APPLICATION DEVELOPMENT FOR STUDENT WITH DYSCALCULIA

BY

Lam Jing Sung

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEM (HONS)

Faculty of Information and Communication Technology
(Kampar Campus)

JAN 2020

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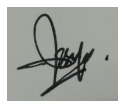I _____LAM JING SUNG_____

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Date: 23 APRIL 2020_   **Date**: 23 APRIL 2020

BIS (HONS) Business Information Systems
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DECLARATION OF ORIGINALITY

I declare that this report entitled "**Application Development for Student with Dyscalculia**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Lam

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Name : _____
Lam Jing Sung

Date : _____
23 April 2020

ACKNOWLEDGEMENTS

Foremost, This project would have been impossible without the support of Miss Nur Syadhila Binti Che Lah. I would like to express my gratitude towards my project supervisor Miss Nur Syadhila Binti Che Lah for the approval of my work and all the assisting toward to my project. She is always patient to help me out with questions. Her guidance and suggestion helped me a lot in how to get this project done properly.

Then I would like to thank my parents and friends who helped me with their valuable suggestions and opinions. I am indebted to their encouragement and enthusiasm in helping me. Without their guidance, I think that I would not be able to complete this project by myself.

Thirdly, I would like to express my gratitude to Universiti Tunku Abdul Rahman (UTAR) for their well establishment and support have help me in various ways in completing my project.

I am making this project not only for marks but to also increase my knowledge.

Finally, I would like to apologize to all other unnamed who helped me in various ways to have a proper project done.

ABSTRACT

This project is a mobile application development project for academic purpose. This project is developed specific for student with Dyscalculia. Recent research shown that there is a less focus or study on Dyscalculia in Malaysia. Less focus is therefore creating a situation that there is very less educational mobile application being studied or developed in Malaysia for the children who suffer Dyscalculia. A severe ignorance from the society regarding this matter, has therefore created limited studies, investigation and not much of development on educational game for the children diagnosed with Dyscalculia. With today's technological advancement the quality of life has improved a lot due to the rapid technology advancement and innovation. This has benefited the people diagnosed with disability in improving their learning environment. Research also state that disabled people can learn better with the support of technology. This helps them to focus on the subject matter eliminate the unnecessary distraction from the surrounding. Method that has been deployed for the development in this project is Calculic Model. This proposed model composed three factors, which they are, Instructional Factor, Environment factor and Personal factor. The development of the application will be guided with this model. The tools used to development would be Construct 3. It is a mobile application tools that uses HTML5, JavaScript as their language. The development requirement will follow according to the proposed model. Based on these three factors, a suitable mobile application will be developed. The application will be composed four subjects, which are addition, subtraction, division, and multiplication and additional quiz. Each of these will contain several levels designed with different difficulties. This project aims to provide a solution to help the primary children with Dyscalculia diagnosed in better learning in mathematics. So, they won't found learning mathematics is boring and trouble

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
BDA	British Dyslexia Association
LDA	Learning Disabilities Association of America
SDLC	Software Development Life Cycle
TSA	Transcortical Sensory Aphasia

CHAPTER 1

Introduction

1.1 Problem Statement

According to (Ariffin *et al.*, 2017)**,** there is very less educational mobile application being studied or developed in Malaysia for the children who suffer Dyscalculia. Not much of educational game can be found offer to the children with Dyscalculia in Malaysia due to the limited study and investigation. (Nagavalli and Juliet, 2015), multimedia content in mobile application could encourages children with Dyscalculia interact more often and learning mathematics more effectively. Incorporation of video, animation, pictures and music stimulate them to learn maths better and ability to link mathematics concept to real-world objects. A research done by (Ariffin *et al.*, 2017) shows that children improved vastly after using mobile application to learn math. Comparing pre-test and post-test result, it increases by 17.85%. The feedback from the teacher participated the study also said that mobile application can vastly improve the performance of learning mathematics for the children with Dyscalculia. Thus, creating an education mobile application with creative content should help the Dyscalculia children a lot by incorporating animation, video, stories, pictures, music, and other multimedia content.

(Perelmutter, McGregor and Gordon, 2017) said that a one-size-fits-all mobile application would not be a solution to improve the performance of learning for the learning disability people. It might satisfy a portion of people but not all. A customize educational mobile application is needed instead of one-size-fits-all mobile application. A customize educational application develop for specific learning disability is a better solution. Customized settings that reflect the characteristics of Dyscalculia is needed(Halim, Sugathan and Ariffin, 2018). An effective application should enable Dyscalculia the ability to level the difficulty. In the proposed project, an application development would carry out to deliver a substantial and customize application to the Dyscalculia people with features that benefits them. Incorporating a lot of multimedia content to make it more interactive and enjoyable to the Dyscalculia children.

1.2   Background and Motivation

According to (World Health Organization, 2018), "*Over a billion people, about 15% of the world's population, have some form of disability.*" The numbers of disability are to say to be gradually increased as the population of the world are facing ageing and chronic diseases problems. Rates of disability can be increased by poverty through dangerous and polluted surrounding, shortage of clean water and shortfall of nutrition. Disability can also increase the rate of poverty due to disability circumstances lead to unstable job and education opportunities, shortage of proper income and rise in cost of living (World Health Organization, 2018). In Malaysia, numbers of people with disability registered with the Social Welfare Department are estimated around 409,269 as in 2016 (Malaysian Social Welfare Department, 2016).143,334 individuals from 409,269 are diagnosed with learning disability. According to (LDA, 2018), "Learning disabilities are neurologically-based processing problems Social Welfare Department of Malaysia categorized disability into 7 types (Department of Statisticss Malaysia, 2016). Those are sight, speech, hearing, physical, learning, mental and multiple disability. Learning disability can be further classified into Dyslexia, Dyscalculia, and Dysgraphia. Individual with Dyslexia has difficulty in reading and Dysgraphia has difficulty in writing. While individual diagnosed with Dyscalculia has difficulty in learning math.

Nowadays, the quality of life has improved a lot due to the rapid technology advancement and innovation. This creates more option for people on how to help the disabled people with learning disability. According to (Skiada *et al.*, 2013), children with learning disability learn better when utilizing mobile learning. Mobile learning encourages people to learn stuff, it avoid any unnecessary distractions and focus on the device's screen. (Perelmutter, McGregor and Gordon, 2017) claimed that, Assistive technology can vastly improve the quality of life, ways of learning and quantitative educational results. But there are still some limitations, assistive technology is not designed specifically to specify individual and has a misconception that one one-size-fits-all solution will solve the problem of the individual with learning disability. (Halim, Sugathan and Ariffin, 2018) said that, developers are not yet able to design a suitable mobile application for learning disability children due to lacking instruction or guidance. The objective of this study is to think a way to improve the learning method of learning disability of people, especially individual with Dyscalculia. An application that customized specifically for the Dyscalculia people.

1.3   Objectives

1.3.1 To design an educational mobile application that specifically for the Dyscalculia children.

The purposes to develop an application for Dyscalculia children is to let them learn mathematics in a more fun and better way. Hoping that they won't lost their interest in learning mathematics despite it is difficult for them to learn.

1.3.2 To develop an educational mobile application that is fun and simple to use.

This group of people might already lost its interest in learning mathematics but this application is designed simple and fun to use, hoping that their interest won't be lost. The application is created in a simple way to let children use so that they won't feel annoy and give up learning mathematics.

1.4   Highlight of what have been achieved

This project aim to help the children with difficulty in learning mathematics and also children with Dyscalculia. This mobile application is developed to help them in learning mathematics and letting them to have fun with the games too. There are 4 modules developed throughout this project. There is video module, which consists of video teaching children on learning mathematics, such as learning numbers, and operators. Number module is a more to interaction part, where user can learn numbers by touching figures, and matching numbers. Then, operator modules which has 4 types of operators letting children to drag any number to the box to form and equation and calculate, like a mini calculator. The last module which is the challenge module, which children will challenge themselves on how much quiz questions can they answer.

1.5   Report Organization

This report consists of 6 chapters. The first chapter will be mostly covered the problem statements. The objectives to developed this application, background information of Dyscalculia. Second chapter discuss about the conducted literature review on Dyscalculia. The variation of definition, symptoms of Dyscalculia, current problems exist, review and compare different applications. Third chapter will show the system design, cover from an

overall design to a more narrow part design.Fourth chapter will discuss about the methodology chosen in this project and how the method would be used in this project. Chapter 5 will shows the implementation and testing part, where it will shows the steps on how to start using the application and different test cases are prepared. Final chapter will discuss the conclusion made and also the future work can be done.

Chapter 2

Literature Review

2.1   Definition

Dyscalculia was first introduced by, Dr. Ladislav Kosc, a Czechoslovakian researcher defined this kind of disorder as "developmental dyscalculia" (Kosc, 1974). He said that this type of disorder has trouble in arithmetic because of weakness to specific areas of the brain associated with cognition of mathematical, however should not have trouble in one's mental abilities. (Koontz, 1996) defined dyscalculia as "Arithmetic Learning Disabilities". (Temple & Sherwood, 2002) defined it as "Number fact Disorder". According to (Wellington, 2018), often dyscalculia refers to as learning disability in math or the math version of dyslexia. Some individuals also called dyscalculia as math blindness. Individual who has trouble or issues in comprehending arithmetic and math concepts.

Table 2.1: Definition of Dyscalculia

Author	Definition
(Kosc, 1974)	developmental dyscalculia
(Koontz, 1996)	arithmetic learning disabilities
(McLean and Hitch, 1999)	specific arithmetic learning disabilities
(Temple and Sherwood, 2002)	number fact disorder
(Butterworth, 2012)	number blindness

Symptoms of dyscalculia can be varied by individual. At different age groups, individual show different act and sign. (Drigas and Pappas, 2015) estimate that 10% to 15% of the whole world population has dyscalculia. (BDA Dyscalculia Committee, 2018) said that, dyscalculia patient can face difficulties in calculation from backwards to forwards, unable to read clocks, memorising placing numbers, scheduling time for work or to school. As mentioned above, these are general symptoms of dyscalculia. Vary age group might have different signs. (The Dyslexia Association, 2018) further elaborate the symptoms of dyscalculia by different age group. Thus, giving a clearer picture of dyscalculia in varies age group.

Table 2.2: Symptoms of Dyscalculia in different age groups

Age	Description
Pre-school	-trouble in counting -trouble in linking object with number, e.g. '3' linking with 3 cars -Unable to differentiate tallest or shortest object
Primary School	-difficult in remembering number facts, e.g. $6 + 4 = 10$. -unable use more advanced skills to count, e.g. using fingers -Low comprehension of number signs, e.g. +, -, x, / -Confusion in recognizing left right pattern, e.g. $1 + 2$ is equal to $2 + 1$ -Trouble in placing value, e.g. place in wrong position -Comprehension of mathematics language is lower than other -Unable to understand greater or less than -Unable to count or keep score in games or sports, e.g. counting balls -Unable to count total value -May avoid dealing things that associate with mathematics
Secondary school	- Confusion in understanding statistics, e.g. graph, chart -Trouble in relating mathematics in real life object, e.g. money -Difficult in understanding reasoning methods and multi-step calculation procedures -Unable to find different ways to solve maths

problem

-Unconfident in dealing activities that require understanding speed, distance and directions, and may get lost easily.

-Cannot understand reasoning and multi-step calculation steps

Adult	- Unable to count backwards-Calculate mathematics slower than others
	-Weak mental arithmetic skills
	-Weak sense of number estimation
	-Unable to place value
	-Anxiety of mathematics very high

2.2 Application Learning for Dyscalculia

(Gabrielle and Jeffrey, 2015), said that assistive technology could bring huge advantages or benefits to the disability people. Mobile learning could give those disabled people motivation or confidence in dealing with mathematics. It also can help them to focus, avoid any unnecessary avoidance. It is a very good platform for the disabled people to learn maths. It claimed that, it will increase their mental mathematics skills. According to (Nagavalli and Juliet, 2015), multimedia helps dyscalculia to understand mathematics sign or "number sense" more better. Videos, music, and visual aids could help them in connecting math concept to the real-life environment. (Skiada *et al.*, 2013), mobile application encourages children to learn more. Research shown, children are more willing to learn on mobile rather on paper. Performance of the children is better after using mobile application. It can improve children mind mapping ability. Thus, improve their "number sense".

2.3 Problems of Dyscalculia

(Abdul Nasir and Erman Efendi, 2016) said that, in Malaysia research or development for disabled person is considerable very low. Special education or method is needed for those children with disabilities in Malaysia. The obstacle facing in Malaysia are due to scarce appropriate resources such as financial constraint, lack of interpreter service and lack of professionals who are capable in handling disabilities. Facilities are said to be very poor

because problem such as incomplete infrastructure or lack of special device provision for disable people. Incomplete or insufficient teaching material for disable person and awareness of disability in Malaysia is very low. In the report generated by (Perelmutter, McGregor and Gordon, 2017), problems of assistive technology in these days are lack of customization. Application are not developed specifically to specific disability group. Thus, some individual benefit from it, some individual seems to be not very effective. Lacking inappropriate in instruction and guidance in designing mobile application is one of the problem(Miller *et al.*, 2017). (Ariffin *et al.*, 2017) claimed that, Malaysia is lacking educational mobile application being developed. Limited studies about Dyscalculia children in Malaysia are the reason of shortfall development of educational mobile application.

2.4   Techniques

There are several ways to improve the techniques or strategies in helping the Dyscalculia people. A model was introduced by (Fiqa Azureen, Mazeyanti and Savita, 2017), called Calculic Model. This model is believed can be used to greatly improve the Dyscalculia people.

This model contains 3 factors which they are personal, environment and instructional factors. In instructional component, it contains another 6 components. The identified components are example, practice, error, objective, progress screening, language, and feedback with correction. In personal component, it contains 9 components. The identified personal components are font, image, colour, motivation, navigation, layout, sound, video, and speech. Whereas, in environment component there is only one component, content error & bias. They said these components are very crucial for Dyscalculia children in terms of their learning. Among these components, the focus should put on the Personal factor and Environment factor.
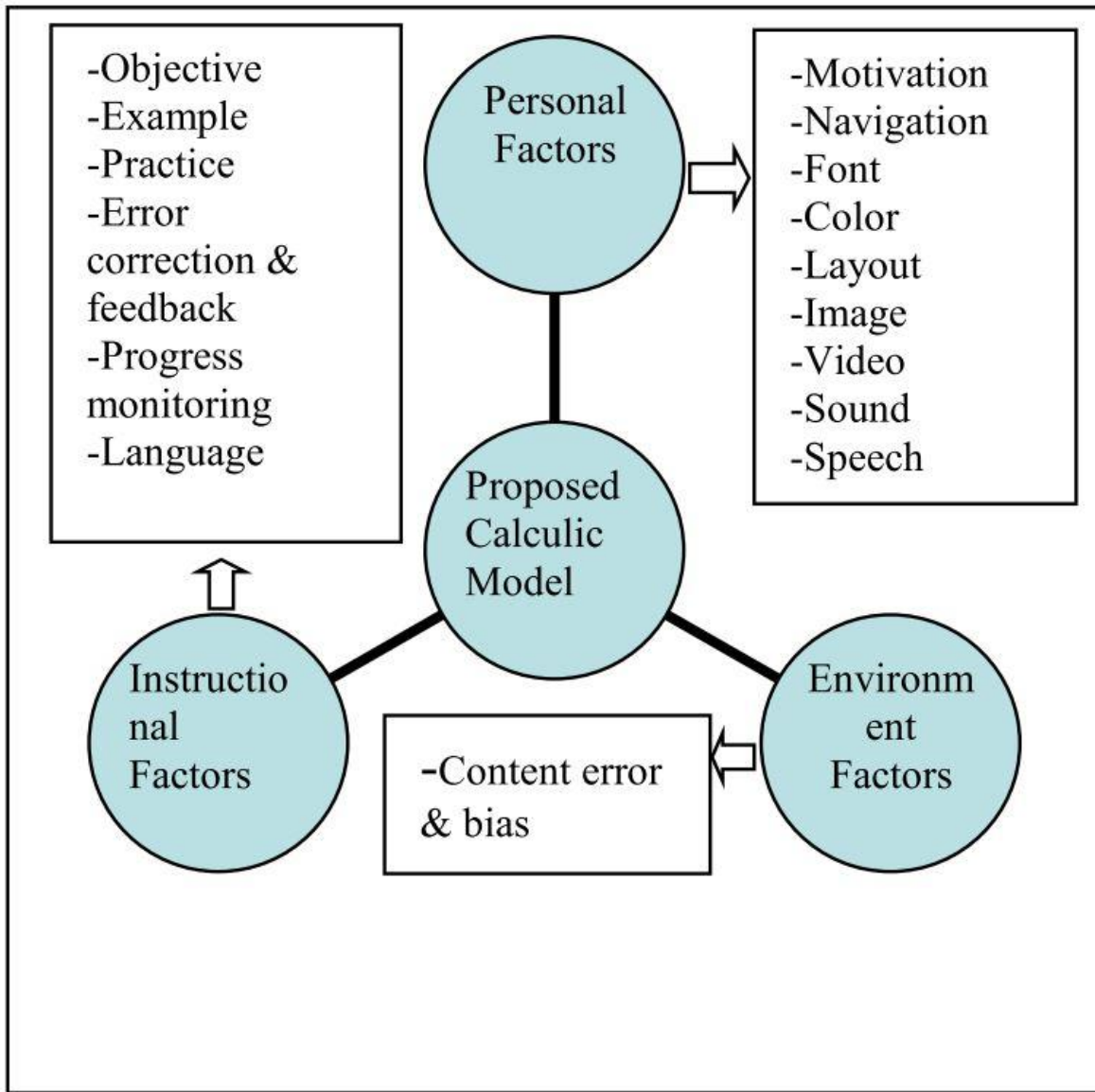
Figure 2.1: Proposed Calculic Model

Font size is very important in the Personal factor, because font size could influence a certain people reading performance and understanding. Suggested font size from the report are san serif and Arial font. They claimed it could improve the way that Dyscalculia people read. They also say that the "practice" component from the instructional factor should provide a clear guideline for the Dyscalculia children. A clear guidance or exercise should help them overcome the problem of learning math. Report stated, some people support the idea of giving exercise because it improves their math solving skills and the exercises should have different level of difficulty. One interviewee from the report said that, exercise is important because exercise is part of the learning process. Colour is important in improving their learning skills too. Providing suitable colour and hint could enable them to solve math better.

It gives them motivation to do better. The layout is made to be attractive, avoid cramping materials, use short text and numbering or bullet point. Simple and consistent design could help them in navigating throughout the application. Incorporate image, animation or speech could make the application livelier. Thus, it draws their attention and focus more on the application.

Content error and bias component in the environment factor stated that, learning content in the application should be free of error. Leaning material is prohibited because improper examples could mislead the children and lead them into confusion. The content of learning should up-to-date and provide new features or learning content as latest as possible.

According to (Ariffin *et al.*, 2017), there are only 9 component that should looked into to improve the interface for Dyscalculia children using the application for learning. Those 9 components are guidance, intonation, narration, language, image, assessment, background, user layout and font. The guidance component states that colour font of question and answer provide hints to the children. Colour could stimulate their brain to choose the better answer. Colour could help them in relating the correct answer with the hint given. It also can avoid any unnecessary confusion in reading the number and the allocation of number in the answer.

The narration component states that, the speech should use a slower pace. Same goes to the intonation. Slower pace could help them to understand the questions better. Language is important concern in intonation. Suggested that Malay language should use in supporting children in Malaysia.

Inclusion of image in the application helps the children learning math better. Showing a real image of human hands or objects they can found in their learning surrounding could help them to relate the situation to the math questions. Object display must be clear, no overlap, and stationary to avoid any confusion or misunderstanding.

The assessment component in the model stated that, the children should feel to be motivated in learning the math. Correct answer should give a motivated sound to them such as clapping hand. Wrong answer should tell them to try again instead of telling them they made a wrong choice. The encouragement could generate the enthusiasm inside the children to learn more math.

Background component stated that, it should keep it simple. A simple colour of white, pink or any soft colour can be used. Soft pastel colour stimulates their brain to focus on the learning. Aggressive colour could lead them into confusion.

Font component suggested from this paper is non-serif. Dyscalculia children has difficulty in reading because they have trouble in recognizing alphanumeric. Non-serif could help them to understand the world better and read it with more confident.

From another report explained by(Ahmad, Jinon and Rosmani, 2013), multimedia element offer the chances to be actively engaged with the real-world environment. Multimedia elements such as, text, voice, pictures and animations. However, the report written that, colour has no significant role in improving the Dyscalculia condition. It claims that any colour could work for the Dyscalculia especially in designing tools for them. In this report, it is written that multimedia element offer the chances to be actively engaged with the real-world environment. Multimedia elements such as, text, voice, pictures and animations.

The report is more focus on two elements, which are graphics and font style. The author stress that graphics should be simply and avoid use of background graphics. The design should be minimized, no disturbing background image to distract the people. Font style should be sans serif font. Arial font type is more recommended since it is clearer and easily recognisable.

The last report reviewed which is from the(British Dyslexia Association, 2006), which it is a white paper document. In this document, they stressed the importance of font type, interface design and format. The font type they emphasized is sans serif. Arial and Comic Sans font type are encouraged to use. Another font such as Verdana, Tahoma, Century Gothic, and Trebuchet can be used too. They say font size in 12 to 14 point is suitable. Black colour text is encouraged to use. White, pink or green colour text are not encouraged to use since some Dyscalculia may have colour blindness. Avoid italics and underline text. Bold text should be use for header or title only. Text in the body should be using non-bold text. Boxes and borders are encouraged to use to organize the text properly. Text should be left justified, avoid narrow columns, 60 to 70 text character in one single line. Bullet point can be used to organize the point. 1.5 spacing is needed to use. Abbreviations should not be used.

As for the interface design, the author suggested that text should be break from multimedia element, which are pictures, images and graphics. Stationary text is preferred than moving or floating text. A simple navigation is suggested, better with a site map if possible. Hyperlink

provided to show user which pages can be accessed. It is recommended that user can customized their own font, background colour and style too. Avoid using large image to block visual or disrupt user readability.

2.5 Existing Mobile Application

Below is the application that are currently offered in the market to suit and support the Dyscalculia people. Table 3 will show the description of the mobile description introduced:

Table 2.3 Mobile Application Comparison

Application name	Target Audience	Operating System	Language	Description
Cuibrain – Brain Teasers & Mind Games	ADHD, Dyslexia , Dyscalculia, All age groups	Android	English	Focus on memorizing colour pattern (memory)
Meister Cody - Talasia	Dyscalculia & primary children	Android	English	Focus on number system, addition, subtraction, multiplication and division operation
Blips	Dyscalculia, Dyslexia & TSA, 3 - 10 Years old	Android	English, French	Focus on reading number, memorizing number
Times Tables Math Trainer Free	Dyscalculia, primary & secondary children	Android	English	Focus on multiplication
Times Tables	Primary children,	Android	English	Focus on

Trainer Free	Dyscalculia			multiplication
Cognifit - Brain Fitness	Dyslexia, ADHD, Dyscalculia & etc, All age groups	Android	English	Focus on memorizing colour pattern (memory)

Among these 9 applications reviewed, the most suitable application to be studied is Meister Cody – Talasia. It has all what it needs in the application. Addition, subtraction, multiplication and division operation are included. None of these are left out. Cuibrain – Brain Teaser & Mind Games lack of mathematics operation, it has no nay mathematics operations included in the application. Only matching patterns of same object. Same goes to, Cognifit Brain Fitness focus on matching patterns only. Times Tables Math Trainer Free and Time Tables Trainer Free focuses on multiplication only. It doesn't have addition, subtractions or division questions. Which seems these applications doesn't suit to the lower primary kids. Blips focuses on reading number and memorizing it. Those four basic mathematics operations were not included. Which seems is not a perfect application for the Dyscalculia children. Among these applications introduced by the market, the application is going to be made should incorporate those four mathematics operations, addition, subtraction, multiplication, and division. Inclusive of some matching pattern games, reading, and memorizing to test the children understanding the math.

Font size decided for the application development would be Arial with size 12 point. Title or hear point will be bold. No italic or underline text is used. Use soft pastel colour for the interface design, (e.g. background, image, graphics). Animation with voice would be incorporate into the application. When user answer correctly, it will congratulate them with voice. When they answer wrong, it will prompt a message ask them to try again with soft voice. Avoid aggressive comment. Tutorial would be provided in the application with real world related images possible. A simple navigation must be designed for the Dyscalculia. Language would be used in the application would be English. Video tutorial will be incorporate into the application too. Simple teaching video with soft and gentle voice. Include some motivation speech for the Dyscalculia. Abbreviation text should be used lesser.
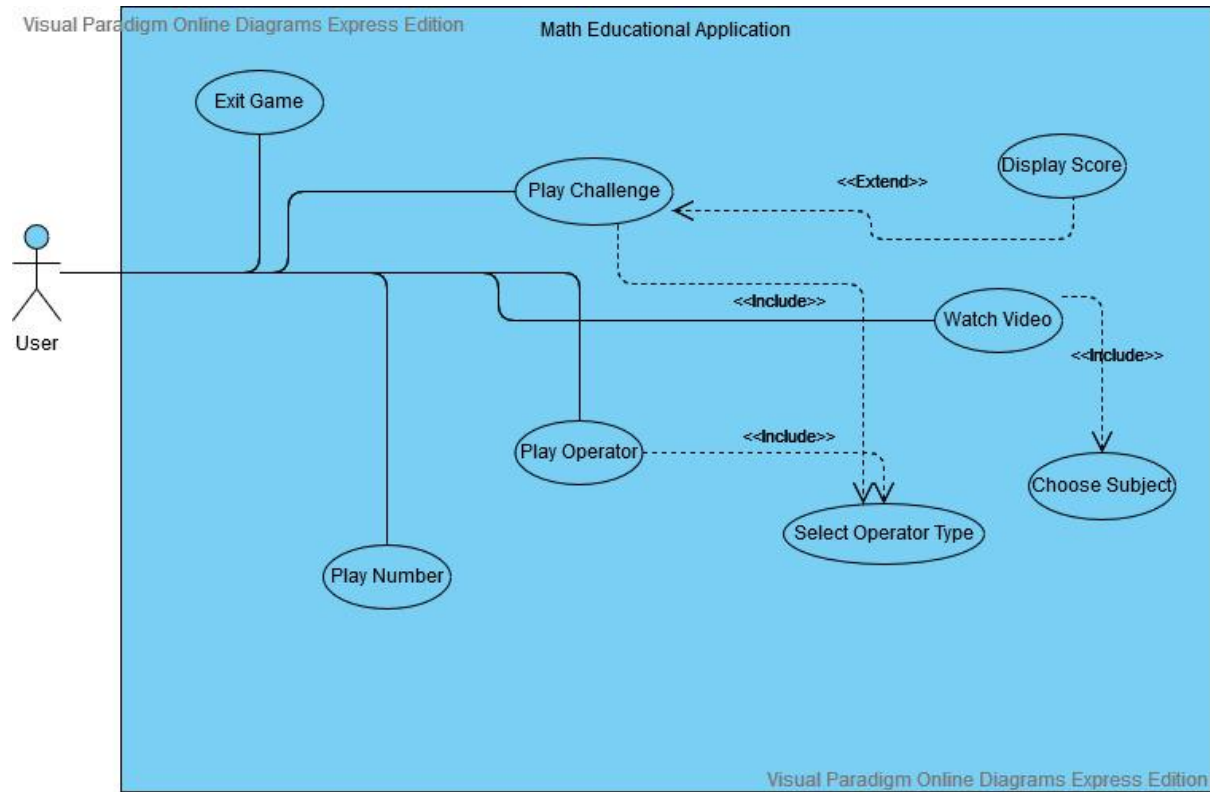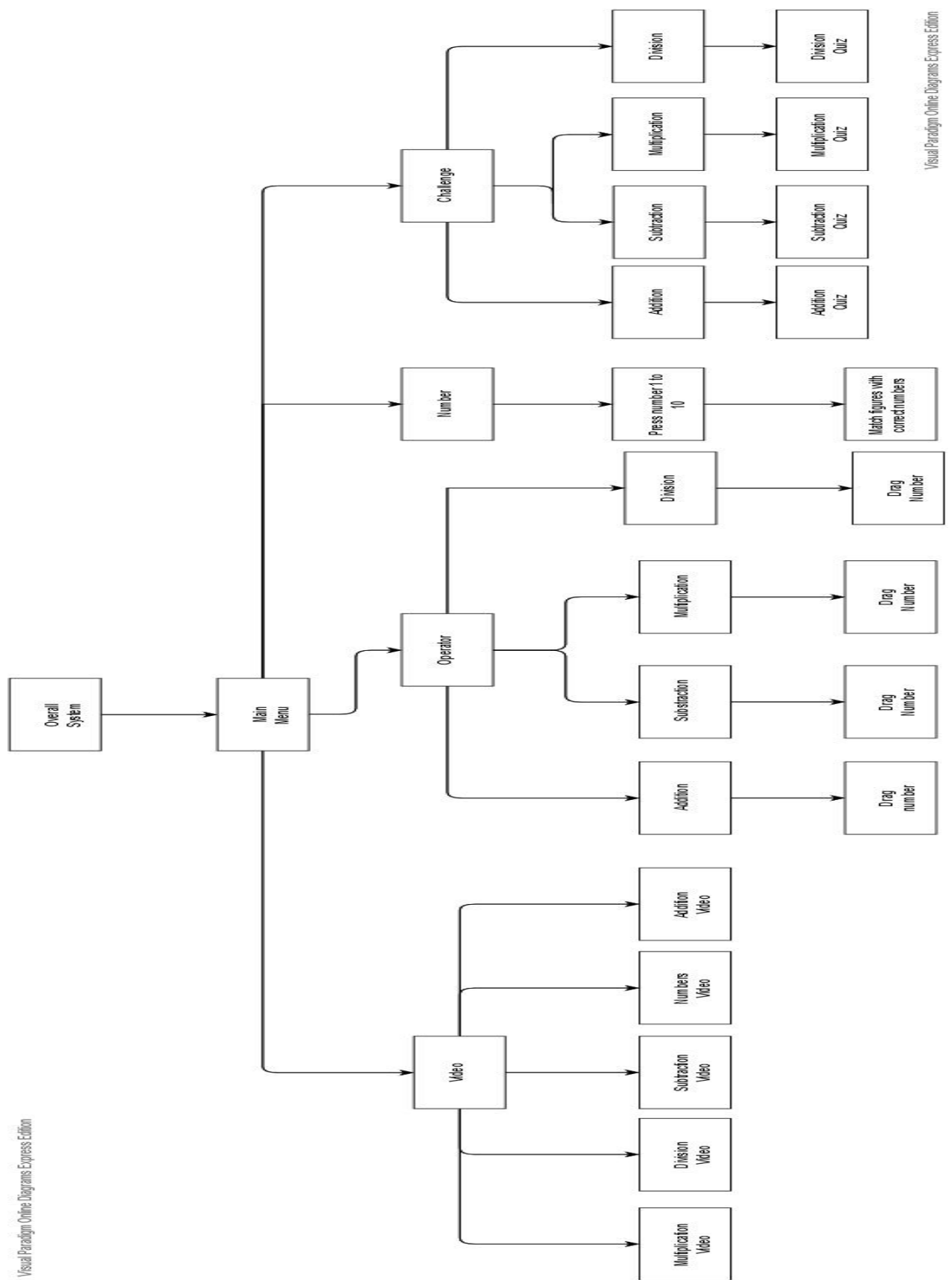
CHAPTER 3
System Design

3.1 Use Case

Figure 3.1: Math Educational Application Use Case Diagram

3.2 System Overview

Figure 3.2: Overall System Overview

i. Main Menu

This page will show the application interface and the all the menu button.

ii. Video

This page will shows all the video subjects. User can watch the video and learn mathematics from there.

- numbers 1 to 10 video

- addition video

- subtraction video

- multiplication video

- division video

iii. Number

This page allows user to learn the numbers from 1 to 10 by clicking the number button. This page also includes number matching where user has to drag the number to the correct box.

iv. Operator

This page has four types of operator to let user choose to learn. User can drag number into boxes provided and calculate the number, like a mini calculator. The purpose is to let them try out whatever combination of number they want in using any operators. So they will learn from there better and faster.

- addition equation

- subtraction equation

- multiplication equation

- division equation

v. Challenge

This page is designed to let user challenge the themselves in quiz. This quiz is also like a mini game. User can choose four different types of operators to test their knowledge in there. Each correct answer is one point and user has to answer correct to not let the monster defeat the warrior.

- addition quiz

- subtraction quiz

- multiplication quiz

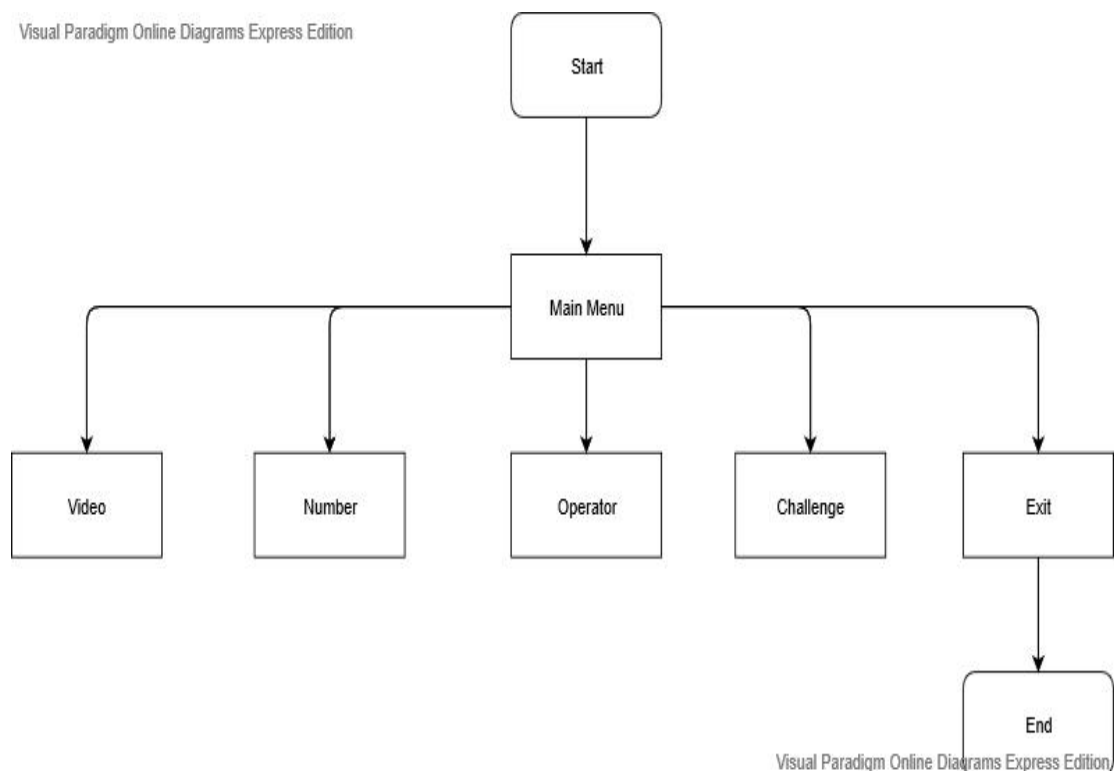- division quiz

3.3 System Flow Chart

Figure 3.3: Overview Flowchart

Figure 3.3 shows the system overview flowchart. At the beginning when application is start, user will direct to main menu. At main menu there will be five options to let user choose. Video will lead user to watch mathematics video, number will lead to number learning from 1

to 10, operator will lead to equation making and challenge would allow user to do quiz. If exit is chosen then the application will end.
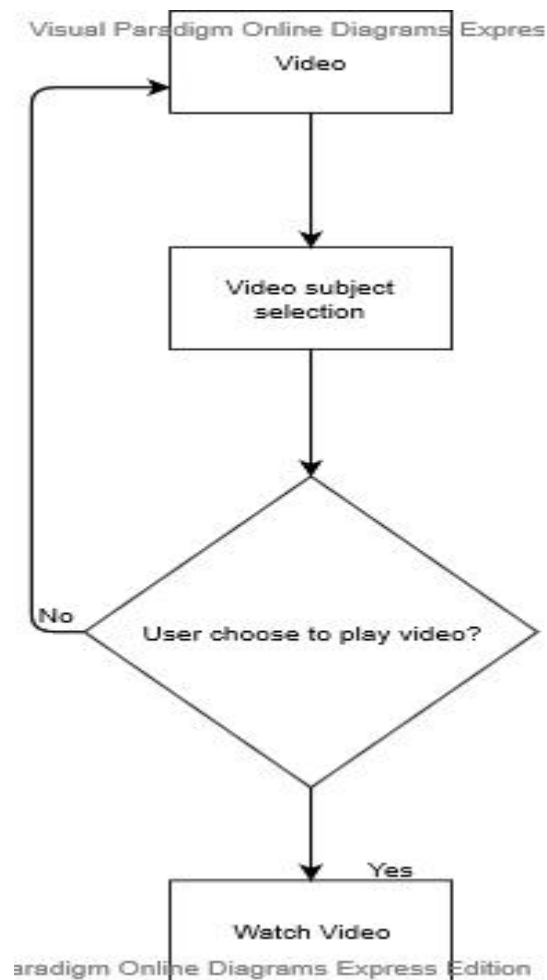

Figure 3.4: Video Module Flowchart

Figure 3.4 shows the video module of the application after main menu selection. Video subject selection allow user to select numbers, addition, subtraction, multiplication and division videos. If user choose to watch the video then it will lead them to the video.
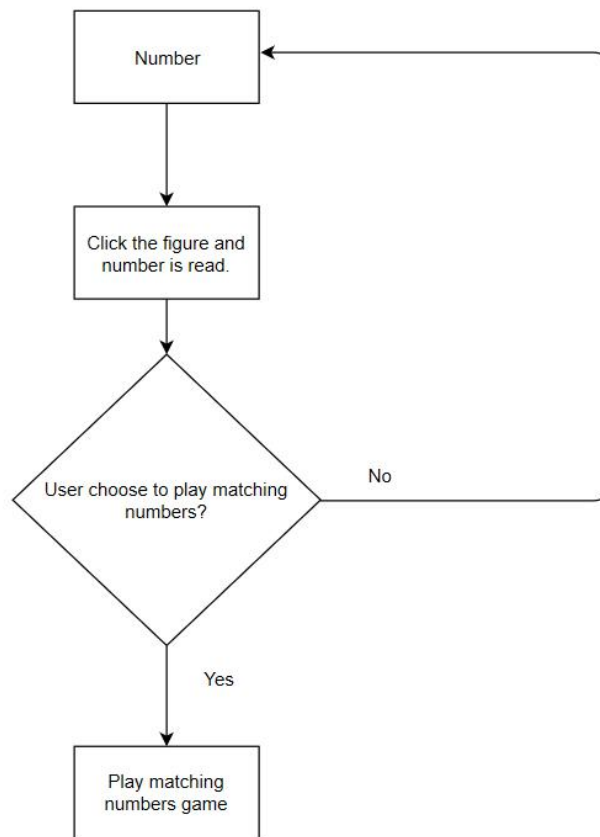
Figure 3.5: Number Module Flowchart

Figure 3.5 shows the number module flowchart. In this module user will learn number 1 to 10. User can click the figure with numbers and the sound of number will be played. Then user can choose to play matching figure with correct number by dragging the number to the correct box.
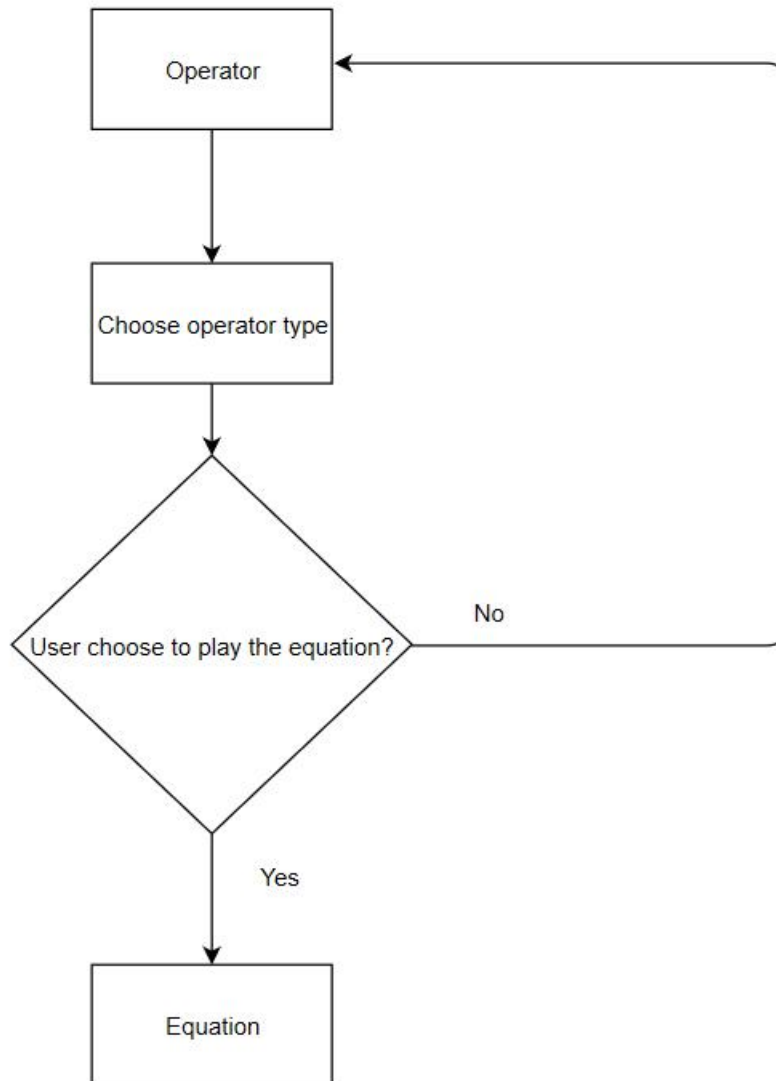
Figure 3.6: Operator Module Flowchart

Figure 3.6 shows the operator module. In mathematics there are 4 operator, addition, subtraction, multiplication, and division. This module purpose is to let user to try out these four operators. Letting them to have experience in these operators and how they will form an equation with these operator.If user choose to play the equation. User is needed to drag numbers in to boxes to form an equation and press calculate to get the result of the equation.
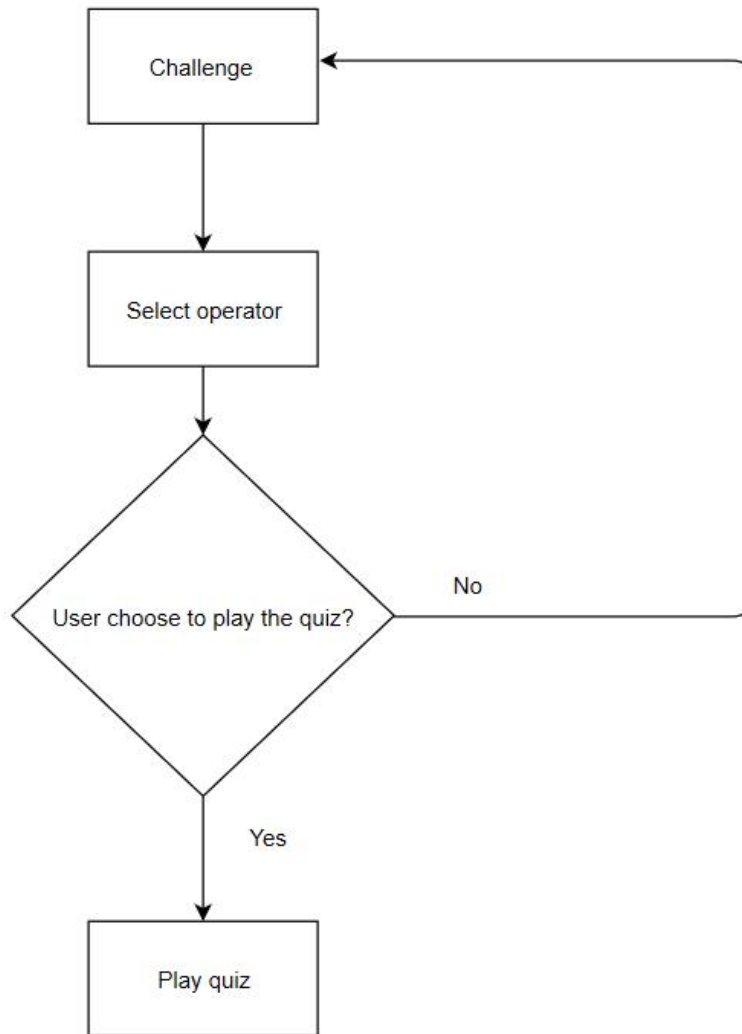
Figure 3.7: Challenge Module Flowchart

This figure shows the challenge module of the application. This module is to let user to challenge themselves how many quiz question they can answer. They can choose among addition, subtraction, multiplication or division quiz. If user choose to play quiz then they will play the quiz on the quiz page.

Chapter 4

4.1   Methodology and tools

Table 4.1 SDLC Model

Phase	Description (Activity/Tools)	Deliverables
Requirement and Analysis	Study the issue, background, gather information. Planning the work using MS Project. Study the needed hardware and software. Review existing mobile application. Review literature about Dyscalculia.	Project plan, Gantt chart, problem domain,
Design	Designing the layout. Draw processed or UML Diagram using visual paradigm.	UML diagram, flowchart, Use case diagram.
Development	Begin development in this phase using Construct 3.Animation is made using Animaker.	Initial prototype.
Testing	Deciding use which approach to test the application. (e.g. unit testing, acceptance. Deciding use which approach to test the application. (e.g. unit testing, acceptance testing). Unit testing test individual module	Test report. Improvement in development.

separately.

Deployment	Deploy the application to the user	A fully operational application.
Maintenance	Providing support to the user. Providing updates. Training.	User manual, further application improvement.

Requirement and Analysis

At the early requirement and analysis phase, we will review some literature regarding the Dyscalculia. Understanding the problems, background and issues of Dyscalculia. Gather data about Dyscalculia and from the data extracted decided what to do. Using Microsoft Project to build a Gantt chart for project plan. Outline the important task. Review any mobile application built for the Dyscalculia. Study the strength, weakness and limitation and descript about it. Dig some research regarding Dyscalculia. Understanding the definition of Dyscalculia. Thus, an initial report is produced.

Design

At the Design phase, the design layout will be working on. Draw graphs or diagram that is needed such as, UML diagram, Flow chart, and Use case diagram. Understand the interaction between the user and the application.

Development

During the Development phase, development is begun. The development required software using Construct 3. Construct 3 is used because it is a very popular android platform game application developer tools for android device. Not much of coding is involved. Compare to other development tools, Construct 3 used HTML5 and JavaScript in making the application. Plus, android smartphone is used throughout the world. Thus, accessibility of the application wouldn't be a problem. An initial prototype would be produced. Animaker is also used to develop the animation or the tutorial videos.

Testing

During this stage, there will be some test cases prepared and the method to conduct the test is chosen. Unit testing and black box testing are the chosen method in testing the application. Unit testing focus on testing the module individually and black box will test the functionality of the application. These testing are done to ensure the application runs smoothly and achieve what is targeted.

Deployment

In deployment stage where the application will be exported out as an apk. This apk is then transfer to anyone who wishes to install. Apk is installed and application is readily to start.

Maintenance

The last of phase of SDLC would be, Maintenance phase. In this phase training would be provided to them. Teaching them how to use. Pre-recorded video is taken to show user how to use. Continues update on the application, in-case there is more request or error in future.

4.2   Requirement

4.2.1 Functional Requirement

Functional requirement can be defined as the functions or modules of the developed application. The functions or modules created must be able to let users to use and meet their expectations. Functions can be any processes, inputs, outputs, or behaviors from the application. These functions will be used to define what a system should do.

- **Use Case**

  Use case diagram modeled the functionality of the system. Use case diagram is drawn to show the possible interactions between user and the application. Actor and use cases are used to represent those interactions.

- Video

Video is made to ensure user can understand the theory of how the mathematics works. Animation with voice to shows more interactions with users. Video module is made into five different videos targeting different topics.

- Gameplay

Some mini games are made in the application to make the process of learning mathematics more funnier. Games such as matching numbers, quiz to test their capability in learning mathematics. Users can also learn how the numbers 1 to 10 pronounce by clicking the numbers 1 to 10.

- Notification

Some simple notifications are made, such as answering correct answer will play "correct" sound or some visual aid such as "stars blinking" to indicate users have answered correctly. Score will be

4.2.2 Non-Functional Requirement

Non-functional requirement shows the system from quality aspects. It describes the usability or effectiveness of the system. It also describes how far can the functionality of the system reached, the limits of the system.

- This system can be installed and run on Android platform only.
- This system supports only from Android 5.0+ Lollipop version onwards.
- This system required minimum 1GB ram and 1GB storage space.
- User must allow the system to install in their phone before it can launched.

4.3   Specification: Analysis, Design and Verification Plan

4.3.1 Unit Testing

Unit testing is a software testing method that test each modules separately. This type of testing is done during development stage. The idea of this test is to test and validate each individual module of the application work as expected. It test and verify the program correctness of each modules separately. Each unit of these can be modules, process, function or objects.The purpose is to test individual modules work fine before integrating them together. This testing helps development more faster as problems are encountered are solved immediately before start the development on next module.

4.3.2 Black Box Testing

Black box testing is used to test the functionality of the application and based on system requirement and specifications. This test method is different than others because it doesn't look look into the code structure. Which means, it doesn't care about the coding part and tested with input directly and compare the output with expectation. This test method focuses more on the usability of the system.

Chapter 5

Implementation and Testing

5.1   Application Screenshot
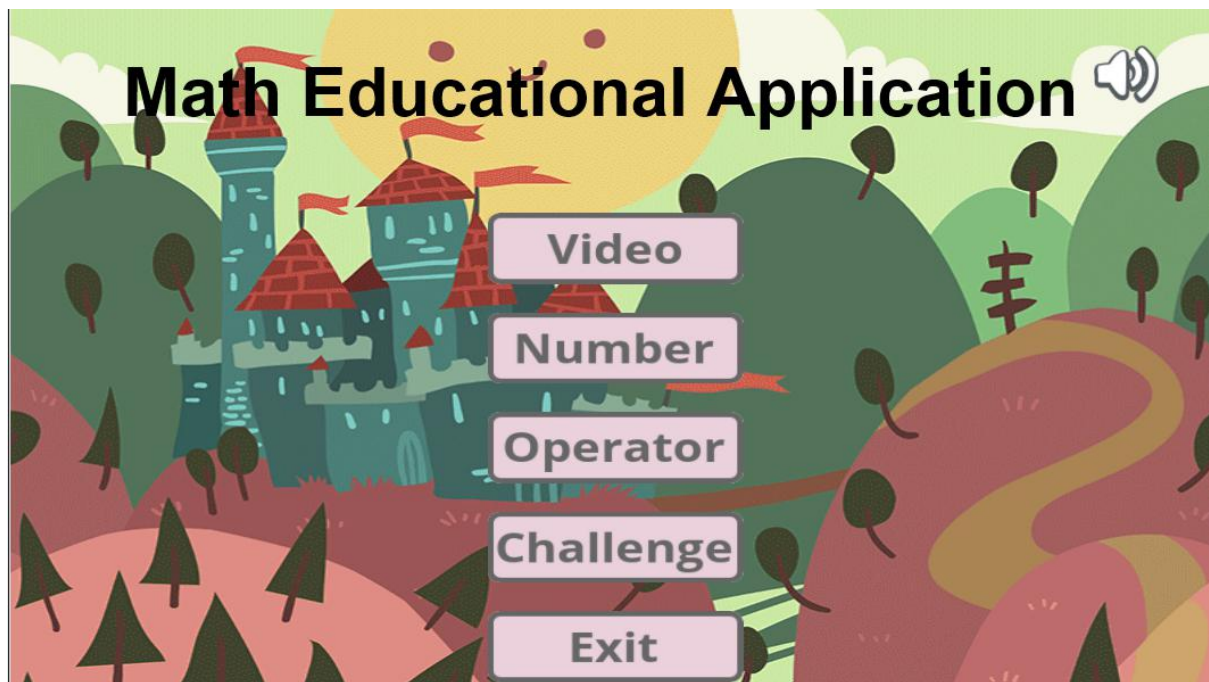
5.1.1 Application Interface

Figure 5.1: Main menu

Figure 5.1 shows the main menu of the application which consists of 5 buttons. Each clicks on the buttons which lead to different pages. Video will lead to video subject selection. Number will lead to number module which user will learns numbers from there. Operator will lead user to operator selection and go the desired operator page. Challenge will lead to quiz page and exit will exit the application. The sound icon on top right corner shows that user can stop the background music playing by clicking on it.
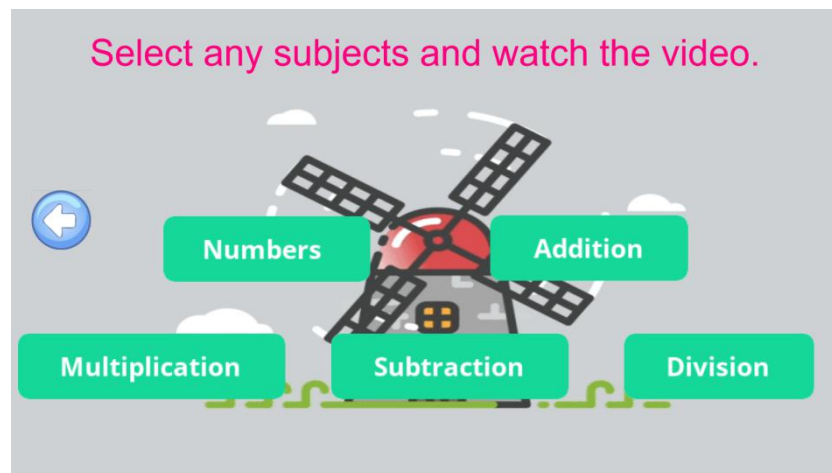
5.1.2 Video

Figure 5.2 Video Subject Selection

If user click the video button from main menu, it will lead them to here. Figure 5.2 shows that user can choose any video subjects they wanted to learn and watch it. Numbers video will shows the numbers from 1 to 10, Addition video teaches how addition work out and etc.
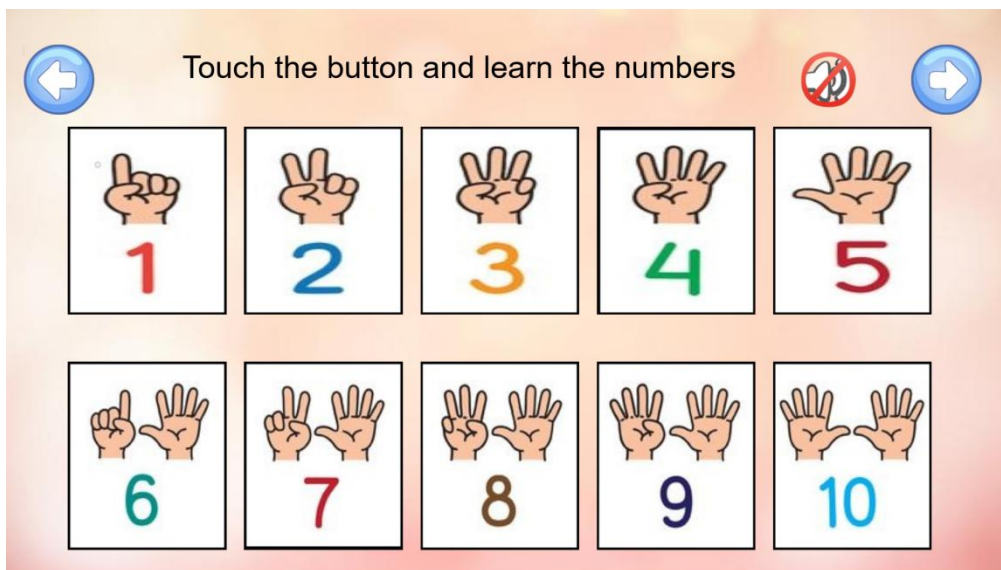
5.1.3 Number

Figure 5.3 Number Learning

After user click number button from main menu it will direct them to here where user will learn the numbers by pressing the button or figures. When pressed the numbers will be read. User can click the next button at top right corner to go to next page or back button at the top left corner go back to main menu.
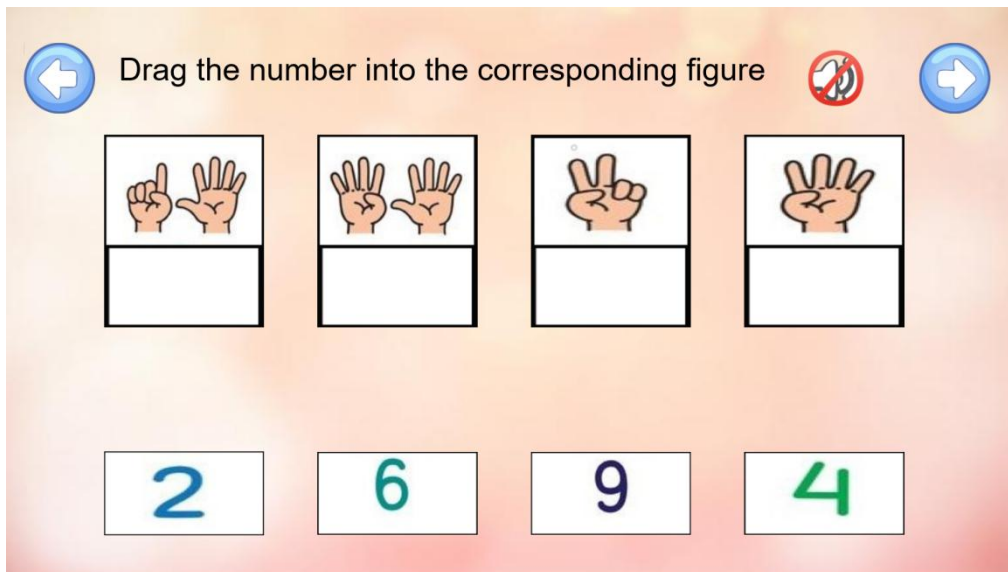
Figure 5.4 Number Arrangement

Figure 5.5 Success Number Arrangement

If user click next button from previous page it will lead to here where user will have to drag the correct number to the correct figures. If they successfully drag all numbers to the correct figures then they complete the stage. A go to next stage button and start blinking indicate they complete this stage and move to next stage. User can go to next page directly without the need to complete this stage. The content on next page is the same with this page which required user to drag the number to the correct figures, the difference will be only the figures and numbers.
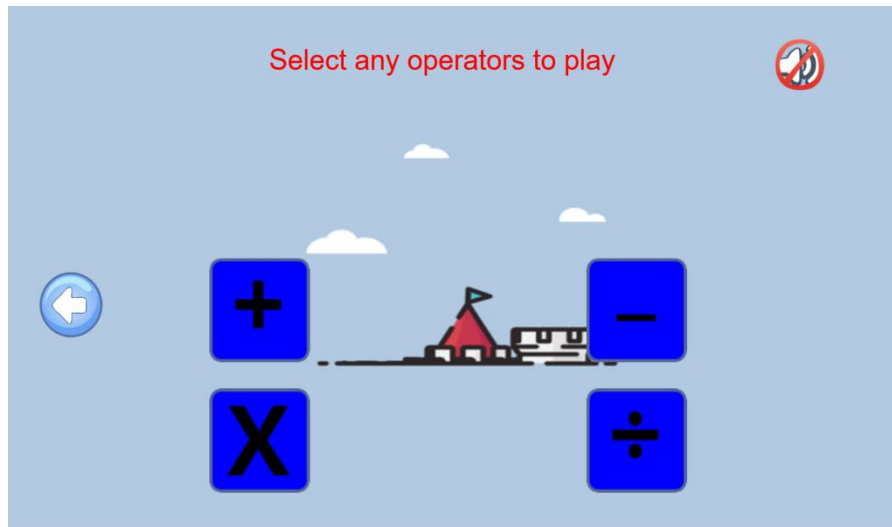
5.1.4 Operator

Figure 5.6 Operator Selection

If user clicks the operator button from main menu, it will direct the user to here. In here users will choose what operator they wanted to learn.
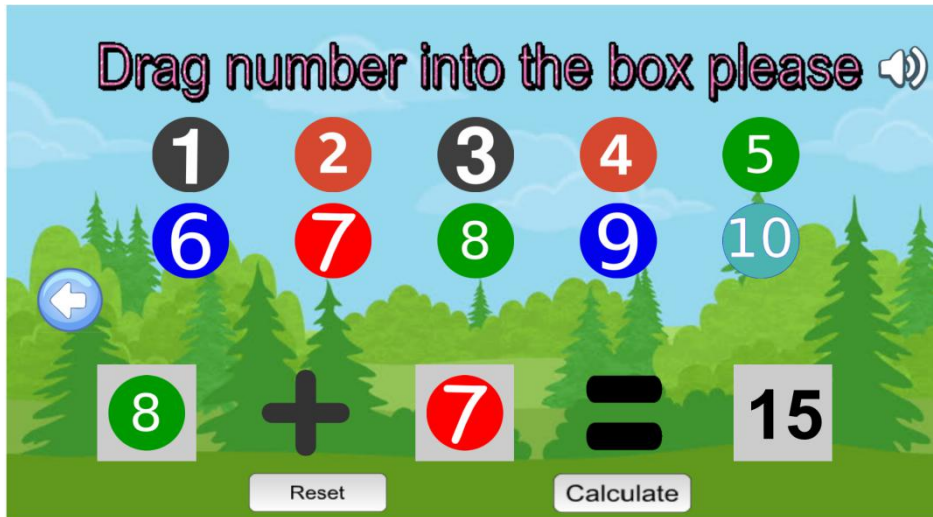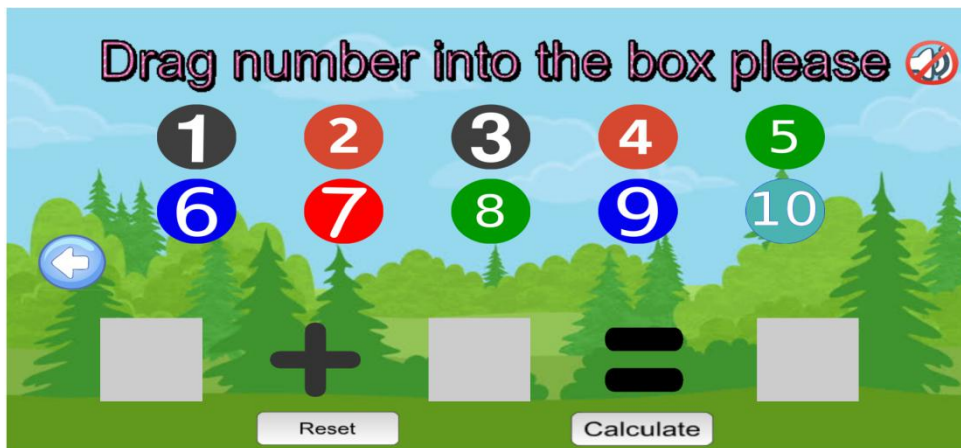
Figure 5.7 Operator Equation I

Figure 5.8 Operator Equation II

If the user choose addition operator then they will go to addition operator page. In figure 5.7 here user can drag the number no top to the boxes and press calculate to find out the number. This module is mainly focuses on letting children to try out the equation as long as they wanted so they now how the operator works. If reset button is pressed the number will return to their initial position as shown in figure 5.8.
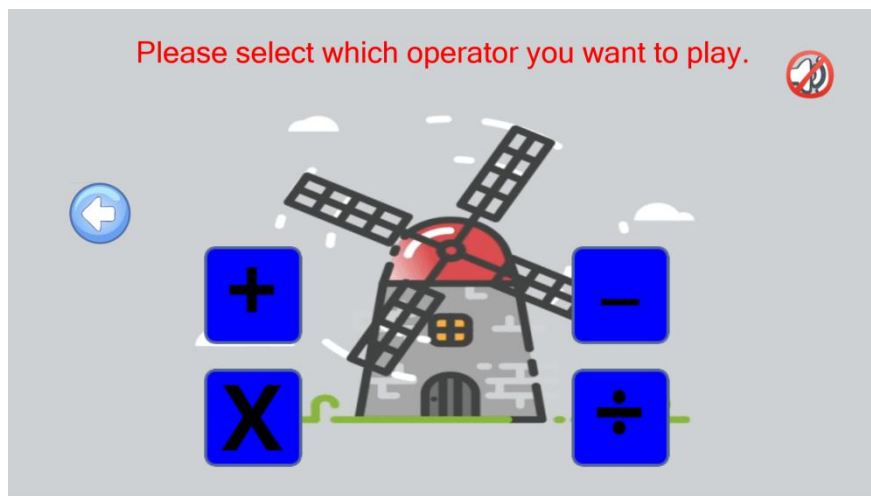
5.1.5 Challenge

Figure 5.9 Challenge Operator Selection

If user clicks challenge button from main menu it will lead user to here figure 5.9. In here user will choose which operator to play the challenge.
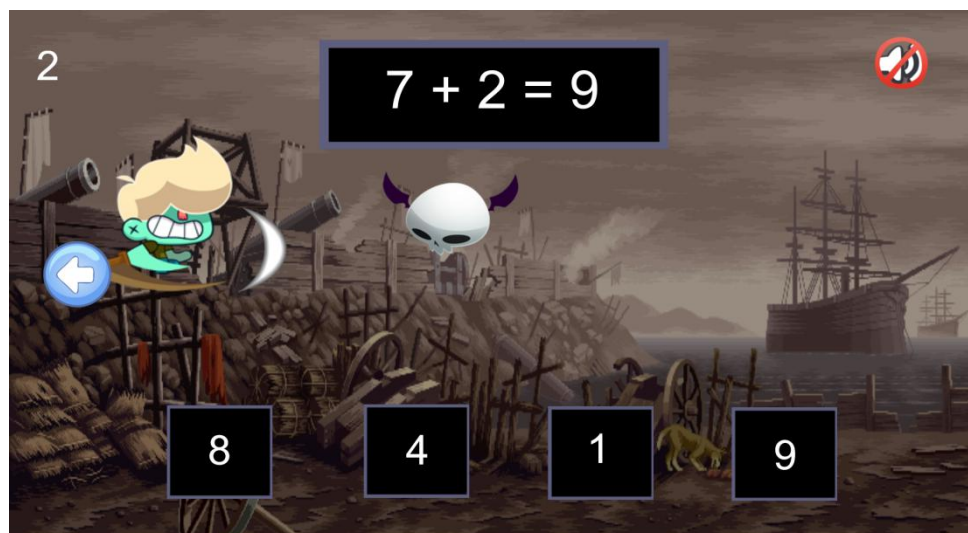
Figure 5.10 Addition Challenge Quiz

If the user choose addition button from figure 5.9, it will lead to here. In figure 5.10, user have to answer the quiz by selecting the correct numbers. If the answer is wrong it will caused the monster defeat the warrior. If answer correctly the warrior will slash the monster as show in figure 5.10. The number of questions that user answered correctly represent one point and the point will be shown in the figure 5.10 top left corner.

5.2 Unit Testing

Testing 1: Main Menu

Objective: To ensure that the button click in main menu able to direct user to desired page.

Table 5.1: Main Menu Activity

No	Test Case	Predictable Outcome	Result
1	Click Video button.	Display video subject selection.	Pass
2	Click Exit button.	Exit application.	Pass
3	Click Operator button.	Display operator type selection.	Pass
4	Click Number button.	Display learning number page.	Pass
5	Click Challenge button.	Display to operator type selection.	Pass
6	Click sound button.	Sound not play.	Pass

Testing 2 : Video module

Objective: To check all video can be played successfully.

Table 5.2:Video Module Activity

No	Test Case	Predictable Outcome	Result
1	Click number button.	Display number video page.	Pass
2	Click addition button.	Display addition video page.	Pass
3	Click multiplication button.	Display multiplication video page.	Pass
4	Click division button.	Display division video page.	Pass
5	Click subtraction button.	Display subtraction video page.	Pass
6	Click back button	Display main menu.	Pass
7	Click number video play button.	Number video play.	Pass
8	Click number video pause button.	Number video stop.	Pass
9	Click number video back button.	Display video subject selection.	Pass
10	Click subtraction video play button.	Subtraction video play.	Pass
11	Click subtraction pause button.	Subtraction video stop.	Pass
12	Click subtraction video back button.	Display video subject selection.	Pass
13	Click multiplication video play button.	Multiplication video play.	Pass

14	Click multiplication video pause button.	Multiplication video stop.	Pass
15	Click multiplication back button.	Display video subject selection.	Pass
16	Click division video play video.	Division video play.	Pass
17	Click division video pause button.	Division video stop.	Pass
18	Click division video back button.	Display video subject selection.	Pass

Testing 3: Number module

Objective: To ensure number module is working.

Table 5.3: Number Module Activity

No	Test Case	Predictable Outcome	Result
1	Click sound button	Sound can on and off.	Pass.
2	Click number figures.	Number sound is play.	Pass.
3	Drag correct numbers to correct boxes.	Numbers is placed in correct boxes, correct sound is play and start is blinking.	Pass.
4	Drag incorrect numbers to incorrect boxes.	Number return to initial places.	Pass
5	Click back button.	Return to previous pages.	Pass.

Testing 4: Operator module

Objective: To ensure operator module is working.

Table 5.4: Operator Module Activity

No	Test Case	Predictable Outcome	Result
1	Click addition button.	Display addition equation page.	Pass
2	Click subtraction button.	Display subtraction equation page.	Pass
3	Click multiplication button.	Display multiplication equation page.	Pass
4	Click division button.	Display division equation page.	Pass
5	Click sound button.	Sound can on and off.	Pass
6	Drag number into addition box 1.	Number is placed in box 1.	Pass
7	Drag number into addition box 2.	Number is placed in box 2.	Pass
8	Click addition page reset button.	Numbers dragged will return to initial position.	Pass
9	Click addition page calculate button.	Two numbers from box 1 and box 2 are calculated and results is return on box 3.	Pass
10	Click addition page back button.	Display operator type selection.	Pass
11	Click addition sound button.	Sound can on and off.	Pass

12	Drag number into subtraction box 1.	Number is placed in box 1.	Pass
13	Drag number into subtraction box 2.	Number is placed in box 2.	Pass
14	Click subtraction page reset button.	Numbers dragged will return to initial position.	Pass
15	Click subtraction page calculate button.	Two numbers from box 1 and box 2 are calculated and results is return on box 3.	Pass
16	Click subtraction page back button.	Display operator type selection.	Pass
17	Click subtraction sound button.	Sound can on and off.	Pass
18	Drag number into multiplication box 1.	Number is placed in box 1.	Pass
19	Drag number into multiplication box 2.	Number is placed in box 2.	Pass
20	Click multiplication page reset button.	Numbers dragged will return to initial position.	Pass
21	Click multiplication page calculate button.	Two numbers from box 1 and box 2 are calculated and results is return on box 3.	Pass
22	Click multiplication page back button.	Display operator type selection.	Pass

No	Test Case	Predictable Outcome	Result
23	Click multiplication sound button.	Sound can on and off.	Pass
24	Drag number into multiplication box 1.	Number is placed in box 1.	Pass
25	Drag number into multiplication box 2.	Number is placed in box 2.	Pass
26	Click division page reset button.	Numbers dragged will return to initial position.	Pass
27	Click division page calculate button.	Two numbers from box 1 and box 2 are calculated and results is return on box 3.	Pass
28	Click division page back button.	Display operator type selection.	Pass
29	Click division sound button.	Sound can on and off.	Pass

Test 5: Challenge module

Objective: To ensure the challenge is working.

Table 5.5: Challenge Module Activity

No	Test Case	Predictable Outcome	Result
1	Click addition button.	Display addition quiz page.	Pass
2	Click subtraction button.	Display subtraction quiz page.	Pass
3	Click multiplication button.	Display multiplication quiz page.	Pass

4	Click division button.	Display division quiz page.	Pass
5	Click addition quiz page sound button.	Sound can on and off.	Pass
6	Select addition quiz page correct answer	Monster is slashed and one point is score.	Pass
7	Select addition quiz page incorrect answer.	Warrior is defeated and game ended.	Pass
8	Click addition quiz page back button.	Display to operator type selection.	Pass
9	Answer selection timeout.	Warrior is defeated and game ended.	Pass
10	Click subtraction quiz page sound button.	Sound can on and off.	Pass
11	Select subtraction quiz page correct answer	Monster is slashed and one point is score.	Pass
12	Select subtraction quiz page incorrect answer.	Warrior is defeated and game ended.	Pass
13	Click subtraction quiz page back button.	Display to operator type selection.	Pass
14	Answer subtraction quiz timeout.	Warrior is defeated and game ended.	Pass
15	Click multiplication quiz page sound button.	Sound can on and off.	Pass
16	Select multiplication quiz page correct answer	Monster is slashed and one point is score.	Pass

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17	Select multiplication quiz page incorrect answer.	Warrior is defeated and game ended.	Pass
18	Click multiplication quiz page back button.	Display to operator type selection.	Pass
19	Answer multiplication quiz timeout.	Warrior is defeated and game ended.	Pass
20	Click division quiz page sound button.	Sound can on and off.	Pass
21	Select division quiz page correct answer	Monster is slashed and one point is score.	Pass
22	Select division quiz page incorrect answer.	Warrior is defeated and game ended.	Pass
23	Click division quiz page back button.	Display to operator type selection.	Pass
24	Answer division quiz timeout.	Warrior is defeated and game ended.	Pass

Chapter 6

Conclusion

This mobile application development project is solely dedicated to develop a mathematics educational application to the Dyscalculia people. The reasons behind of this development are due to some problems exists in society. Mostly are due the scarce educational mobile application to the Dyscalculia children and also the problems of using one size fits all application in learning mathematics. Scarce mobile application designed specifically to the Dyscalculia group has made them difficult to learn mathematics. Children with Dyscalculia at at age 7 compare with normal children with age 7 their capability in learning mathematics has a huge gap. Children with Dyscalculia might not understand what normal age 7 children learned. In total the final application has 4 modules which they are Number, Operator, Video and Challenge. Number module focuses on helping user in learning numbers from 1 to 10. Additionally there will matching number games for them to tryout. Video module allow user to learn mathematics by watching videos. There would be video about numbers, addition, subtraction, multiplication and division. Operator module gives user to learn how the operator works out. Enabling user to test different equation with different operator from number 1 to 10. The final module would be challenge, where user would challenge themselves by looking how much quiz the they can answered. Four different types of operator offers four different type of quizzes. In order to create a mathematics educational application to Dyscalculia, several requirements have to fulfil according to Calculic Model. It has to satisfy the personal factor, environment factor and instructional factor. From personal factor, author has implemented all Arial or non sans-serif font in the application, simple, soft pastel colour for the layout, include image and animation in the layout of application. Whereas for instructional factor, author has able to fulfil the practice and example component, where author include some quiz combination of four different subjects (additional, subtraction, multiplication, division) and some practice questions also based on that four subjects as well. The problem encountered by author would be the unfamiliarity with the mobile application tools, Construct 3 and Animaker. Because author has no experience in mobile application development where author has to learn from scratch and do research by himself. Author struggle especially in the development stage when author try to integrate with other modules.

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Error is found and solving them takes a lot of times. Different types of test care must be prepared to test the application. As a first timer of mobile application developer, it is difficult to develop a wonderful and perfect mobile application. In near future, author hopes to complete more educational mathematics mobile application for the children with Dyscalculia. An awareness of Dyscalculia must be made in the society thus family might able to diagnose their children whether are Dyscalculia or not.

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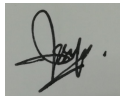
Appendices

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 2
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

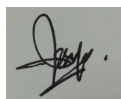| |
|---|
| **1. WORK DONE** |
| Consult tutor for the development of application. |
| **2. WORK TO BE DONE** |
| Full complete chapter 1 report. |
| **3. PROBLEMS ENCOUNTERED** |
| **4. SELF EVALUATION OF THE PROGRESS** |

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Supervisor's signature

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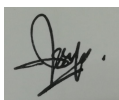
Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	Study week no.: 3
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE

Consult tutor for the development of application.

Consult tutor for the report format and idea.

Chapter 1 report completed.

3. WORK TO BE DONE

Full complete chapter 2 report.

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

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Supervisor's signature

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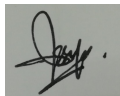
Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 4 - 5
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

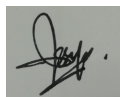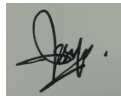| |
|---|
| **1. WORK DONE**

Consult tutor for the development of application.

Complete Chapter 2. |
| **4. WORK TO BE DONE**

Full complete chapter 3 report. |
| **3. PROBLEMS ENCOUNTERED** |
| **4. SELF EVALUATION OF THE PROGRESS** |

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Supervisor's signature

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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	Study week no.: 6 - 7
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE   Consult tutor for chapter 4 and 5 report format.   Parts need to modify in applications.   Full complete chapter 3 report.
5. WORK TO BE DONE   Full complete chapter 4 and 5 report.
3. PROBLEMS ENCOUNTERED   Difficulty in making animation.
4. SELF EVALUATION OF THE PROGRESS   **5.**

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Supervisor's signature   Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.: 8**
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE

Consult tutor for turnitin checking. Discussion on the application flow. Chapter 6 format dicussion.

6. WORK TO BE DONE

Full complete chapter 4 5, and 6 report

3. PROBLEMS ENCOUNTERED

Ddifficulty in system design part.

4. SELF EVALUATION OF THE PROGRESS

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Supervisor's signature

Lam

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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 9
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE

Discussion about which testing apporach is best to test application. Review on the report.

7. WORK TO BE DONE

Improvement on application. Test method is needed to test application. Report needs corrections.

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

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Supervisor's signature

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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 10
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE   Test case is prepared to test the application.
8. WORK TO BE DONE   Feedback and improvement on the system.
3. PROBLEMS ENCOUNTERED
4. SELF EVALUATION OF THE PROGRESS
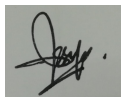
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Supervisor's signature

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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	Study week no.: 11
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE   Testing on all four modules.
9. WORK TO BE DONE   Improvement on applications.
3. PROBLEMS ENCOUNTERED
4. SELF EVALUATION OF THE PROGRESS

_____   _____

Supervisor's signature   Student's signature
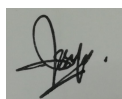
FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 12
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE

Consult tutor for the development of application and full review on the report.

10. WORK TO BE DONE

Fully functional application.

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

_____

Supervisor's signature

_____

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I / Project II)

Trimester, Year: Year 4 Trimester 2	**Study week no.:** 13
Student Name & ID: Lam Jing Sung 1405172	
Supervisor: Nur Syadhila Binti Che Lah	
Project Title: Application Development for Student with Dyscalculia	

1. WORK DONE

Consult tutor for the demo and presentation. Discussion submission matter and final application usability.
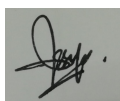
11. WORK TO BE DONE

Full complete application.

4. PROBLEMS ENCOUNTERED

Video module encoutered some bug error.

4. SELF EVALUATION OF THE PROGRESS

_____

Supervisor's signature

_____

Student's signature

APPENDIX B – POSTER

Title: Application Development for Student with Dyscalculia
Supervisor: Puan Nur Syadhila Binti Che Lah || Student : Lam Jing Sung

Introduction

With today's technological advancement the quality of life has improved a lot due to the rapid technology advancement and innovation. This has benefited the people diagnosed with disability in improving their learning environment. This project is a mobile application development project for academic purpose. This project is developed specific for student with Dyscalculia. People with learning disability is called Dyscalculia.

Methods

This project is developed using Construct 3 mobile application tools. The language used are HTML5 and JavaScript. The project is developed according to SDLC Methodology. Gantt chart is included to keep track of the progress.

Discussion

This project is a math educational application designed specifically for Dyscalculia. It covers four subjects, which is addition, subtraction, division and multiplication. Minigames and tutorial included to provide more fun for the people to learn Mathematics. Not much of application like this appear in Malaysia. In future more feature will be include to make this application more fun for the Dyscalculia to learn math.

Conclusion

This project is a HTML5-developed offline application. User can learn mathematics easily and more fun on this application. User can experience different level with different difficulty. It cover 4 main mathematics subjects with tutorial guidance. User just have to play the game and answer the questions with selection on a time limited scenario.

PLAGIARISM CHECK RESULT

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1	Fiqa Azureen Abd Halim, Mazeyanti Mohd Ariffin, Savita K. Sugathan. "Towards the Development of Mobile App Design Model for Dyscalculia Children in Malaysia", MATEC Web of Conferences, 2018 Publication	<1%
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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

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Signature of Supervisor   Signature of Co-Supervisor

Name: Nur Syadhila Binti Che Lah   Name: _____

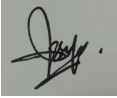Date: _____23 APRIL 2020_____   Date: _____

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