

# Multimedia Games for Elementary/Primary School Education and Entertainment

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**Abstract**—Computers are increasingly being used as educational tools in elementary/primary schools worldwide. A specific application of such computer use, is that of multimedia games, where the aim is to combine pedagogy and entertainment. This study reports on a case-study whereby an educational multimedia game has been developed for use by elementary school children. The stages of the application's design, implementation and evaluation are presented. Strengths of the game are identified and discussed, and its weaknesses are identified, allowing for suggestions for future re-designs. The results show that the use of games can engage children in the learning process for longer periods of time with the added benefit of the entertainment factor.

**Keywords**—Education, entertainment, games, school

## I. INTRODUCTION

PROPERLY planned Educational Multimedia Games with a clear purpose can be an innovative, fun, visual, and interactive way of engaging students in the learning process by combining pedagogy and entertainment [1]. Games are an important part of most children's leisure lives and of our culture as a whole [2], while the global gaming market is worth billions of dollars [3].

Until recently games were considered a distraction from homework, however today researchers and teachers are asking how this medium can be used to support learning [2].

Games have a motivational power which makes learning fun. People play computer games to win or achieve a goal thus the key to motivation is winning [4]. Motivated learners can learn almost anything [5].

Game-based learning mainly focuses on how a game itself can facilitate learning but it is claimed that the educational opportunity in computer games stretches beyond the learning activities in a game [6].

By observing most people playing games, you can see them using the internet to download guidelines and participate in online forums to share strategies and talk about the game. Therefore, almost all game playing can be described as a social experience [7] and in addition, learners perceive the content of the communication between them as an information source [8]. Thus, learning is not just embedded in a game itself, but it is also in the community of practice of those who inhabit it [6].

It has also been shown that playing games benefits school performance [9]. Linear cause-and-effect games encourage means-end analysis strategy, while adventure games encourage inferential and proactive thinking [10].

Another advantage of computer-assisted learning is that the learners can learn at their own pace and time [11]. All these tell us that games should not only be considered as a mode of entertainment, but also as a dynamic tool which can motivate and interest children to learn by means of a more visual, interactive and fun way. These reasons underlined the motivation for creating an educational game to assist children with their school subjects.

The paper continues with an overview of the case-study, followed by an explanation of the methods used and the results are presented and discussed. The study used the design, implementation, evaluation method whereby the prospective users of the game were identified and the learning objectives set out.

Following this, the actual game was implemented using multimedia authoring tools. The final products were packaged professionally including CD labels and cover-cases.

The study ends with an evaluation of the game by its prospective users and the results are discussed.

## II. DESIGN

The aim of this study was to create an educational game with the purpose of assisting children in their school learning activities.

Specifically, this game is targeted to be used by elementary school children so that they can practice mathematics and also obtain some general knowledge about animals.

The first step of the design stage was the production of an organizational timeline to assist with the planning and time-management of the project.

This included identifying the target audience, creating the content outline, collecting the various learning materials, creating storyboards, developing the game, and testing and evaluating the application.

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Identifying the target audience was an important stage in the game's development. From a Human-Computer Interaction [12] perspective and a student-centered learning approach [13] it is important to know and understand the prospective users and their characteristics from the beginning, so that the developed applications will better match their individual abilities and learning needs.

For this case-study, the target audience is children between the ages of five to eleven. They attend elementary schools where they take a wide range of classes including mathematics and general knowledge subjects. Many times these children are assisted by their parents when working on homework exercises.

Young children mostly learn through practice. In order for them to construct their own knowledge, each child must have opportunities for learning experiences that match his or her level of development [14].

For this purpose, an educational multimedia game was created where the children could practice mathematics exercises and also learn about the animals of the world. The application had to be engaging, visually attractive and fun to use so that the children would want to use it.

The suggested settings for use of this game are classroom activities at school as well as homework activities after school, and the methods of distribution are CD-ROM.

### III. IMPLEMENTATION

Following the design stage, the next stage of the study was the implementation of the game. The game was developed in Director, while Photoshop was used for the graphics, CD label and cover-case designs. The application is a game of Puzzles and Quizzes and is called PnQ.

In its first design, four Multimedia elements have been incorporated. Text was used for the questions, answers, instructions and descriptive paragraphs. Comics fonts were chosen as they resemble cartoons and comic-books which children are already acquainted with. Graphics were used to illustrate photos of the animals, and to create the puzzles. In addition, bright colors were used as these attract young children. Sounds were used for background music and for feedback on user actions, while animations were used between the levels.

The game begins with an introductory animation (Fig. 1) so that its movement, colors and sounds will interest the children and grab their attention.

When the users click "Let's Play" the menu screen appears (Fig. 2). In this menu, the users can choose to turn the music off or on, view the credits and the designers of the game, start playing the game from level one, or enter a password to continue the game from a previous level that they left off.

In addition there is a "Pictures" option, that is locked (Fig. 3) until the game is completed, thus giving the children an additional incentive to finish the game and be able to see a larger collection of animal photos.



Fig. 1 Introductory Animation



Fig. 2 Main Menu



Fig. 3 Picture are locked until game is completed

To start playing the game from the beginning, the users must select "Click to begin" (Fig. 4).



Fig. 4 Starting the game

The game consists of forty levels, with each level comprising of two parts. The first part is a puzzle featuring a photo of an animal. The users have to correctly answer five arithmetic problems to move on to the next part. With each correct answer, pieces of the puzzle become clearer, slowly revealing the image of the animal (Fig. 5).



Fig. 5 Puzzle game: Mathematics Questions

When the five mathematics questions are answered correctly, the second part of the game begins. In this part, a paragraph describing some characteristics of the animal from the previous puzzle appears (Fig. 6). The students have to read this paragraph and try to remember what they have read. This exercise also enhances the students' reading and understanding skills.



Fig. 6 Information about the animal

When the children click "Continue", a multiple choice question will appear based on the paragraph they had just read, as can be seen in Fig. 7.



Fig. 7 Multiple-choice question

When the children answer correctly, they are presented with a password and the next level commences. This password (Fig. 8) is the one that is required in order to continue the game from this stage, at a later playing time.

Once the game is completed, the Pictures button (Fig. 3) will be unlocked and the children will have the opportunity to click and look through all the various photos of the forty animals they had just learnt about.

The duration of the game depends on a child's current competency with mathematics, English and general knowledge, and is influenced by their computer-use experience. However, their experience with using computers is usually not a problem since in our era children are born into technology and its applications, and already use computers in their schools and homes from a very early age.



Fig. 8 Password for next level

#### IV. EVALUATION

The application serves as a pilot study and was tested by a convenience sample of 21 students, sometimes with the help of their parents. The primary task was to provide feedback on the game's interface, usability and acceptance by the children. The students were given the CD and had a chance to play the game for a few days. After that, informal interviews were carried out with the children and their parents enabling free conversations to develop where they could say what they liked about the game, what they didn't like, what they would change, and what additional features they wanted.

The children liked the colors and animations in the game, as well as the playful tunes accompanying it. However it was noted that some more characteristic sounds could have been used as feedback on correct and incorrect answers in addition to sounds being used when buttons or images were clicked. Furthermore, there were suggestions for brief instructions prior to each part of the game explaining how the game is played, although overall, the children found it relatively easy to learn how to play it.

The parents were also helpful in providing feedback. For example, some parents pointed out they noticed more enthusiasm from their children when they had to do their homework using the game, rather than when they had to do their homework using the more traditional pen-and-paper method. In addition, they spend longer amounts on time on the task and can play on their own without having to have their parents help them all the time or make them do their homework.

Another suggestion by some of the parents was that of personalization. For example, at the start of the game a dialogue box could appear where the learners would type their name. Based on the user input, the game could refer to the child's name at various stages of the game, thus making the experience more focused to the individual and engaging the children more in the learning process. For instance, when a child answers a question correctly, the system could respond with an audio or text message like "Good job Peter!"

Since the application is distributed on CD-ROM, and does not require internet or broadband connections, a future re-design could include an additional type of a multimedia element, namely, video. For instance, after each successfully completed level of a specific animal, video clips can be used to show short documentaries of the animals in their natural habitat making their natural sounds, instead of just showing drawings and pictures of them. Additionally, short cartoons featuring the specific animals, can be displayed to the children as a reward for their correct answers.

Finally, the results of this study show that when using educational games, children can benefit not only with the learning attributes of the game, but also with its entertainment values, since this makes the educational applications more motivating and engaging. These findings are also backed up by other research where it has been revealed that 85% of parents who evaluate games with their children believe that computer games contribute to learning as well as providing entertainment [15]. Therefore it is the findings of researchers, but also the opinions of the parents and the children playing the games, that computer games assist learning in a fun way.

#### V. CONCLUSION

This paper addressed a case-study where an educational multimedia game was developed as a tool to assist elementary school children with their mathematics and general knowledge subjects. The game is recommended for classroom and homework use and its purpose is to help educate the students in a fun and visually attractive way. The design, implementation and evaluation stages of the study were presented, while strengths and weaknesses were identified and discussed.

Future directions and re-designs will include a newer version of the game that will be enriched with additional multimedia features like video to make it more interesting and lively, as well personalization features to make the game more engaging for its users.

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#### REFERENCES

- [1] A. Laghos, "Educational Multimedia Games: Design, Implementation & Evaluation," *Developing Innovative Visual Educational Resources For Students Everywhere (DIVERSE 2008 Conference)*. Haarlem, Holland, 2008.
- [2] J. Kirriemuir, and A. McFarlane, "Literature Review in Games and Learning". *Futurelab*.  
[http://www.futurelab.org.uk/research/lit\\_reviews.htm](http://www.futurelab.org.uk/research/lit_reviews.htm) (accessed May 1, 2008).
- [3] ELSPA, "Interactive Leisure Software: Global Market Assessment and Forecast to 2006," *Report for ELSPA (The Entertainment and Leisure Software Publishers Association)*, 2003.  
<http://www.elspa.comserv/screendigestbrief.asp> (accessed 1 May, 2008)
- [4] Becta, "Computer Games in Education project"



- <http://www.becta.org.uk/research/research.cfm?section=1&id=2826>  
(accessed 1 May, 2008).
- [5] C.S.Ang, and R.K. Rao, "Theories of learning: A Computer Game Perspective," *IEEE Fifth International Symposium on Multimedia Software Engineering*, 239-245. Taipei, Taiwan, 2003.
  - [6] P. Zaphiris, J. Ang, A. Laghos, "Online Communities," In: Jacko, J.A. & Sears, A. (Eds.), *The Human-Computer Interaction Handbook*. Mahwah, NJ: Lawrence Erlbaum & Associates, 2006.
  - [7] J. Kuo, "Online video games in mental health," *Annual meeting of the American Psychiatry Association*, New York, 2004.
  - [8] R. Aviv, "Education performance of ALN via content analysis". *Journal of Asynchronous Learning Networks*, 14(2), 2000.
  - [9] A. Mitchell, and C. Savill-Smith, "The use of computer and video games for learning". *ULTRALAB. Learning and Skills Development Agency*. <http://www.lsda.org.uk> (accessed May 1, 2008).
  - [10] H. Pillay, "An investigation of cognitive processes engaged in by recreational computer game players: implications for skills of the future," *Journal of Research on Technology in Education*, 34(3), 2003, pp. 336-360.
  - [11] A. Laghos, "Using Games to Preserve and Educate," *International Conference on Virtual Systems and MultiMedia Dedicated to Digital Heritage. (VSMM 2008)*. Limassol, Cyprus, 2008.
  - [12] ACM SIGCHI, "Curricula for Human-Computer Interaction," New York, NY: *the Association for Computing Machinery*, 1992.
  - [13] J. Kurhila, M. Miettinen, P. Nokelainen, & H. Tirri, "The Role of the Learning Platform in Student-Centered E-Learning," *Proceedings of the 4th IEEE International Conference on Advanced Learning Technologies*, 2004.
  - [14] M. Christoforou, M. & A. Laghos, "A Comparison of New Interactive Environment Games, Classic Computer Games and Traditional Games, and their Impact on Children's Education and Mental and Physical Balance," *5th International Conference on Multimedia and Information and Communication Technologies in Education (m-ICTE 2009)*, Lisbon, Portugal, 2009.
  - [15] A. McFarlane, A. Sparrowhawk, and Y. Heald, "Report on the Educational Use of Games", *TEEM*. <http://www.teem.org.uk> (accessed May 1, 2008).