How to cite this paper:

Mazeyanti Mohd Ariffin, Fiqa Azureen Abd Halim, & Norshakirah Abd Aziz. (2017). Mobile application for dyscalculia children in Malaysia in Zulikha, J. & N. H. Zakaria (Eds.), Proceedings of the 6th International Conference on Computing & Informatics (pp 467-472). Sintok: School of Computing.

MOBILE APPLICATION FOR DYSCALCULIA CHILDREN IN MALAYSIA

Mazeyanti Mohd Ariffin[1], Fiqa Azureen Abd Halim[2], and Norshakirah Abd Aziz[3]

[1]*Universiti Teknologi Petronas, Malaysia, mazeyanti@utp.edu.my*
[2]*Universiti Teknologi Petronas, Malaysia, fiqazureen@gmail.com*
[3]*Universiti Teknologi Petronas, Malaysia, norshakirah.aziz@utp.edu.my*

ABSTRACT. Learning disability alludes to a huge impairment of general intellectual and adaptive functioning that begins in childhood. Dyscalculia is one of the learning disability that directed to the number and math which can affect their math learning. Therefore, Dyscalculia children need an interesting and appropriate method in teaching math effectively such as supportive learning tools. The mobile application called Calculic Kids, in Android platform was develop to help Dyscalculia children in numerical learning based on the mobile application method of learning.

Keywords: Learning disability, Dyscalculia, Mobile Application, Children

INTRODUCTION

A particular learning disability is characterized as a turmoil in one or more of the essential learning process required in comprehension or in utilizing language, spoken or written, that may show difficulties in influencing the capacity to listen, read, write, spell, or do arithmetic. According to Butterworth (2013), learning disabilities are problem that influence the brain capacity to receive, process, analyze and store information. These processing issues can interfere with learning fundamental abilities, for example, reading (Dyslexia), writing (Dysgraphia) and math (Dyscalculia).

Fortunately, in today's technology world we have numerous option techniques for educating and supporting fundamental skills in reading, writing and math. This project will focus on the development of Calculic Kids as a supportive learning tool for disabilities children, which have difficulties in math or the other name is Dyscalculia. The application should be able to teach Dyscalculic children the basic number system, addition and subtraction operation.

Problem Statement

There is a lack of study on educational mobile application for Dyscalculia children in Malaysia. Recent studies show that there is a limited of study on educational game for Dyscalculia children in Malaysia. Research by Juliet & Nagavalli (2015), have shown that assistive technology such as mobile application can be utilized to help Dyscalculia children perform in classroom and empower them to independently learn. Mobile application is an interesting method to learn because of the graphic and the sound can help them to stimulate their brain to learn math effectively and grab the concept quickly (Juliet & Nagavalli, 2015).

The aims of this research are to (1) to investigate the existing mobile application for Dyscalculia children, (2) to develop a mobile application called Calculic Kids for Dyscalculia children and (3) to evaluate the effectiveness of the developed mobile application.

LITERATURE REVIEW

Learning Disability

Learning disabilities are neurologically-based processing issues (Butterworth, 2013). These processing issues can meddle with learning essential aptitudes, for example, reading, writing and math. They can likewise meddle with more elevated amount aptitudes, for example, organization, time planning, dynamic thinking, long or transient memory and focus (Learning Disabilities Association of America, n.d). Learning disability emerge from neurological contrasts in brain structure and capacity and influence a person's capacity to receive, store, process, recover or convey data (National Center for Learning Disabilities, 2014). The most well-known sorts of particular learning disabilities are those that effect the parts of reading (Dyslexia), math (Dyscalculia) and writing (Dysgraphia). They may co-happen with different issue of attention, language and behavior, yet are particular in how they affect learning (National Center for Learning Disabilities, 2014).

According to Zabidi Azhar (1998), learning disability among children including Dyslexia, Dyscalculia and Dysgraphia is a typical issue, with the pervasiveness evaluated at 10-15% of primary school children worldwide including Malaysia.

Dyscalculia

Dyscalculia is a specific learning disability that related to math and the term Dyscalculia is created for the disability of performing mathematic operations (Ferraz & Neves ,2015). According to Learning Disabilities Association of America (2014), Dyscalculia is a particular learning disability that influences a person's capacity to comprehend numbers and learn math facts. Learning Disabilities Association of America (2014) found out general characteristic of Dyscalculic children are summarized in the Table 1:

Table 1. Characteristic of Dyscalculia Children.

Signs of Dyscalculia			
1	Indicates trouble understanding ideas of place value and amount, number lines, positive and negative value, carrying and borrowing.	2	Shows trouble utilizing steps included as a part of math operations.
3	Experiences issues putting language to math processes.	4	Demonstrates trouble understanding fraction.
5	Experiences issues sequencing data or occasions.	6	Shows trouble perceiving designs when adding, subtracting, multiplication, or dividing.

Morin (2014) discovered that Dyscalculic children learn better through instructive amusements and fun learning tools. This method is a practical way to practice their math skills, could help to reduce math anxiety and they can develop a positive perception towards math. The math games could be used as an informal teaching method for them.

Mobile Application for Learning Disability Children

Now days a lot of information and communication technology (ICT) have been developed and some of them can help the children with learning disabilities. According to Special Education Support Service (2007), the viable utilization of ICT has advantages for all learners, incorporating children with learning disability. According to Mulligan (2012) dy-

scalculic children should utilize the mobile learning to make learning easier and ease to adapt this method of learning. Mobile applications support children with dyscalculia to complete a bigger number of activities and concerning the children interaction and learning through mobile, it can logically enhance their mind mapping capacities (Skiada et al.,2014).

Existing Mobile Application

Currently, there are several of mobile applications offered in market that claimed to support Dyscalculia children. The Table 2 shows the description of the existing application:

Table 2. The Existing Mobile Apps.

Application Name	Target audience	Operating system	Language	Description
Dyscalculia Game	Dyslexia & Dyscalculia	Android	Malay	The exercise is not focus only on the math but have the exercise for teaching size, shape and color.
Dyscal	Dyscalculia	Android	Dutch	Focus on the number system and addition operation.
Math Worksheets	Dyscalculia & Primary school children	IOS	English	Focus on the addition operation.
Time Tables Math Trainer	Primary school children & Dyscalculia	Android	English	Focus on the multiplication operation.
Dyslexia Math	Dyscalculia	IOS	English	Focus on number system, addition, subtraction, multiplication and division.
A Dog Counting Game for Children	Dyscalculia & pre-school children	IOS	English	Focus only on number counting.
Meister Cody – Talasia	Dyscalculia & primary school children	IOS & Android	English	Focus on number system, addition, subtraction, multiplication and division operation

Calculic Kids is focused on number counting, object counting, addition and subtraction operation. Calculic Kids will be developed in Malay language in order to support the Dyscalculic children in Malaysia because Malay language is a main language in Malaysia. The operating system for Calculic Kids application is on the Android platform. Furthermore, Calculic Kids is developed based on their characteristic.

METHODOLOGY

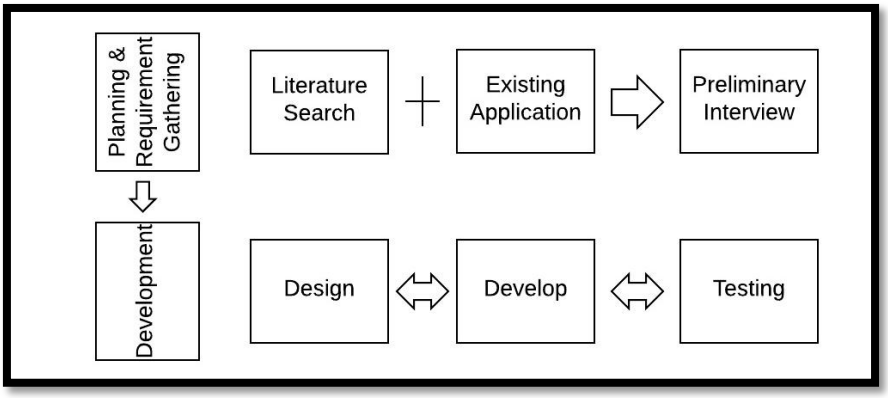

Figure 1. Methodology Model.

The Planning phase of this research is to determine the background of study, problem statement, objective and project scope. The requirement of this project is gathered through interview. The interview session conducted at Persatuan Dyslexia Malaysia in Ipoh, Perak with Mr Saifulazrin Shamsudin. He is the program coordinator and also a math teacher for Dyslexia children. The interview session was conducted and recorded to gather information about the Dyscalculia children, the appropriate method to teach them, how mobile application can help them and how to improve the existing game for Dyscalculia children which focus on the number, addition and subtraction operation.

In development phase, the activity to design of this application is made using Android Studio. Four sub sets of game were designed to include in the Calculic Kids which is number counting, object counting, addition operation and subtraction operation. In this project, the target users are Dyscalculia children in Persatuan Dyslexia Malaysia. Their response was observed and recorded for improvements. Besides that, the feedback from teachers were also be gathered for the system enhancements.

RESULTS & DISCUSSION

Normal children specifically have no problem with the learning process and able to understand the learning concepts. However, Dyscalculia children have trouble understanding math concepts and performing mathematical calculation such as difficulty in number arrangement, addition and subtraction operation. It is crucial to identify the distinct characteristic of Dyscalculic children to ensure that the developed game meet their requirements and expectations.

Elements of Calculic Kids

Based on the characteristic of Dyscalculia children, there are 9 strategies that can be used to design the user interface. Prior to the development, sets of game elements and strategies were identified. The Table 3 shows the elements of Calculic Kids:

Table 3. The Elements of Calculic Kids.

Elements	Description
Guidance	Hint given is through the same color font of question and answer.
Intonation	The pace is slower
Narration	In Malay language. The pace is slower.
Language	Malay language.
Image	The image should be clear and not overlap. The image is related to them

	for example human hand.
Assessment	Encouraging sound such as clapping hands are used.
Background	Calculic Kids used plain white color as the background color of every activity page.
User layout	Used more on symbol.
Font	The font used non serif.

As mentioned earlier, Calculic Kids give the hint through color. Providing hint to them could stimulate their brain to choose the correct answer. Every exercise in Calculic Kids have answers option to choose from, the hint is given through color and inside the shape. According to Mr Saifulazrin, they can relate the correct answers from the hint given through color. The number or the answer option given is inside the shape because this method can avoid their confusion in reading the number when the number is allocating nearer to each other.

The narration used in the Calculic Kids is in the slower pace as well as the intonation. Speak slower can make their listen and understand what is being said. Besides that, Calculic Kids used Malay language in order to support the Dyscalculic children in Malaysia.

The Calculic Kids is used the real image which is the human hand to illustrates the number. In the object counting section, the real images of clip paper have been used because the clip paper is the material that they can found in their learning surrounding. According to Mr Saifulazrin, the usage of learning materials such as stationary is better because they are familiar with the learning material that they have seen. Moreover, the objects display should be clear and not over lapping so that they can count the object one by one and no confusion.

The assessment element in Calculic Kids is to motivate and encourage the Dyscalculia children to learn math. In exercise section, if they choose the correct answer, the capping hand sound is produced. If they choose the wrong answer the sound "cuba lagi" is produced. According to Mr Saifulazrin, Dyscalculia children have very sensitive feeling and easy demotivated in learning. The encouragement word can help them to become enthusiasm to continue learning.

According to Mr Saifulazrin, pastel color such as white, beige and soft pink can be used as a background color because pastel color can stimulate their brain to keep focus on the learning. The bright color can disrupt their concentration to learn.

Generally, Dyscalculia children have difficulty in reading because they have trouble in recognizing the alphabets and numerical and because of that Calculic Kids is used more symbols than words and the words use in this mobile application is less. For example, Calculic Kids used the symbol in a certain page which is the arrow symbol button to go to the next page and home symbol button to return to the main menu. The font used is non-serif in order to help them to read and understand the words displayed. The elements that included in Calculic Kids is to carter their characteristic with the design of the Calculic Kids in order to meet the requirement of Dyscalculia children in learning.

User Testing

As the prototype has been developed, the testing phase was conduct to test the effectiveness of the Calculic Kids. There are 7 Dyscalculia children were involved in this testing phase. Before they used the application, they are required to answer the simple math questions as a pre-test. The pre-test questions were prepared to determine their level of competency in math. The pre-test questions consist of 2 addition operation question and 2 subtraction operation question. The post-test was conducted to identified their improvement after they have used the application. The post-test questions consist of 2 addition operation question and 2

subtraction operation question. Later, the average percentage of the pre-test result and post-test result was compared. The Table 4 shows the total average of pre-test and post-test result:

Table 4. The Total Average of Pre-test and Post-test.

	Average percentage of correct answer	Average percentage of wrong answer
Pre-test	75%	25%
Post-test	92.85%	7.15%
Changes	Increase 17.85%	Decrease 17.85%

The effectiveness testing shows the positive improvement by increasing the percentage of children get correct answers in post-test compared to the pre-test. However, there are still have small percentage of the children get the wrong answers.

CONCLUSION

This application is striving to support and assist the Dyscalculia children in math learning. Based on the user testing done with Dyscalculia children produced good respond. The feed-back from the teachers also found out that they believe this application can improve Dyscal-culia children learning process and help them to learn math effectively.

For future studies on this topic, it is recommended for Calculic Kids to add more sub games such as number line, multiplication and division. This sub games will allow them to learn basic operation of math. Moreover, with this mobile application hope to make them interested to learn math in a flexible environment so that they are not left out and have a chance to success in life similar with the normal children.

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