to the expression defined and the generated numbers, result will be generated. Thus, expression will be different in each play, so children will play the same game with the same pattern, but the generated expression will not be equal. Children objective is to arrange the pieces to compound a correctly written expression.

3. A Helping Hand

Traditional help systems are getting obsolete. Lack of interactivity and adaptability in these kinds of systems is the main reason. Nowadays, we demand support systems ready to help at any time inside the application. Frequently, we do not even know that we need help. We do not realize that some action we are doing could be done in a better way, or just faster.

In our virtual learning virtual environment we try to help learning process adding two features: an interactive book and an agent.

Transforming traditional interaction methods into metaphors using familiar items reduces application learning curve. A book is probable the most obvious object to represent a user manual. In our application, a virtual book is used to get access to all the game options, eliminating traditional menu concept. The book includes text, images and videos showing demos from the available games.

While playing, and in virtual book, a pedagogical agent (or personal assistant) [Microsoft, 2001] has been added to make even easier using the application. The agent is able to read the whole book's content so children who cannot read yet are able to obtain the information they need from the book.

Game instructions are included in our virtual book. The book is visible and available at any time in the playground. Thus, the child obtains help clicking on the book, with a keystroke or automatically when the agent detects it is necessary. The book has a nice graphical design, including videos and it has a fully dynamic behavior. Teacher is able to decide the contents that will appear in the virtual book for a game using game editor. Teacher introduces all the contents explaining the rules, including text, images and explicative videos. After the game has been created, it is automatically added to Virtual-Prismaker and will be made available in the book for the age range and subject introduced. All information regarding games is stored in a database. To retrieve data an ordinary web server is used. Active Server Pages (ASP) language is used for this propose. This web-based solution allows centralization in content creation and sharing material between different teachers, increasing teacher's productivity.

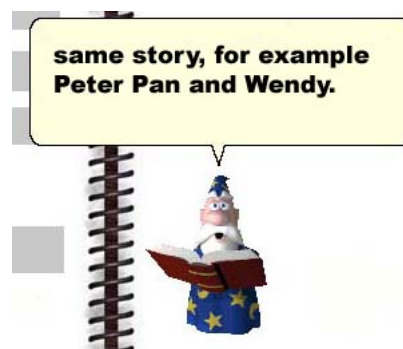


Figure 6: The pedagogical agent.

The agent while reading the book will help the children when using the book using speech synthesis [Fig. 6]. Agent will tell children how to navigate throughout the book and will read instructions for the game selected. Agent has different animations. These animations and the things said are randomly generated, so children don't get bored quickly with a predictable and steady behavior. The child is allowed to deactivate agent whenever he wants.

4. Conclusions

The development of new interactive technologies inevitably has an impact on all aspects of teaching and learning. Children lives are increasingly devoted to video game playing, navigating the Internet and chatting. We have found a new powerful incentive to use in children education.

That is one of the main points we found to develop our application. We have created a virtual learning environment for a set of games. This playground is intended as a support tool for children in education and entertainment.

All game activities are carried out in a virtual room. Eight different virtual rooms have been created so children play in a well-known and comfortable environment. Traditional computing issues such as menus have been replaced by metaphors. For instance, we have replaced loading and saving operations with shelves where children leave their constructions or they get previously stored constructions.

To help throughout playing experience we have included a virtual book and an assistant. The virtual book is used to replace most menu related concepts. Children choose the game they want to play or in which room they want to play using the book. This book is assisted at any time with a pedagogical agent to guide children when using the book. This agent is able to read all book contents, so children who cannot read yet are also able to use the game.

There are four basic kinds of games. We think that these kinds of games incorporate many educative features, and that they are flexible enough to let teachers use them in their necessary curriculum parts.

Acknowledgements

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