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CONTENTS

MOBILE INTERACTIVE APPLICATION FOR EDUCATION SUPPORT OF PRESCHOOL CHILDREN

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Abstract - The increasing pervasiveness of mobile digital devices, cause rapid explosion of various games, videos and educational programs designed for children. The growth of haptic interfaces is also exposing these young learners to more intuitive interactions with digital devices. Various studies conducted in recent years indicate that interactive games can be very motivating for young children, so they need to have more practical role in learning process. Considering these facts, we decided to develop an educational and interactive mobile application that will be used for education of children of preschool age. Through this application, kids will learn how to write letters in Macedonian language, simultaneously improving their motor skills. The application is designed for Android operating system, using OpenGL ES 1.0 version, which support all Android devices. The application interface is made using various colors, sound and animations appropriate for children's age.

The developed mobile application is tested and evaluated and the results are shown in this paper.

I. INTRODUCTION

Today's children grow up with information and communication technology (ICT) embedded in their daily lives. In this context, mobile digital devices are especially interested, because of the features that they offer to their users and because of their mobility. They can be used for various activities, but the most popular activity for preschoolers is games.

Games have a potential to keep the children's attention for a long time, so they can play one game for hours. Playing is an important part of children's cognitive and social development. A child learns through playing with others, creating, and improving his or her stage of development [1], [2], [3]. The process of playing games is engaging. Kids are motivated via fun [4], via challenge and via instant, visual feedback [5], [6].

Prensky identified a combination of 12 elements that make computer games engaging [5].

TABLE I. THE ELEMENTS THAT MAKE COMPUTER GAMES ENGAGING (PRENSKY 2001)

Characteristics of computer game	**How characteristics contribute to players' engagement**
Fun	Enjoyment and pleasure
Play	Intense and passionate involvement
Rules	Structure
Goals	Motivation
Interaction	Doing (i.e. the activity)
Outcomes and feedback	Learning
Adaptive	Flow
Winning	Ego gratification
Conflict/competition/challenge	Adrenaline
Problem solving	Sparks creativity
Interaction	Social groups
Representation and story	Emotions

Number of studies indicates that game-based learning may have a positive effect on learning quality [8], [9], [10], [11]. When learning content is combined with game elements, motivation of the learner is positively affected [12].

Designing games for young children presents unique challenge, because of the pedagogical approaches that should be taken into account, as well as learning tasks that should be presented. Games should encourage children to develop imagination and creativity, develop an ability to manage emotions, thinking skills, sensory-motor skills and language skills. Graphics, sounds and animations are also very important part of game design because they capture children's interest more than text and pictures that can be found in traditional books.

Considering these facts, we decided to develop an educational and interactive mobile application that will be used for education of children of preschool age. Through this application, kids will learn how to write letters in Macedonian language, simultaneously improving their motor skills. Application was developed for devices with a touch screen, as a standard characteristic of modern

mobile devices. This feature allows children to interact with technology at a younger age than ever before. Preschoolers, who used to have problems using a mouse or joysticks for playing, now can navigate with a touch screen intuitively and with ease.

The developed application was tested and evaluated and the results are shown in this paper.

II. APPLICATION DESIGN

For the purpose of this work an interactive mobile-based application, using OpenGL and Android OS, was developed. There are no official statistical data on how many devices is running on Android in Macedonia, but we analyze the major suppliers and came out that more than 80% are tablet devices that have an Android OS. Because of this, we decided to develop application for Android OS. OpenGL ES 1.0 version is available on all Android devices therefore; we have decided to use it for building the game graphics.

The game itself was made using colorful design and animation in order to keep the attention of the children. Various cheerful sounds were also added while playing the game. The touch-based interface for this game is intuitive for this age group.

User interface of a game showing the first letter of an alphabet is shown on Fig. 1

Kids should move red circle located inside the letter at one of the ends to the other end (as they write a displayed letter with a pen). They need to follow the arrow and to stay in bounds that define each letter. Checkpoints are created to mark the key position of every letter where the children need to change the direction in order to draw properly the letter. If the player crosses the border and if there are multiple reached checkpoints then the red circle is returned to the last one.

With positioning the finger on the red circle and start moving it, the timer that measure the time needed to complete the trial is activated. When the children reach the last point of the letter, the timer stops and the time needed to complete the trial is saved on the device memory for further analyses.

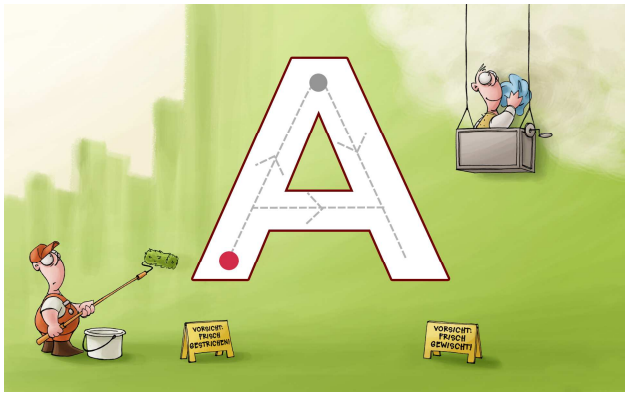

Figure 1. User interface of developed game showing the first letter of an alphabet.

III. EVALUATION

The main idea of this research is to demonstrate that children of preschool age can learn and practice motor skills for writing the Macedonian alphabet while playing an educational game using a tablet PC. The experiment was conducted in one kindergarten, where a total of 18 preschool children (from 4 to 6 years) were participated. The children were randomly selected and divided into two groups. The first group of 10 children was learning on tablet PC, while the second group composed of 8 children was practicing in a classic way (with a pan on a paper).

In the experiment, they tried to learn the following letters "А", "И", "Е ", "М ", "О", "Ц", "З ", "В". The experiment was conducted in two steps:

- **Training phase -** In this phase the group of 10 children was given a tablet PC with the game installed. Every child taught two letters a day, while repeating the letters in 10 attempts. This phase lasted four days and time required to draw each letter separately in all 10 attempts was measured. At the same time, the other group of 8 children was given coloring books and drawings with the same letters as in interactive application. Caregiver at kindergarten worked with them to help children through these materials to learn the letters by writing and coloring using the classic way.
- **Testing phase –** In this phase children from both groups were tested in order to see their progress in writing the letters from the alphabet. Each child was given 5 randomly selected letters (from the set of letters taught during the training phase). Time needed for completing each activity, as well as number of successful and failed attempts for writing the given letter were measured.

The obtained data were summarized and processed during the phase of data processing.

From the results, it can be observed that the children learn significantly more in the first trial when the error is greater, so they need more time for writing the letter. According to results, the satisfactory level is achieved after the 6^{th} attempt, when the learning rate and the error are small.

Data from the last attempt have been summarized and the average value and standard deviation were calculated. These data are shown in Table II.

From the table it can be observed that children write the given letters in a remarkably short time with small deviations that vary between each child. This confirms the fact that they have successfully mastered the writing of letters by using the developed application.

The data analysis also showed dependence: the children that previously have used tablet PC are making fewer mistakes and write the letters faster than those children who do not have. This confirms the fact that new technologies have significant impact on children especially of this age group, so it is very important how and for what purpose they use it.

TABLE II AVERAGE VALUES AND STANDARD DEVIATION OF LAST TRIAL

Letter	Average (sec.)	Standard Deviation (sec.)
А	9.18	1.36
И	8.36	1.70
Е	8.68	1.92
М	9.15	1.53
О	7.93	1.99
Ц	9.64	2.3
З	9.65	1.71
В	11.038	3.64

At the end of the test, a survey with several questions for children from the first group (the group who used the developed application) was conducted. Results are summarized and presented in Table III.

TABLE III USERS OPINION REGARDING THE NEW TYPE OF LEARNING (TOTAL NUMBER OF PARTICIPANTS = 10)

Survey question	Yes	No
Is it fun to learn and write letters in this way?	9	1
Is it easy to write in this way?	8	2
Would you like to learn the other letters?	9	1
Do you want to compete with friends in collecting points?	7	3
Do you have device with touch screen at home?	5	5

Results show that children's commitment in learning the alphabet with the use of new technology is very high. Nine out of ten children responded affirmatively that this way of learning is interesting, and that they also want to learn the other letter. This is due to ease of use of the developed application, good graphics and animation that keeps the children's attention for a long time. The game also allows them to compete with each other allowing them to collect points.

It was also noted that the children's interest while someone was playing the game was very high. They encouraged the one currently playing the game, thus contributing to his/her improvement.

IV. CONCLUSION

Nowadays, devices such as mobile phones, PDAs, and tablets are fully integrated into our life. Children are exposed at a very young age to these new technologies that affect the way they learn. Learning through playing games causes largest interest among children especially among preschoolers. Studies indicate that game-based learning have a positive effect on learning quality. However, there are some specifics that must be taken into consideration, when designing educational games for preschoolers. Properly designed games for preschoolers should motivate children to use it, at a same time having positive effect on memory enhancement and motor skills coordination.

In this paper, we have presented the design of an interactive mobile educational game for preschoolers. The developed application was tested and the results of the evaluation are presented and discussed.

The results have showed that the developed application motivates children to use it and that the application offers sufficient learning opportunities to create a learning effect. From the evaluation results, we can also state that this type of learning is

interesting and fun for this age group, and that they would like to practice this way of learning more often.

The conclusion is that this type of informal learning should be considered as an addition of the formal school learning.

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