

THREE LITTLE PIGS DISCOVERING MATERIALS

A Software for the Sensitization of Primary School Students to Environmental Themes

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Abstract: This paper describes a software suite aiming at the sensitization of children to environmental themes such as materials use and recycling. The software, in the form of an interactive book, by means of the famous "Three little pigs" story introduces the handled themes which are treated more in detail through some knowledge improvement scenes extending the main story. The suite is completed by some games which verify the users understanding of the treated themes. The developed software is usable both as a stand alone software both via Internet embedded in a web page. Tests of the suite have been performed on a group of primary school students and proved the efficiency of the software, its high interactivity level and an encouraging comprehension of the treated themes by the users and suggested the authors the future developments.

1 INTRODUCTION

The current world situation in terms of environment is critical. Energy use, resources consumption and pollution represent key issues which will affect life quality in the present and in the future years. For this reason it is clear that for a responsible development the world has not only to operate in the direction of the elaboration and improvement of new and more sustainable technologies in order to intervene directly on such problems but also in the direction of making people aware of environmental problems. Even more so, it appears important the awareness of young children to this kind of problems. For this purpose a software suite for the sensitization of primary school students to subjects such as material use, recycling and energy saving was developed as these aspects *will* play a key role for the environmental impact. In the last three decades educational software production increased year by year together with its importance, exploiting each time more sophisticated technologies which allowed the development of ever more capturing software (Johnson, 2003). The story of educational software starts in the early sixties with the production of lean softwares without multimedia and interaction with the user and continues up to today characterized by many tools rich of fascinating 3D graphics, sounds effects and a higher level of inter-

activity. The whole scenery of educational software is very complex and can be classified on the basis of its contents and methods: from the common tools for children's home learning to more complex packages suitable to the use in the classrooms under the control of a teacher or to the so called *edutainment* in which the main characterizing element is the *entertainment* and the educational part plays a secondary role. Technology improvements played a primary role in the development of educational software (Khalifa et al., 2000) making possible the use of multimedia resources and interactivity which are fundamental for the success of this tools (Straker and Govier, 1996) as in the modern world children have to be stimulated to the learning through educational software otherwise their attention will be kept by other kinds of media such as television or gaming consoles, less interesting from the strictly educational point of view, but more captivating. In the recent years educational software and the introduction of computer to the schools were proved to accelerate children's learning process (Contreras, 2002) and by consequence a multitude of educational software was developed for several purposes: mathematics, history, foreign languages, geography, music, religion, physical education and many others. A list containing a review of most representative products categorized by subject area can be found in (Dig-

ital resources guide, 2005). In the complex scenery of educational software, due to the aggravation of world environmental situation, specific environmental education software and books appeared in order to disseminate to a large public the main concepts on the basis of sustainable development. Some of these tools are addressed to children but, due to the handled topics and to the level of inspection, many others are addressed to mature users.

This paper presents an educational software in the form of a living book addressed to young children aiming to their sensitization to the correct use of most common materials. This paper is organized as follows: a general description of the complete software is depicted in section 2 then sections 3, 4 and 5 describes the parts the suite can be divided in on the basis of the teaching approach. Some considerations on the testing of the tool on a group of primary school students and some remarks on the future perspective of the suite are discussed in section 6.

2 THE SOFTWARE SUITE

The developed software consists of an interacting set of tools for the sensitization of primary school children to topics related to the environment such as the correct use of materials and their recycling. Such subtopics were chosen among the others because they are nowadays very common and not completely unknown to the target public; moreover they are considered very important for the future preservation of the environment. The target users the educational software is addressed to and the handled subjects imposed some tricks on several aspects of the product. In particular the age of the public required the software to be continuously snappy and able to keep as high as possible the attention of the young users. Moreover it was decided to give the users the possibility of learning what they want by selecting particular topics or to deepen the concepts they are interested in. Finally there was the necessity to monitor the actual learning of the treated concepts by the user in order to evaluate the effectiveness of the software. Beside these methodological issues there were also technical aspects which have been considered: the portability of the software in order to make it usable on various OS platforms; its accessibility from the web and modularity in order to allow an easy addition and update of new parts in the future. The basic idea of the suite was thus to create a software handling the above mentioned environmental issues by exploiting the framework of a well known fairytale opportunely modified in order to add the desired contents. The educational

software consists of an interactive animation similar to a *living book*.

The story which was chosen to be represented is the famous novel *Three little pigs* (Jacobs, 1890), a fairy tale featuring animals published for the first time in the late 18th century although the story is thought to be much older. This particular story was chosen because it was considered very appropriate to the treated topics as the original story is already oriented to themes such as materials as it tells the adventures of three little pigs defending from a ravenous wolf by building their dens once in reed, then in wood and finally with bricks experimenting that way the features of these materials. Both the technical and methodological organisation of the suite reflect the standard methods utilized for the development of educational software (Barbosa, Maldonado, 2006) which aim to the creation of efficient tools in terms of teaching capabilities. The developed tool is logically divided into three parts in which the user can freely move as shown in figure 1. These three parts combine entertaining elements, games and information which are acknowledged to be the backbone of an efficient educational software (Jovanovic, Starcevic, Stavljjanin, Minovic, 2008). Giving the user the freedom of passing arbitrarily from one scene to another is a method for keeping high the interest of the user by letting him decide what to see and what to learn (Finlayson and Cook, 1998). Each part was designed in order to meet the requirements mentioned in this section:

The main story in this part of the suite the main story of the *Three little pigs* is told by means of interactive animations. Beside the story, many informations concerning the materials employed by the little pigs are passed to the user. This part is described in detail in section 3.

The knowledge improvements in this sections main informations about materials, their use and their recycling process are reported together with simple quizzes and other curiosities on the treated themes. This part is described in detail in section 4.

The games some well-known games have been realized in order to verify in a funny way the learning of the concepts and to entertain the young users. This part is described in detail in section 5.

In order to meet the technical requirements it was decided to develop the main story and the knowledge improvement part as a Flash animation which allows various interactions with the user, is familiar to children as many web pages already use such technology and can be either part of a stand alone executable software or embedded in an HTML page. On the other

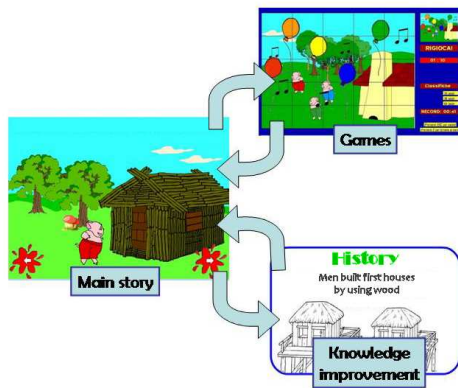


Figure 1: A scheme of the parts composing the suite and the connections among them.

hand games were implemented by using the Java programming language which grants the portability of the software which is a key issue for a wide use of the software (Beynon and Mackay, 1993) (OECD, 1987).

3 THE MAIN STORY

The account of the story of *Three little pigs* is the main part of the whole suite from which it is possible to reach the other parts of the software. The original story is related faithfully and is used as a pretext to discuss the desired environmental issues thanks to the additions of several considerations as, for instance, on the materials employed by men for building houses or to perform some common works. For the development of the Flash animation used for the representation of the story the commercial software Macromedia Flash MX was employed. Such software is the standard professional tool for the creation of interactive animations consisting of graphic elements, texts and web applications and allows the publication of created animations on a web page integrated in a HTML form.

In the design of story scenes several considerations for the improvement of their appearance were applied:

- for the choice of colors and settings of the novel, vivid pastel colors were preferred to realistic ones. Pastel colors are more familiar to children as they are used in cartoons
- the language used in dialogs and narration is very simple and as similar as possible to comics style, moreover typical comics balloons are used for the dialogs among characters
- several hidden animations have been put into the scenes.

Interactivity and animations are very important in the scenes. For the realization of such aspects a tool named *ActionScript* available within the *Macromedia* package was used.

The main story consists of 35 scenes telling the story of the *Three little pigs* and focusing on materials themes by means of some added scenes or elements. During the representation of a scene it is possible to interact with some of its elements. When a scene ends, it will be possible for the user to move to the next or previous scene or, if available, to enter a scene containing some knowledge improvement as shown in figure 2



Figure 2: A sample scene of the story where links to previous and following scenes can be seen as well as the highlighted link to the steel knowledge improvement.

The story includes music and sound effects. Both the narration and the dialog among the characters are written and read so as to allow the use of the software to those children who are still not able of reading. Currently the software supports Italian and English language but the possibility of adding further languages is fully supported.

4 THE EXTRA CONTENTS

In addition to the story, some special contents for improving the knowledge of interested users on material themes were added. The framework of the story in this sense works as a starting point for more detailed information on a specific set of topics. In facts from some story scenes it is possible to jump to other scenes where materials features are described more in detail by pressing a button or interacting with a character as seen in figure 2. The presence of these links on the scenes are supposed to prompt the children to know something more on the topics the particular scene is related to. These extended contents have been realized by means of flash animated scenes as it was done for the main story. Nevertheless these scenes are characterized by a higher level of interactivity as it is needed for an active involvement of the

child in the teaching process . The considered materials at this stage are: wood, concrete, steel, plastic and glass. For each of them the following aspects have been treated :

Story the story of the material, its discovery and first use and some other curious information

Use the way the material can be used, highlighting its main features and the reason of each specific employment with many examples from the real world

Recycling what happens to an object when its use is over: the parts which can be recycled, which materials are the most suitable for such purpose and the advantages of recycling are presented.

Figure 3 shows some screenshots of the concerning such topics and of the window which allows the relative choice.

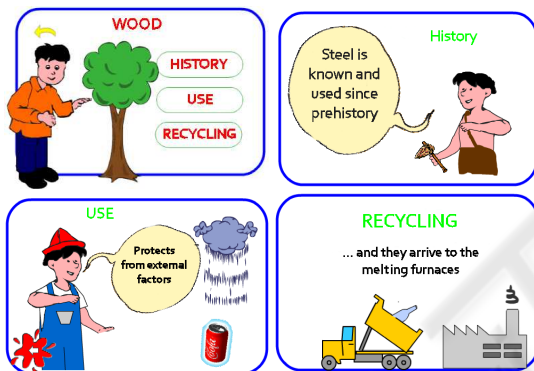


Figure 3: Some screenshots of the scenes for the knowledge improvements on materials. In particular the main menu for wood is presented (top-left) from which it is possible to reach the subtopics.

In this part there is a high level of interactivity, in particular during the narration the child will be asked to answer simple questions or to play little games in order to keep him interested in the explanation as suggested in (William and Noel, 1998) and to verify if he is going to understand the treated arguments. These interactions give also the chance to give additional information: as an example (see figure 4) the child is asked on the material he would use for building a house through a multiple choice quiz and each time he gives the wrong answer he obtains the explanation of why the chosen material is not suitable for that purpose until he answers correctly and gets some additional information on the goodness of the material for the particular aim. Another kind of game added to the software consists on the match of a carpenter tools with their names by means of *drag-and-drop*. This latter game was appreciated by children as it involves an higher level of interactivity by respect to the simple

question–answer interaction. During the description of materials features the presence of an extra character was exploited. In particular since the beginning of the story a smart beaver is commissioned to give information, explanation on the materials and to suggest to play the games or answer the question. The use of this kind of characters is popular in living books and educational cartoons and makes simpler and more natural the interaction of the software with the user.



Figure 4: The Beaver character during one of its quizzes.

5 GAMES ON MATERIALS

The aim of the story and of the content extensions is to teach the children the concepts on the basis of a responsible usage of materials. In order to evaluate their comprehension of such concepts two interactive games were developed and added to the software suite for entertaining children and evaluating their understanding of the treated themes. The importance of games as an instrument for the learning process is widely acknowledged (Morsi and Jackson, 2007) (Frazer, Argles, Wills, 2007). The games have been embedded in the software suite and they share with the rest of the package the same characters, contents and philosophy. The games were designed in order to be stimulating so as to spur the children in the exploration of the package and so as that their entertaining nature should emerge hiding its didactic aims. Among the various types of games suitable to be adapted to these ideas two very common games were selected as they were considered the most convenient to our aim:

Memory it is a very popular game, known by most children. A set of pairs of cards representing various subjects is placed on the table so that only the back of the cards is visible, then the player will try to find all the couples by disclosing the cards two by two. In this work a particular extension to the game was added: the associative memory in which a couple of cards corresponds to two cards brought together by a particular criterion (i.e. a couple of animals or a couple of objects made in wood)

Puzzle is the classic puzzle game in which an original picture is cut in several pieces and the user has to recompose it.

These two games were developed in the Java programming language in order to exploit the well known portability of this technology, in fact, Java allowed to create two applications that can be run both as stand alone software both as part of a web page by means of an applet.

5.1 Notes on the *Memory* Game

Two kinds of the Memory game were developed: the traditional one and its associative version. The user can choose the type of game through a starting menu in which it is possible to select the difficulty level and the theme of the employed card deck. There are 3 different difficulty levels: easy, normal and hard which differ for the number of the involved cards (8, 16 and 32 for the three levels, respectively) while for the traditional memory game two cards themes are supported: the first one representing the characters utilized in the *Three little pigs story* and the other one representing the materials presented in the story and in the contents extension. It is possible to extend the number of card themes in a simple way. Two different themes were created for the associative memory game: the first one involves the associations objects-materials in which the user is asked to combine objects made of the same material; the second one is for the association job-tool in which the task is to associate a job to its specific tools. The choice of card themes has the aim of maintaining a relation between the strictly educational part of the suite with this entertaining part preserving the interest of the child on the material topics. Within this game some simple tricks have been applied in order to vary the game each time it is played: the background of the screen and the back of the cards are changed (with a color or with a texture) and, within the same cards theme, different pictures can be selected randomly by the software. During the game a score measuring the performance of the user on the game in terms of number of cards disclosed is calculated. The lower is this number the better is the performance.

The game finishes when the user has found all the card couples. If the obtained score lies within the 10-highest scores the user is asked to write his name which is added to the game rating. In order to update the rating it was necessary to use the PHP language to write on a local file storing the 10-highest scores because the Java Applet does not allow to write on local files for security reasons. The main aim of the games is making the children familiar with the themes and

the characters presented in the story and to recall them the narrated situations together with the treated concepts. The memory game, in addition, in the object-material associative version, is able to teach the users on the materials the objects are made of. This aspect is quite interesting as children get aware of the materials forming some common object they everyday use and this new information can be used once they decide to recycle these objects helping them, for instance, choosing the correct garbage can for disposing each object.

5.2 Notes on the *Puzzle* Game

The puzzle game follows the general rules of traditional puzzle games. In the real version of the game the pieces have irregular shapes but in this case the pieces have a square shape and have to be combined by the user not on the basis of their shapes but of the images on each piece. The picture used within the puzzle are taken directly from the represented story in order to maintain a relation with its themes although the developed software allows the addition of further images. As for the memory game, there are different levels for the puzzle game as well. The levels are determined by the number of pieces the original picture is cut into: 25, 36 and 64 for the easy, normal and hard levels respectively which can be selected from the initial menu. Figure 5 shows the main window of the game where it is possible to see that, together with the shuffled picture, a scaled version of the original image is shown to help the user in the reconstruction.

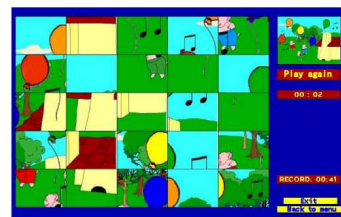


Figure 5: Screenshot of the puzzle game where it is possible to see the cut image on the left and a miniature of the target image. On the right a timer and action buttons are shown.

Once the game starts the player will have to recompose the original picture as fast as possible, in fact the elapsed time will be used as performance indicator for the game and, as for the memory, there is a rating for the first 10 highest scores based on the time criterion. The user is allowed to move one piece per time from a position to another of the grid which identifies the shuffled image by means of a *drag-and-drop* operation.

6 CONCLUSIONS AND FUTURE WORK

In this paper an interactive software suite for the sensitization of primary school students to the proper materials use, recycling and energy saving was presented. The software is formed by three interconnected parts: the first one introduces the main themes by means of the very famous *Three little pigs* story; the second part deepens the knowledge of the users on the materials presented in the story; the third one, by means of some games and quizzes related to the handled themes, verifies the learning of the children of the treated topics and entertains them. The main aim of the software package is to make the children aware of materials features and recycling. These themes are presented with a familiar language by the characters of the story in a *children-friendly* form which favors a natural and gradual teaching of the concepts. The effectiveness of the developed software is supported by the tests performed on a group of primary school students who used the package at school for several days. The tests were very encouraging as the children interacted with the software in all its aspects and enjoyed all the parts; moreover in the successive talks and interviews with the teachers, they proved a good understanding of the treated themes and a particular interest on the concepts (i.e. materials features, the advantage of using certain materials and the importance of recycling). Students particularly appreciated the main story and the extra contents for their *interactive-cartoons* behavior while games were useful for revising the concepts with the teachers each time objects, characters and scenes were presented on the screen; furthermore games enjoyed the students and kept alive their interest and curiosity on the software and the themes. The test was also used to get useful information on the software and for planning its future improvements. This kind of test is recognized as a very useful instrument for the evaluation of the developed tool and for the identification of possible modification on the basis of users reactions which could improve software's quality (Jones et al., 1993). In the future the software suite will be extended by treating more materials and adding new games. The quality of graphics and animation will be improved as well as music and sound effect. At the current stage the Italian and English languages were used in the whole suite but the software was developed in order to support further languages. Finally more tests involving a number of primary school students will be performed in order to evaluate the efficiency of the software and to exploit users reactions and suggestions for further developments.

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