Quest for Research Excellence On Computing, Mathematics and Statistics

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Faculty of Computer and Mathematical Sciences

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Chapters in Book

The 2nd International Conference on Computing, Mathematics and Statistics (iCMS2015)

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Content

CHAPTER 30
Learning Numerals for Down Syndrome by applying Cognitive Principles in 3D Walkthrough

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Abstract. Down Syndrome (DS) is a condition where extra genetic chromosomes cause delay in children development either mentally or physically. However the cognitive ability can be develop with the help of surrounding people and technology. Many available applications provided for children with learning difficulties like DS. However there are only a few of them that help in numerical learning. Due to the problem stated, this research study to provide an application that help the DS children range of four to five years olds in learning numerals (one to ten) in an interactive way applying the cognitive principles attention and memory using the walkthrough work frame. The effectiveness and the usability of this application are evaluated through testing and questionnaires. The projects were successful met the objective of the research.

Keywords: Down syndrome, education, walkthrough learning, ADDIE

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1 Introduction

Down syndrome (DS) is also known as the genetic syndromes and also the most extra chromosome disorders lead to intellectual disability in the world. It is normally seen in all ethnic groups in Malaysia and mostly are male.

There were many available applications provided for children with learning difficulties like DS. However there are only a few of them that helps in numerical learning. Meanwhile, other applications are for speech skills and motor skills. Apart from that, available software does not concern on special requirements for DS children. Thus, this factor decreases the success of the application, or even more it may result as an application that is not accessible by them [1].

Game development help to encourage the development of cognitive abilities for DS children in pre-scholar which their age in three to seven years old. Game development also encourage the communicability of the game interface [2]. Applying walkthrough in learning the numerals definitely help the learners. Thus, there is lack of application to learn numbers for children with cognitive disability.

Due to the problem stated, this study represents an application called Let's Learn the Numbers that may help DS children in learning numerals. This application applied interactive way applying the cognitive principles attention and memory using the walkthrough work frame.

2 Related Research

Children with DS are visual learners whose have completely strong visual responsiveness and learning skills [3]. They are mostly non-verbal learners and good visual learners. Non-verbal children were able to recognize only simple words and short sentences [4]. Other than that cognitivist had control on education such as the problem solving, mental imagery, decision making, long and short term memory, attention theories, verbal acquisition and more [5].

According to Rossi [6], the walkthrough is an organized tour that uses look-for to focus on the elements of effective instruction and learning. Walkthrough is also known as virtual reality. There are few types of walkthrough that can be used to develop a multimedia learning such as cognitive, panoramic, and interactive. Cognitive walkthrough has been chosen since it can be applied to relevant cognitive theory in an evaluation process under time and resources limitations [7].

2.1 Comparison between available applications

Comparison between available applications on market are made. This is to ensure that Let's Learn the Numbers fulfil the needs and requirements of intended user.

Table 10: Comparison on available software

NAME	WALKTHROUGH	3D INTERFACE	DESCRIPTION
Bugs and Button	X	√	Math concepts and fine motor based games that progressively adapts to the child's own level. Balance, counting, colours, shapes, sorting, letters, tracking
Monkey Math School	X	X	9 interactive games, teaching concepts of sequence, pattern, counting, adding and subtracting
I touch Learn Numbers	X	√	Consist of three sections Numbers Games and Music
Let's Learn The Numbers	√	√	Walkthrough learning

Based on Table 1, comparison between available applications that teach children to learn numbers were discovered. Most of the applications have contents that are higher than the cognitive capabilities of DS children range of four to five years old. The existing applications offer counting, adding, subtracting, and sorting. However, it was differ from Let's Learn the Numbers that offers learning numbers based on the cognitive DS disabilities using a walkthrough application.

3 Walkthrough 3D Application Development

Let's Learn the Numbers used ADDIE model in development phase. The intended purpose of developing using ADDIE is for an effective, efficient, and relevant than less rigorous for planning instruction [8]. ADDIE stands for five phases which are the analysis phase, design phase, development phase, implementation phase and evaluation phase.

During the analysis phase, problems are analyzed. Current available walkthrough learning applications for DS children are figured out. Other than that, DS requirements in using computer skills were investigated through observation of single person study, interview and research.

Let's Learn the Numbers was designed by following multimedia design principle. This application, focus on the cognitive load of the users. The design should able to capture user's attention through colors, audio and animation. By applying these, DS learners can at least remember to recognize the numbers. There are five basic design principles which are alignment, communicability, contrast, proximity and repetition. Repetition was chosen to guide for designing final product.

In the implementation stage, the application is tested. The application is shown to the subject person or anyone that represent the users. In this case, the product was tested on DS children aged four to five years old.

The evaluation is done after the application is shown to the DS children of four to five years old. The purpose of evaluation is to determine whether the application's interface grab the attention of the DS children. In this research, evaluation on the application was taking place after DS children watch the entire application. Then, DS children were evaluated by showing and questioning on each flash card.

4 Result and Discussion

After testing had been carried out, questionnaires were distributed among the intended respondent. Data and result collected were analyzed. The questionnaires consist of five categories that define the usability of the application. According to [9] on 2012, state that usability is measures on how easy user interface can be use and control by the user. Thus the questionnaire contains five categories which are ease of use, learnability, attention ability, memorability and satisfaction.

4.1 Ease of use

For this category, questions were being asked to get to know, can user control and run the application at ease.

Figure 1 shows the evaluation for ease of use questions. For question 1 from category ease of use, 40% of the respondent were agreed, 20% of the respondents were strongly agreed and another 40 % of the respondents were neutral that the application is easy to control by the user. For question 2, 60% of the respondents were agreed, 20% of the respondents were strongly agreed, and another 20% of the respondent were disagreed that the application is simple to use. For the last question of this category, 40% of the respondents were agreed, 40% respondents were neutral and 20% respondents were strongly agreed that the application does everything they would expect such as by clicking the linking of scene, audio and graphic.

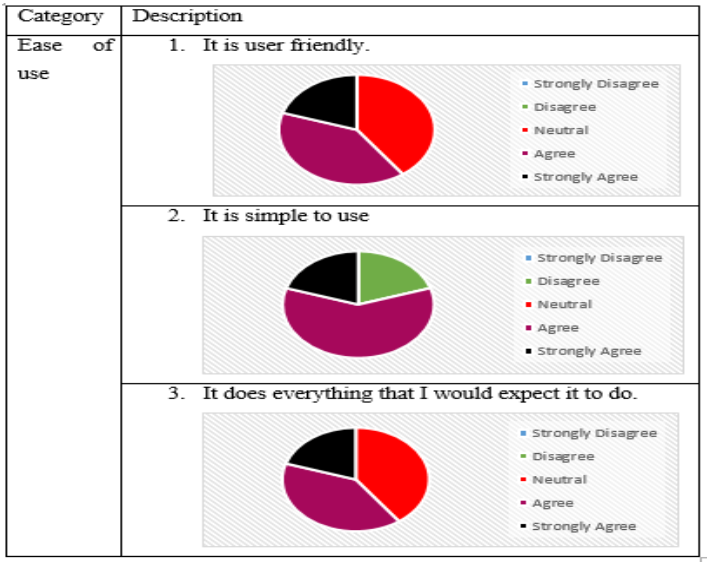


Fig. 1. Ease of Use Evaluation.

4.2 Learnability

For learnability category, questions were given to investigate whether the principles used in the application development had succeeded.

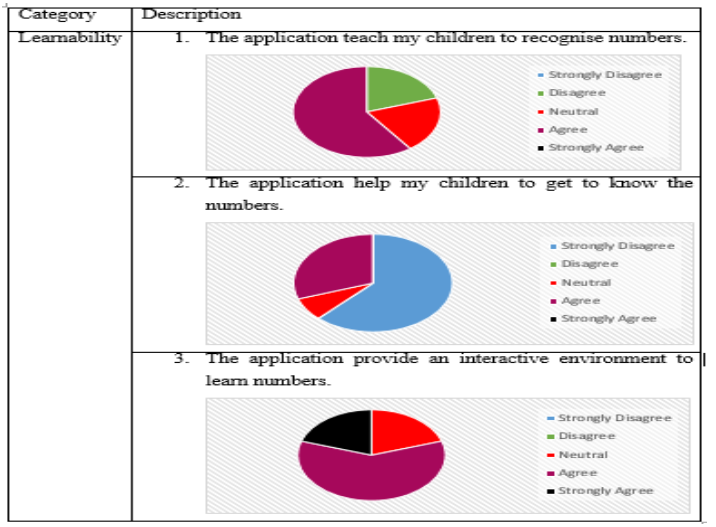


Fig. 2. Learnability Evaluation.

Figure 2 shows the evaluation of the learnability category. Question 1 was intended to know whether the application able to teach DS children to recognize numbers. 60% of respondents were agreed, while another 20% respondents were neutral. However, 20% respondents disagreed. These might due to the acceptance of the DS children to learn numerals. Each of the respondents might have different cognitive abilities. For question 2, 80% of respondents agreed that the application somehow helps DS children to get to learn numbers. Another 20% respondents were neutral. For the last question of this category, 60% of the respondents were agreed that the application provides an interactive environment for DS children to learn numbers. Meanwhile 20% of respondent was strongly agreed and 20% respondents were neutral.

4.3 Attention ability

In attention ability category, questions regarding colors and audio had been asked. This is because colors and audio can grab DS childrens' attention and make them stay along the application.

Figure 3 shows the attention ability evaluation. For question 1, the respondent had been asked about the use of color in Let's Learn the Numbers, whether it is suitable for learning or not. 80% respondents were agreed and

another 20% respondents were strongly agreed. Research have shown that colors are capable in grabbing and preserve attention, encourage emotional reactions, affect an individual's opinion, build attitudes, and develop learning and persuasiveness [10]. Next, the respondents were asked on the suitableness of the audio used in the application. 80% was agreed and 20% of respondents was strongly agree. For question 3, 60% of respondent agreed that the application grabs DS childrens' attention and 20% were neutral and strongly agreed.

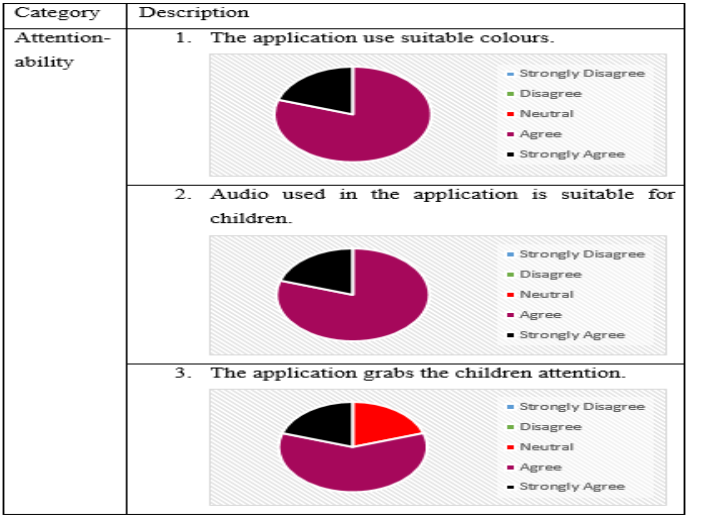


Fig. 3. Attention Ability Evaluation.

4.4 Memorability ability

Memorability category gave questions to evaluate whether DS children able to recognize the numbers. Numbers from 1 to 10 were shown to DS children by using flash cards after they complete watching the applications.

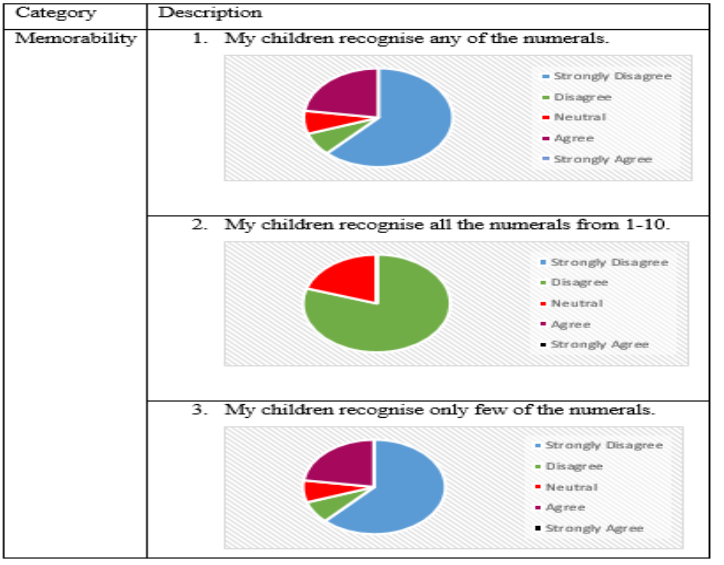


Fig. 4. Memorability Evaluation.

Figure 4 represents the memorability evaluation, to know does the children memorize and recognize the numerals. For question 1, 60% of the respondents were agreed that their children are able to recognize any of the numerals. 20% goes for neutral and disagree. For question 2, 80% of the respondents believe that their children is not capable in recognizing complete ten numbers after the flash card shown to them. For question 3, 60% of the respondents agree that their children are able to recognize some of the numbers. 20% goes for neutral and disagree. Some of the DS children able to recognize all the numbers and some are not. Some of them can even recall the numbers, but some of them are not able to recall it. This is because they have different cognitive ability.

4.5 Satisfaction

The purpose of the last category is to fulfill the needs and requirements of the users. Parents are the one who decide whether the application is satisfying their children's needs in learning.

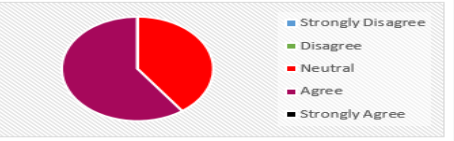
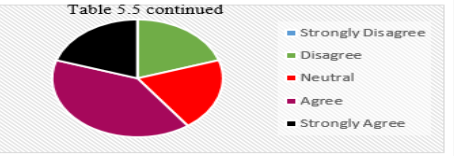
Category	Description
Satisfaction	1. I am satisfied with the applications. 
	2. The application help my children to recognise numerals 

Table 5.5 continued

Fig. 5. Satisfaction Evaluation.

Figure 5 represents the satisfaction evaluation from the respondents. For question 1, 60% of the respondents were satisfied with the application and another 40% respondents were neutral. For question 2, 20% of the respondents were strongly agreed, 40% respondents were agreed, 20% respondents were neutral and another 20% respondents were disagreeing that the application help their DS children in recognizing numbers.

5 Conclusion

After research to classify the needs and requirements of the project, development is carried out to ensure the final products of the application developed is suitable for Down syndrome (DS) children to learn numbers from 1 to 10. There are methods of learning that are advisable to be followed such as cognitive principle, repetition and redundancy principle. This project was successfully met the objectives. This application was developed by analyzing cognitive principles which are the attention and memory by using walkthrough environment. Apart from that, this application manipulating the DS children cognitive abilities, to learn using a numerical application.

The objectives of this research which is to design an application for DS children to at least recognize numbers from 1 to 10 can be said to be successful. Literally the attention and repetition are one of cognitive principle that can be followed to design applications for disabilities children. Thus, the study comes out with results on developing new multimedia application that helps the Down syndrome children of four to five years old to learn and recognize the numerals in 3D walkthrough.

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