Computer Based Learning in the Malay Language for Children with Dyslexia

By

NURUL AINA BINTI OTHMAN

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Information & Communication Technology)

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CERTIFICATION

CERTIFICATION OF APPROVAL

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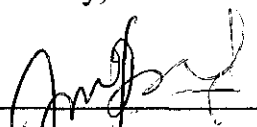
Approved By,



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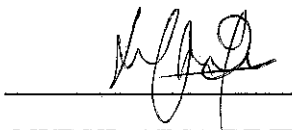
UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
DECEMBER,2011

CERTIFICATION OF ORIGINALITY

This is to certify that i am responsible for the work submitted in this project, that the original work is my own except as specified in the acknowledgments and references, and that the original work contained herein have not been undertaken or done by unspecified source or persons.



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ABSTRACT

The aim of this project is to develop a multimedia learning aid (SpleXia) to facilitate Malay word recognition, recall and usage by dyslexic children, based on studies of cognitive information processing. The objective is to demonstrate a 15% improvement in word recognition and replication, over a two-week period with SpleXia, among dyslexic children. Dyslexia is a condition where an individual having difficulties reading because the brain does not able to recognize and process certain symbols.

The idea of this project arose from a needs assessment of the reading problems faced by dyslexic children, which affects their performance in daily life and academic environments. Current therapeutic approaches to the treatment of dyslexia in Malaysia are often ineffective as they usually involve drill-based activity that creates stress for children, parents and therapists during clinical sessions as well as the special education teachers in remedial classes. Such approaches also often foster an over-dependence on teachers, excluding independent self-learning by children and participatory involvement by parents.

The reason why SpleXia targets to aid dyslexic children to improve their reading skill in Malay is because Malay is the national language of Malaysia thus it is being used widely in this country. Besides, the needs assessment also revealed a shortage of computer-based learning aids for dyslexic children in the Malay language. Benchmarking of existing Malay educational software was carried out. The application developed in this study is differentiated by (1) the placement of word cues in environmental settings, and (2) a stronger linkage between cues and relevant interests within the target age group.

The target user of SpleXia is dyslexic children aged between 7-11 years old. According to Piaget's cognitive development theory, children that belong to this age group are at the concrete operational stage where they see things in logical and

abstract manner. They have started to understand that every object has its own characteristic and behaviour. Therefore, they are the most suitable users for SpleXia.

Meanwhile, the research for this project will focus on: (1) remediation of language disorder, specifically developmental reading disorder or dyslexia, and (2) the application of multimedia technology suitable for dyslexic children, based on studies of Human-Computer Interaction (HCI).

The methodology employed for this project was the incremental development paradigm whereby the system was developed in stages according to user needs requirements and integrated towards the end of the development.

Preliminary user testing revealed a 14% increase in word recognition and a 8% increase in word replication over a one-administration trial. Users reported that the system they subjectively perceived the application as "attractive", "fun" and "beneficial". Results can be extrapolated to suggest that long-term improvements in language performance might be anticipated over a longer administration period and additional sessional trials of the application. The research finding shows an improvement in target users' reading ability after using SpleXia for two weeks thus proving that SpleXia can be useful for dyslexic children in Malaysia and computer-based learning can revolutionize the traditional therapeutic approach for special needs children.

ACKNOWLEDGMENT

First of all, the highest gratitude to Allah S.W.T the Almighty for the gift of health, strength and ability for me to complete my Final Year Project I and II within the allocated times. Alhamdulillah. I also would like to express my appreciation towards my Final Year Project supervisor, Madam Emelia Akashah and my co-supervisor Dr. Alan G. Downe. The knowledge, experience and guidance that they shared were very valuable and without them, the process of completing this project would not have been easy. Deepest thanks to my parents and family members for their constant support, materially and motivationally, regardless my condition and situation. I sincerely appreciate that. Last but not least, I would like to thank everybody involved with the completion of this project.

Table of Content

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND NOMENCLATURES

HCI: Human- Computer Interaction
FYP: Final Year Project
DRD: Developmental Reading Disorder
UML: Unified Modelling Language
IDA: International Dyslexia Association
BDA: British Dyslexia Association
APA: American Psychological Association
UAT: User Acceptance Test
ADHD: Attention Deficit Hyperactivity Disorder
UITM: Universiti Teknologi Mara
UTEM: Universiti Teknikal Malaysia
LINUS: Literacy and Numeracy Screening
ADDIE: Assessment, Design, Development, Implementation and Evaluation
DIMLOM: Diksleksia Interaktif Multimedia Learning Object Model
USDHSS: United State Department of Health and Human Service

CHAPTER 1
INTRODUCTION

1.1 Background Studies

The title of this project is Computer-Based learning for Special Needs Children with Developmental Reading Disorder (Dyslexia) in Malay Language. Therefore, the focus of this project is to do research on the related disciplines in order to make sure that the final outcome of this project is align with the needs and requirements from every discipline, as well as developing a computer-based learning aid for dyslexia, named SpleXia. The main areas that were being investigated for this research are:

1.1.1 Developmental Reading Disorder - Dyslexia

Developmental reading disorder or dyslexia is a condition where a person having difficulties to read because the brain is not being able to recognize certain symbols or shapes. Dyslexia comes from the Greek words where "dys" means difficulties or impairment and "lexis" is language [1]. According to International Dyslexia Association (IDA), a person is confirmed to have dyslexia if they faced problems recognizing, spelling and decoding words or syllable. There are two consequences that are caused by dyslexia; the first one is a person may have limited ability in reading, writing or spelling phonological component, despite their skills in other areas. The second consequence is they might find it difficult to understand the reading process. This situation then will cause the inclination of their reading experience and the development of their vocabularies will be distorted [2]. Meanwhile according to Malaysia's Ministry of Education, dyslexia means reading disorder faced by individual who otherwise has average or higher level of intelligence [3]. Therefore, dyslexia is not related with mental retardation.

1.1.2 Multimedia Studies

The second discipline that was being covered for this project is the multimedia studies; specifically in the area of game development and human-computer interaction, as the expected outcome or product to support this research is in the form of multimedia application.

1.2 Problem Statement

1.2.1 Problem Identification

Most dyslexic children in Malaysia are being taught in school environments, often placed in a special needs class and receiving guidance from the teachers. Most common classroom teaching methods are drill-based and learning activities are often repetitive. The target outcome for every learning session is to ensure the student is able to enhance their reading ability at least by the end of the class.

Among the classroom activities for dyslexic students are interactive games, story reading, symbols and alphabets recognition and others. It cannot be denied that these approaches can help dyslexic children to an extent, but there is still room for significant pedagogical improvement. Even though there is interaction between students and teacher during the learning session, this approach may be less effective as there are a few factors that could hinder the target from being achieved. The points below identify problems in using conventionalise approach for educating and treating dyslexic children:

- ***Children's Attention and Focus Span:***

  Children interest and focus span is often quite short. During a learning session, teacher will teach the student on how to spell, read or write correctly. When a student tries to read or recognize particular word, the teacher will help by spelling and reading out the word, followed by the student. This method will be repeated until the children can pronounce the word correctly. Usually when these children are asked to repeat the same tasks and activity during every session they will get bored and eventually give up if they fail to read or write the words correctly. In addition, they might lose their interest to come to school to learn.

- ***Minimum Involvement from Parents***

  The next factor or problem that can cause this approach to be less effective is the minimum involvement from parents of these children. Some parents leave all the treatment works to the teachers at school or therapists at the speech centre without making any initiative to guide their children at home; this may be caused by pack schedule, no suitable materials or other constraints. The treatment for the child depends solely on the teachers and the learning or treatment sessions only conducted during school hours. These children will not be able to improve their reading ability if they do not have follow-up treatment at home. Parents' participation is actually very crucial if the traditional face-to-face therapy approach is being implemented.

- ***Teachers' Frustration***

  Special education teachers are doing their best in treating their patients. With their knowledge and expertise, the learning sessions that were conducted will be helpful for their students. They can implement a lot of treatment methods during the therapy sessions. However, speech therapists are still human being with emotions and limitation. Sometimes, they might get tired from conducting continuous therapy sessions and facing their patients for the

whole day. They may feel overwhelmed and disappointed if they fail to see their patients' improvement. This disappointment might be reflected through their ability in handling that particular session. Besides that, inside a remedial class, every student has different condition and problem. For example, the treatment to treat student with Attention Deficit Hyperactivity Disorder (ADHD) is not the same with the treatment for dyslexic children. It is a huge challenge for the teacher to give adequate treatment session for all students at once as every problem needs different approach and focus. This condition can contribute to ineffectiveness of the treatment sessions inside a classroom.

- ***Limited Number of Remedial Classes in Public Schools in Malaysia***

The rate of dyslexia among school children in Malaysia is very alarming. This means enough number of facilities such as remedial class and trained teachers to treat this group of students is very necessary. However, according to the news report from Berita Harian [4], the number of facilities for remedial classes is limited and the number of special education teachers that specialized in dyslexia is very small. For example in Sarawak, there are only four schools that offer the program for dyslexic students, despite the huge dyslexia rate in that state [5].

1.2.2 Significance of the Project

The significance of SpleXia's features that distinguishes it from available most of computer-based learning software for dyslexia is its intermediary language, which is Malay. SpleXia also has a more flexible navigation feature where the player is free to explore the functionality inside it. Aside from that, SpleXia is also different in term of its teaching approach. Besides from aiming to help dyslexic children to improve their ability to recognize and replicate alphabets and words, SpleXia also emphasize on the usage of the words in real life situation, thus allows them to relate what they learnt from SpleXia with their surroundings.

1.3 Objectives

This project has two main objectives to be achieved by the end of the research and development period:

- To develop a multimedia learning aid (SpleXia) to facilitate Malay word recognition, recall and usage by dyslexic children based on the studies of cognitive information processing.
- To demonstrate a 15% improvement in word recognition and replication, over a two-week period of interaction with SpleXia, among dyslexic children.

1.4 Scope of Studies

1.4.1 Target Users

The target users for SpleXia are dyslexic children aged between 7-11 years old. According to Piaget's theory of cognitive development [6], this age range is where children are at the concrete operational stage, where they have started to see things in a logical and organized manner. They have the ability to order objects by category or understand simple Mathematics. Therefore, they are most suitable target users as they already able to see and understand SpleXia's concept and degree of difficulties but at the same time they still can appreciate the value of fun and interactive learning offered by SpleXia.

1.4.2 Speech-Language Pathology

Speech and language pathology is a discipline under health science. It covers large human linguistics aspects including articulation disorder, speech disorders, voice disorders and language disorder. This discipline divided into two sub disciplines which are speech and language. However, the focus of this project will be on language pathology instead of speech pathology, as

dyslexia falls under reading disorder, which belongs to language disorder category.

1.4.3 Multimedia Application Development

The target for SpleXia development is to come out with a simple multimedia application for children not just only with a lot of animation, colours and attractive user interface but most importantly it is able to help these children to learn and improve their reading skills. The attractive interface is to ensure that the children are interested with the application, so that they will voluntarily undergo the learning sessions. There are many aspects that were being considered during the development phase of SpleXia, including the design pattern and stimuli or motivation factors to achieve and complete the challenges inside SpleXia. A good Human- Computer Interaction (HCI) aspect of the game was being analyzed. The basic yet important SpleXia's element including the colour schemes of the game, suitable font, audio, navigation of the application, designs as well as the audio are being developed according to HCI concept and rules that are suitable for dyslexic children.

1.4.4 Malay Language

SpleXia is using Malay language as the intermediary because there are small numbers of multimedia application for dyslexic children in Malay language, yet the number of dyslexic children in Malaysia is rather huge. Besides that, Malay language is a widely used language in Malaysia and this shows the importance of possessing the ability to write or read in Malay language. As for these reason, this project will focus on the development of applications in Malay language.

1.5 Relevancy of the Project

This project is actually relevant considering the current situation regarding dyslexia in Malaysia at the moment. The problems that were being stated above are actually the current situation in Malaysia. The schools and number of dyslexia specialist are not enough to support the numbers of dyslexic student in this country. Therefore, coming out with alternative solution to reduce the negative impact of these problems is important. One of the ways is by introducing multimedia solution for dyslexic children. Therefore, the development of SpleXia might be very helpful to help children with dyslexia. This is because SpleXia is a computer application that can be used by the children regardless their location, as long as they have access to computers. SpleXia also support self-learning concept therefore these children can learn from SpleXia without being too dependent with their teachers. Thus, the relevancy of this project is to provide alternative learning method that can support the learning development of dyslexic children as well as to ease the work of special education teachers.

1.6 Feasibility of the Project within the Scope and Time Frame

This project took 8 months to be completed and this duration were being divided into two; the first 4 months are being allocated for research, information and data gathering process and the next phase is for the development and testing of SpleXia. The project activities inside both phases are being carried according to proper time line and milestone that had been fixed during the first phase of this project. This project is feasible and can be completed within the allocated period as there are no problems in obtaining legit information that is necessary for developing a program that suits its purpose and target. Besides that, the tools and software that are needed for the development of SpleXia are all available and can be used without complexity.

CHAPTER 2
LITERATURE REVIEW

2.1 Dyslexia – Worldwide Perspective

The problems regarding Dyslexia or Developmental Reading Disorder among children have opened the eyes of many parties in several countries in the world. The estimation revealed by United State Department of Health and Human Services (USDHHS) shows that 15 to 20 percents students in United States of America (USA) suffer from dyslexia [7]. Meanwhile according to British Dyslexia Association (BDA), the estimated dyslexia rate in the United Kingdom is 8 percent of its population [8]. As in Japan, 5 percent of school children are dyslexics [9] where the research conducted by Uno shows that 1 percent of children faced difficulties in reading Katakana and 5 to 6 percents of them having problem reading Kanji [10]. The ministries, non-governmental organizations, teachers and parents of these countries are aware about this matter therefore a lot of research and measures had been conducted in order to find the remedies for this situation. These statistics show that dyslexia is a worldwide problem. In fact, according to IDA, in year 2010 10 to 15 percent of the world population are dyslexics [11].

2.2 Dyslexia in Malaysia

In Malaysia, the statistics revealed by Department of Census Special Education, Ministry of Education showed that more than 31,400 Malaysian children aged 7 to 12 years old are dyslexics [12]. The awareness of dyslexia in children is also increasing. Parents are more concern about the reading and writing ability of their children. This situation shows a good sign as dyslexia among children cannot be taken for granted as it could give a lot of negative effects towards the children as well as people around them. As part of the effort to eradicate or reduce dyslexia rate

in Malaysia, the responsible ministry, Ministry of Education had introduced a module called Literacy and Numeracy Screening (LINUS) in 2010 [13]. Under this module, children (Year 1 – Year 3 Students) reading and calculating capabilities will be tested and screened. Through this test and screening process, students with learning difficulties will be identified. The main objective of LINUS is to recognize students with learning difficulties and classified the problems that they faced and treat them accordingly while it is still at the early stage of their learning process [14]. A number of 15,500 special education teachers are handling this program after they had completed their training, which were held in order to prepare them for the implementation of LINUS [15].

2.3 Classroom/Clinical Approach to Treat Dyslexia

In Malaysia, dyslexic students are placed in the special needs class. The difficulties that they faced when reading caused them to be left behind academically, if compare with students without dyslexia. According to Ramasamy[16], the activities that are usually being carried inside the classroom are drill-based as dyslexic children are usually having short term memory. Teachers also must take the extra effort to ensure that their students are paying attention and understand what are being taught [17].

Marshall [18], a dyslexia expert mentioned that dyslexia cannot be treated with medication or drugs as the condition is actually a different learning style and not a disease. Besides, medications only eliminate the symptom of dyslexia for a short while but not curing it. The disadvantage of giving drugs to dyslexic children is the possibility of having dangerous side effects as well as the addiction or dependency on it. Therefore, the best way to treat dyslexia is through proper therapy and learning methods instead of relying on drugs or medication.

2.4 Computer- Based Approach to Treat Dyslexia

Another approach to improve the clinical or classroom approach is using the computer-based therapy. Since so many years back, a lot of research had been conducted and method being applied to find the best solution to help children with

reading disorder. Regardless the tools, technology and methods that are being used, all of them are aiming for the same objective, which is to enhance children's with dyslexia capability and performance in reading, communicating and learning.

A studies by Reed [19], a child neuropsychologist had stated several advantages of treating dyslexic children using computer or game-based approach. One of them is the motivational factor of the game environment. Usually computer games are designed with the intention to attract the players; therefore computer game-learning has attractive and interactive features that can increase the attention span of the players. Players also "challenged" to achieve their goals in particular level of the game therefore they will feel motivated to complete the tasks inside the games. Besides that, they will be more focus during the treatment compare with the common teaching approach which is less rewarding and straight forward.

This finding is supported by Umanski et al. [20], where they mentioned that computer-based edutainment games is one of the preferable methods in motivating children to do tasks that are less interesting by nature. The capability of computer games to give immediate or real time feedback allows the children to adjust their behaviour in a more accurate manner. Murray [21] mentioned that a research carried out by Cotton [22] proved that children with special needs; those who have reading disorder, hearing impairment, speech disorder and mental disturbance can benefits from today's technology integration. In fact, these children are showing remarkable progress with computer- based learning compare with the normal education approach. This may be because dyslexic children have good understanding when they see three dimensional (3D) figures and object as well spatial reasoning [18].

According to Parrette [23], the usage of multimedia inside courseware or learning application has its benefit because multimedia's feature such as animation has strong attraction that can draw the interest of special needs children. In order to use the animation in a more precise manner, it is important to understand and identify the characteristics of dyslexia and its suitable therapy or treatment method. From this combination, a functional courseware that suits its purpose can be developed.

One of the applications that are making use of the computer-based learning concept is Disleksia Interaktif Multimedia Learning Object Model (DIMLOM). Fadilahwati et.al [12], a group of researchers from Universiti Teknologi Mara (UiTM) Shah Alam had developed this interactive multimedia application to help dyslexic children to learn numbers and solve numerical problems. This application has an interactive feature with colourful and attractive interface. The instruction is given to the player through audio where there is voice that will read out the game instructions for the players. The development model that was being adapted was the ADDIE model, where it's emphasizing on these attributes by sequence; needs for assessment, design, development, implementation and evaluation.

The next application that was recently developed is a courseware by Mahidin et.al [24] from Universiti Tenaga Nasional (UNITEN). Named E-Z-Disleksia, this courseware is aiming to help children with dyslexia to read in Malay through animated games. It consists of 6 modules with 12 sub modules whereby every module will teach a target syllable and its pronunciation. Exercise session is available in between 2 modules. E-Z Disleksia is developed by combining three basic learning styles which is auditory, visionary and kinaesthetic.

Abdullah et al. [25] had come out with MyLexics, another courseware to help dyslexics to learn in Malay. MyLexics is focusing on structuring words from basic, thus it has 3 modules namely *Huruf* (alphabets), *Suku Kata* (syllable) and *Perkataan* (words). This courseware also making used of the multimedia concept by implementing the concept for this game-based application. However, [12] had criticized the interface design, particularly the black-coloured handwriting and its white background. Black handwriting and white background actually does not suit the dyslexic children as interface with this colour scheme will cause them to see as if the alphabets are moving and consequently brings difficulty for them when they are trying to read.

Kast et al [26], researchers from University of Zurich, Switzerland had also developed a game-based application named Dybuster. Kast is associating multitude visual – auditory concept inside Dybuster as these two sensors can help to increase the memory strength of phonemes and graphemes for dyslexic children. Dybuster is divided into 3 interrelated parts which are colour games, graph games and learning

games. In the colour game, player is required to identify alphabets based on its colour. While in the graph game, a complete word will be displayed and the player task is to break-down this word according to syllable that constructed the word. Finally the learning game is when the program displayed a word and it teaches the player how the particular word is constructed through the representative of graphs, colours and shapes. An audio that spells out the word also being displayed and the player can insert the input that they see and heard according what had been taught.

American Psychological Association also had recommended a video training program to treat dyslexic children named Fast Forword [27]. Fast Forword consist of series of games that emphasized on children's attention as well other factors such as reading skills and linguistic. Player will need to solve the displayed problems starting from basic to the advance level. Just like another games-based method, Fast Forword counts player's scores and rewards them if they able to provide correct answer. One of the tasks that need to be completed by the player is to differentiate between the sound of "pa" and "ba". After the completion of a task, the difficulties level of the game will be increased. A professional trainer is monitoring player's performance via the internet.

Table 1: Comparison table between dyslexia treatment methods:

Program / **Features**	**DIMLOM**	**E-Z-Disleksia**	**MyLexic**	**Dybuster**	**Fast Forword**
Visual Feedback	✓	✓	✓	✓	✓
Audio Feedback	✓	✓	✓	✓	✓
Real-time Feedback	✓	✓	✓	✓	✓
Tactile Learning	✓	✓	✓	✓	✓
Internet Dependent	×	×	×	×	✓
Focus	Numeration	Language	Language	Language/ Music	Language
Language	English	Malay	Malay	English	English

2.5 Overview on Computer Based Therapy Approach

Table 1 shows the available software or programs that are using computer/game-based approaches to provide the treatment for children with developmental reading disorder or dyslexia in particular. As can be seen from the table, every approach has differences and similarity between each other. The most significant features on most of this software are visual feedback, audio feedback, real-time feedback and tactile learning. Visual, audio and real-time feedback is obviously necessary for game application in order to create the interactive environment and consequently attract the interest and increase the focus of the children during the learning session. This statement is supported by the finding by Mortimore [28], which proved dyslexic children can enhance their reading ability through multi-sensory method as their senses (sight and hearing) are being used actively during the learning process, thus increased their focus and attention.

Meanwhile the tactile learning or kinaesthetic learning is also important as it gives the opportunity to the dyslexic children to the task on their own without being too reliable with teachers or therapists. In addition, the questionnaire results obtained by [24] showed that tactile learning is the most preferred learning style by dyslexic children. Integration of audio, visual and tactile when developing game-based application for dyslexic children is necessary as these elements are the basic learning style that could give remarkable improvements towards dyslexic children's reading performance.

Another attribute of these methods is the dependency on the Internet connection. Some of the software such as Fast Forword is dependent with the internet connection as the treatment process is done on the server over the internet. Internet-based learning has its own advantages and drawback. Using internet-based is effective in a way that it requires low hardware requirements compare with the stand-alone application. The disadvantage of Internet-based learning is the session cannot be conducted when the Internet connection is not available or the server for the system is down.

In term of focus of these applications, 4 out 5 of them are aiming to enhance reading ability of dyslexic children. 2 of these programs are being carried in Malay language while the rest are in English. E-Z Disleksia and MyLexics have the same concepts with this SpleXia, which is to aid dyslexic children to read in Malay language. The features that will distinguish SpleXia from these 2 applications is that, SpleXia has 3 different familiar scenes (living room, beach and playground) where the player will need to learn word building based on the objects that they can see on each scene. E.g. "kerusi" or chair is an object that we usually see in a living room. Through that, they can relate the real world situation while playing SpleXia or vice versa. Based on this benchmarking, SpleXia is differentiated by the placement of word cues in environmental settings, and it has a stronger linkage between cues and relevant interests within the target age group.

CHAPTER 3
METHODOLOGY

3.1 Research Methodology

For the first part of this project, several data gathering methodology were being used to get all the information that is related and relevant with the project title. The information is obtained from few sources such as:

3.1.1 World Wide Web (www) / Internet

Internet provides a lot of related information. The research result, information yielded from the internet can give a lot of insight and ideas in order to carry on with this project. The journal papers that are produce by the experts in their own field can be obtained from scientific journal databases such as:

- Springer
- IEEE
- ACM
- Sciencedirect
- Journal of Medical Speech – Language Pathology

The "Advance Search" provided by Google also make the search for the information become easier.

3.1.2 UTP Information Resource Centre (UTPIRC)

UTP IRC provides books to be borrowed by students and staffs for reading or research purpose. There are several books that are related with this project can be found at UTP IRC. The topics regarding speech disorder, voice recognition and game development are available and the advantage of getting

information from books is that they provide details, convincing and reliable information.

3.1.3 Interview

The type of interview carried during the initial phase of this project is open-ended (semi structured) interview. The interview was between a special education teacher and a staff that works at a clinic-based rehabilitation centre. The interview is conducted via phone and the purpose is just to get the early feedback regarding SpleXia from those who are working in the area as well as to obtain the current approach that is used at the school or centre.

3.1.4 Questionnaire

The purpose of conducting a questionnaire is to gather information from larger numbers of the target group in order to see and analyze their response. The target audience for this questionnaire is the special education teachers that work in remedial classes in Malaysian public school and speech therapists in speech centres. This questionnaire consists of 3 patterns of questions which are close-ended questions, open- ended questions and likert scale questions.

3.1.5 Site visits and program observation

Site visits and program observation had been done at a remedial class in one of Primary School in Sri Iskandar; this is to see the actual scenario of how dyslexia treatment is being carried by the teacher at this school. Through the visit, observation can be made to see the relevancy of SpleXia if it were to be implemented at this school. Room of improvement for both class and SpleXia can be explored through the exchanges of ideas between teachers, parents or even the children themselves.

3.2 Project Methodology

3.2.1 Project Activities

The software methodology or software development paradigm chosen to develop SpleXia is the incremental development paradigm. Figure 2 shows the flow of software development by using Incremental Development and will be followed as the project activity during the development of SpleXia.

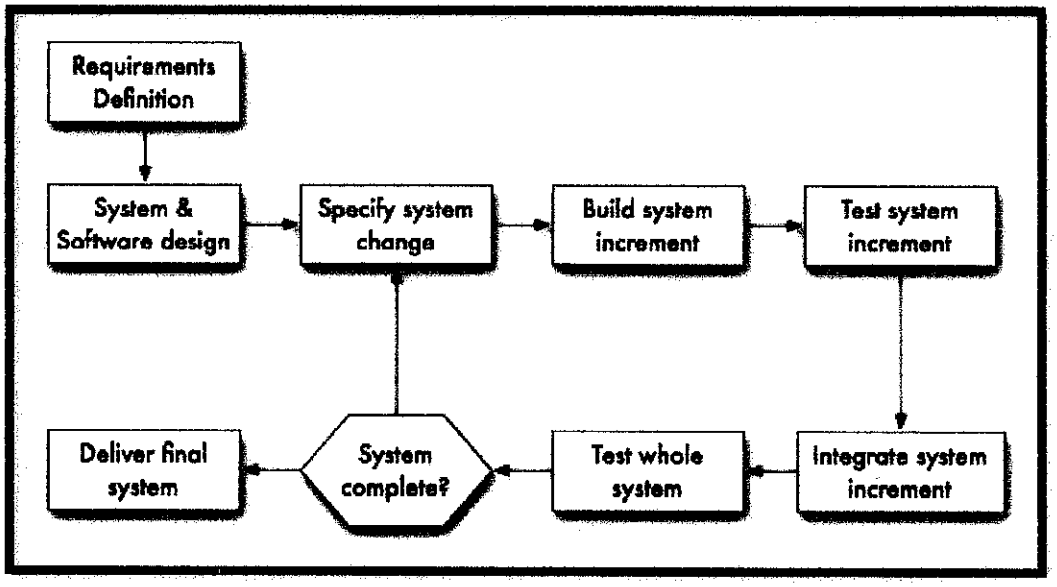


Figure 1: Incremental Development Paradigm

- ***Requirements and Definition***

The first stage involved gathering the information and requirements that is suitable to develop an application that aim to treat problems faced by children with dyslexia. The requirement is obtained by doing analysis and observation on the current scenarios in remedial class in public school field and typical approach used by special education teachers to treat dyslexia among children in Malaysia. From the observation, the area that can be improved is identified and the requirements according to children preferences, teachers'' ideas and knowledge and parents' opinion and the definition of the system are listed and recorded.

- ***System and Software Design***

  Than the early design of SpleXia is being developed which include the design and the functionality of each increment for the system which includes two main parts, the game environment and the scripting. Both parts have their different functionality but will be developed at the same time during the development phase.

- ***Specify System Change***

  The early design for the system is being proposed and shown to the special education teachers and language therapists to get their opinion regarding the design of SpleXia. Their ideas for improvement or changes on the application are taken into consideration so that SpleXia can serve its purpose and suits its users, children with dyslexia

- ***Build System Increment***

  SpleXia was developed incrementally, from scenes by scenes. Each scene has its own sub scenes. There are 3 scenes all together and each scene is being developed incrementally, starting with the design of every scene and its sub scenes, followed by the animation process

- ***Test System Increment***

  The testing will be done after the completion of the scripting and animation process for each scene. The tested element includes the navigation flow, functionality of every component inside each scene such as button and audio instruction, time frame as well as animation effects. Every error will also be identified and debugged during this stage

- ***Integrate System Increment***

  Once every scene is working and able to suit its function, all these scenes will be integrated in order to produce the whole complete system.

- ***Test the Whole Application***

  Once integrated, error identification and debugging will be done to ensure each scene is compatible and can be compiled as one complete application. The complete version of SpleXia than will be tested by users to see their feedback. (User Acceptance Test (UAT)).

- ***Deliberation***

  The deliberation stage includes determining and makes a conformance that the whole SpleXia application is complete and meets all of its design requirements and objectives.

- ***Deliver Final System***

  The final deliverable of SpleXia will be made it is already meets all the design objective and requirements. Since SpleXia is a stand-alone application, the system will be converted into exe. file format and will be distributed in CD-ROMs.

3.2.2 Analysis and Design

- ***Multimedia Application Development:***

  The most challenging part in development of multimedia learning application is to integrate the learning and therapeutic aspects with the application's environment [20]. Generally, research had identified the main elements that are needed to create an effective learning application or courseware is provision of feedback, control, curiosity and a feeling of competence. According to Hubbard as being mentioned by [20], the attractiveness and immersion effects should be created so that children will submerged into the environment, therefore increase their attention and will focus more to achieve the goals and complete the challenges. Therefore, the development of SpleXia is based on 7 steps of development by Makar [29]:

  1. Think and develop idea
  2. Identify the target audience and modify the idea where necessary to fit the audience.
  3. Decide the experience and the environment of the application
  4. Search for the needed resources to help accomplishing the area that acquire more thought in order to accomplish it.
  5. Eliminate any parts that may be less necessary.
  6. Develop
  7. Quality Assurance – Usability testing and debugging.

- ***General Idea:***

  SpleXia is multimedia application courseware that requires input from the user in the form of words or alphabets. The intermediary language of SpleXia is Malay.

- ***Application's Environments/ Scenes:***

  There are 3 options of scenes that can chose by the user which is in a house (living room), beach and playground.

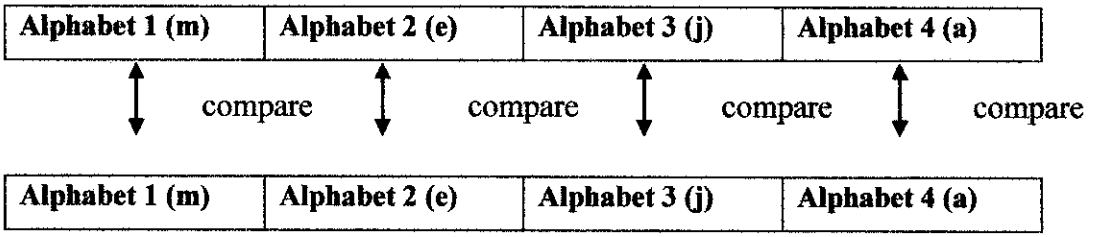
- ***Description of Application:***

  User is given 3 options of scenes where they can choose from, and these 3 scenes are not differentiated by degree of difficulties, but the usage of words inside each scene. If the user chooses the icon of scene 1, the environment of scene 1 will be displayed and the game starts. Inside this environment e.g. the living room, there will be objects that are clickable and the player will be navigated to the sub scene screen if they click on the particular object. At the sub scene, an enlarge version of the clicked object is displayed and there will be set of instruction to guide the user. The user is required to insert the correct spelling of the object inside a provided box. There will be a sound button that can be clicked and it will display an audio of how the word is pronounced, which can be a clue or idea for the user. They can type and insert their answer inside the box. SpleXia will then provide feedback or effect based on user's answer. User will be given 5 marks if they got the correct answer and no mark for wrong answer. SpleXia does not implement drill-based approach whereby if the user could not provide correct answer, they have the option to obtain the correct answer by clicking on the answer button. An answer screen will be displayed where it provides the answer for each question, which shows how to memorize the alphabets inside the word together with audio on how to spell that particular word.

- ***Input Comparison Process***

  The diagram below shows the comparison of input provided by user with the correct answer recorded in SpleXia for the word "meja".

SpleXia recorded answer:



Input by user

Figure 2: Comparison of player's input with SpleXia's answer

As being illustrated inside Figure 2, the comparison process is done alphabet by alphabet. Every alphabet that constructs the input that is entered by the player will be compared with the answer that had been fixed inside SpleXia. This process is input as it will determine whether the provided input is correct or otherwise. It also crucial as the scoring and reward process is also dependent with this comparison process.

- ***Action Script***

The works behind SpleXia including the animation, audio display, scenes navigation and input or answers comparison are being coded by Action Script. The scripting process is one of the core parts of SpleXia and it must be done accurately to ensure the logical sequence and flow of the application.

- ***System Flow & Implementation***

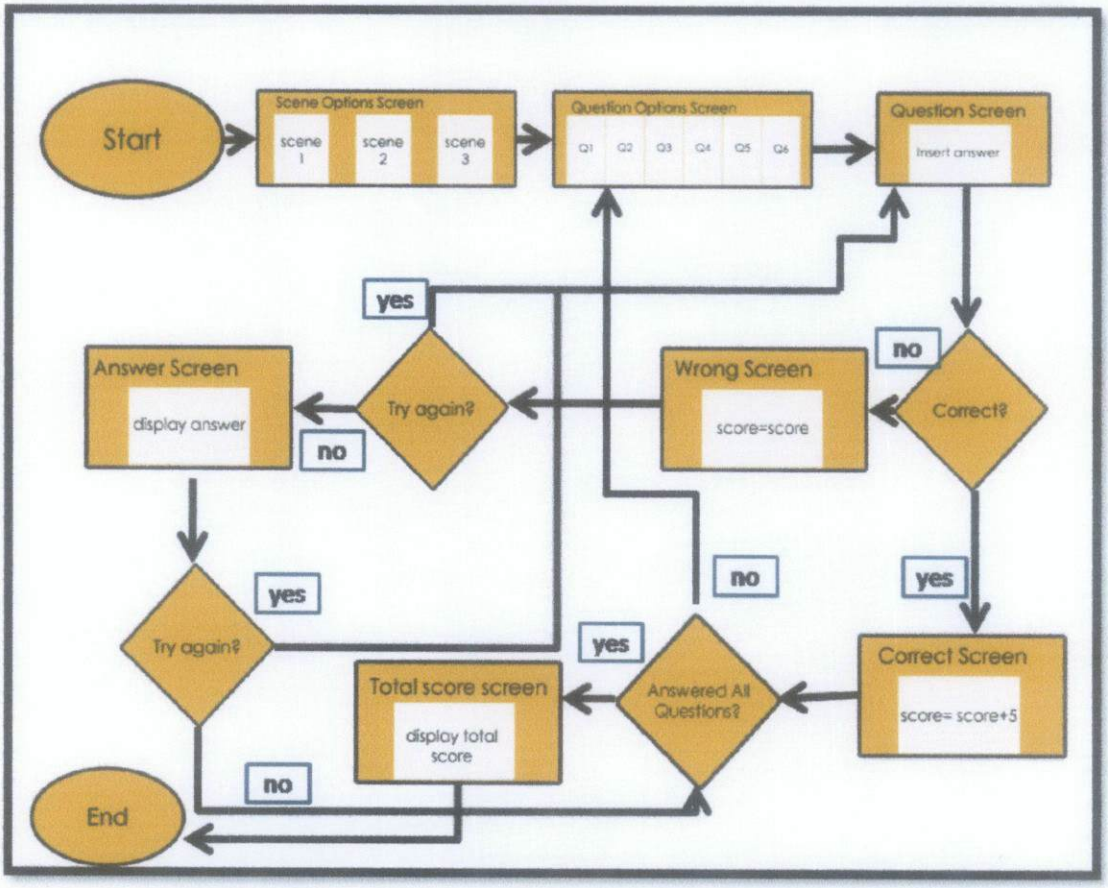


Figure 3: The system flow of SpleXia

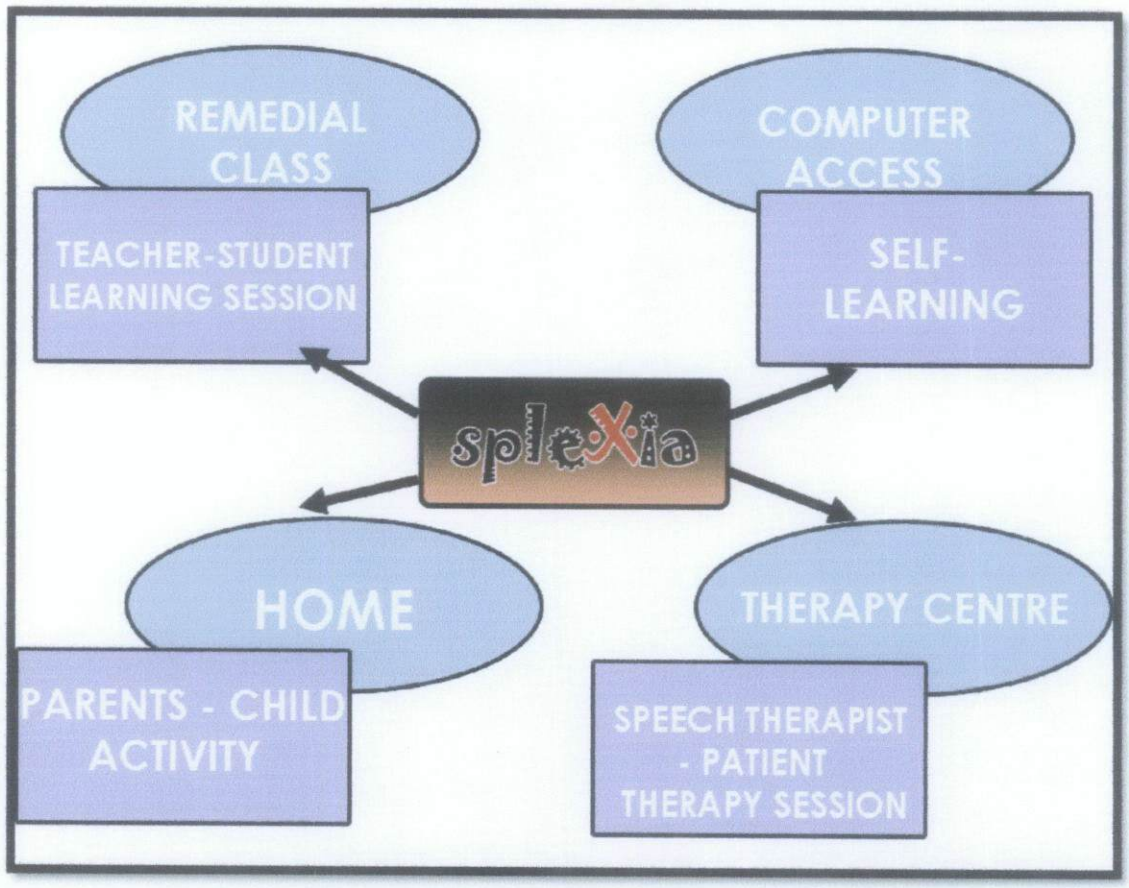


Figure 4: SpleXia's Implementation

3.2.3 Gantt chart and Mile Stones

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Initial Analysis														
Research on existing system														
Conceptual research														
Data Gathering														
Interview														
Questionnaire														
Planning														
Requirements specification														
Application design														
User Interface Design														
System Components														

Table 1(a): FYP 1 Gantt Chart

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
System Components Development														
SpleXia														
Interface														
Animation														
Scripting														
Integration														
Testing														
User Acceptance Test														
User Potential Evaluation														
Release														

Table 1(b): FYP 2 Gantt Chart

3.2.4 Tools

- ***Software:***
  - Portable Swish Max3
  - Adobe Photoshop CS4
  - Sony Vegas Version 9
  - CamStudio Recorder

- ***Hardware:***
  - Acer Aspire 4720
  - 2G MB DDR2
  - Microphone

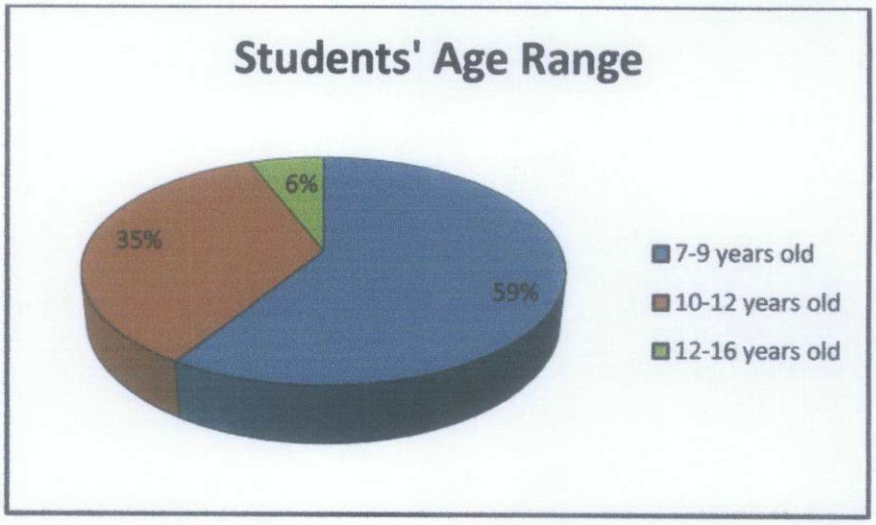
CHAPTER 4
RESULTS AND DISCUSSION

4.1 Data Gathering

4.1.1 Pilot Studies – Questionnaire Result

To get the early feedback of this project, a set of questionnaire question had been distributed to the target audience, special education teachers and speech therapists from various schools and speech therapy centre in Malaysia. There are 3 special education teachers and 5 speech therapists that had responded on the 8 questionnaires questions and their answers are represented by charts and explanations below:

- Question 1: Students' Age Range

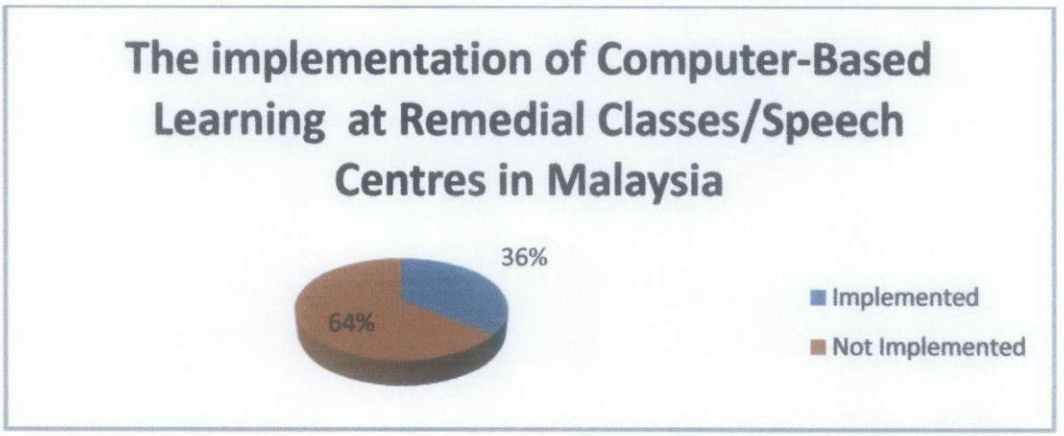


- Question 2: How do you conduct the learning session for dyslexic students?
  - One on one
  - In pair
  - In group

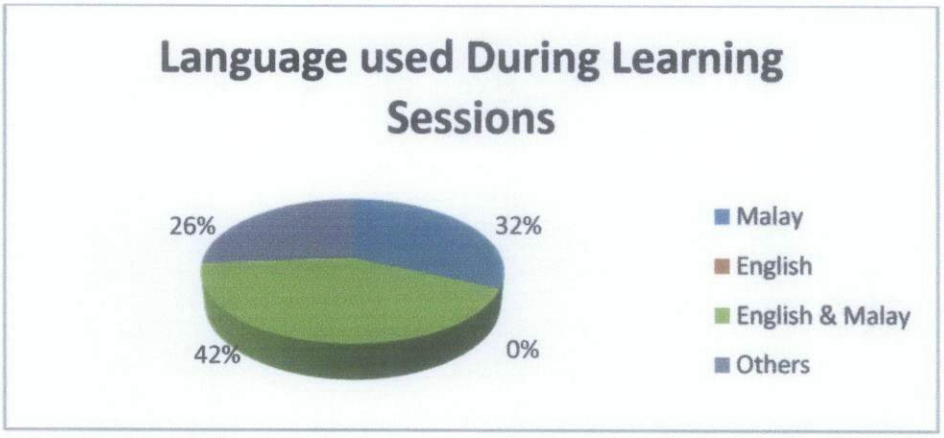
Result:

The questionnaire result shows that all 8 respondents are conducting their therapy using one – on- one (1 teacher with 1 patient). 3 of them also conduct the therapy in pair (1 teacher with 2 students) and 2 had conducted in-group therapy (1 or more teachers with more than 2 students).

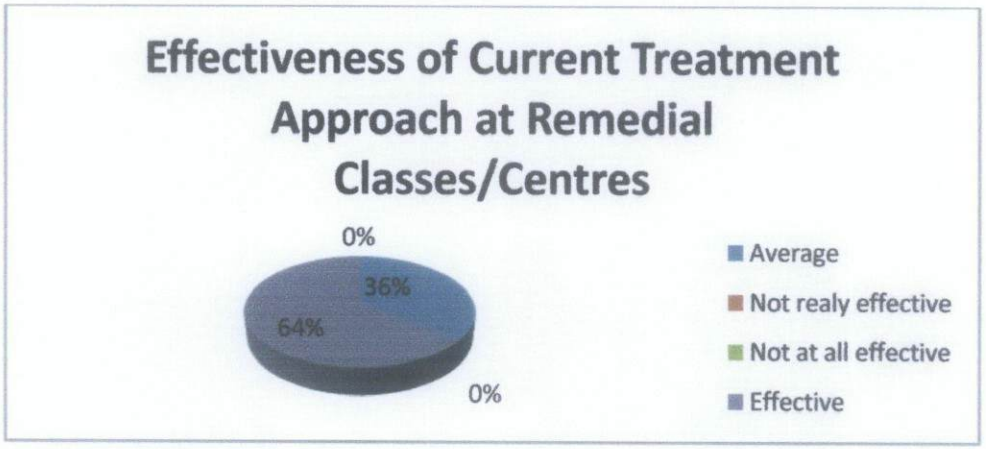
Question 3: Do you implement the computer-based learning during the learning sessions?



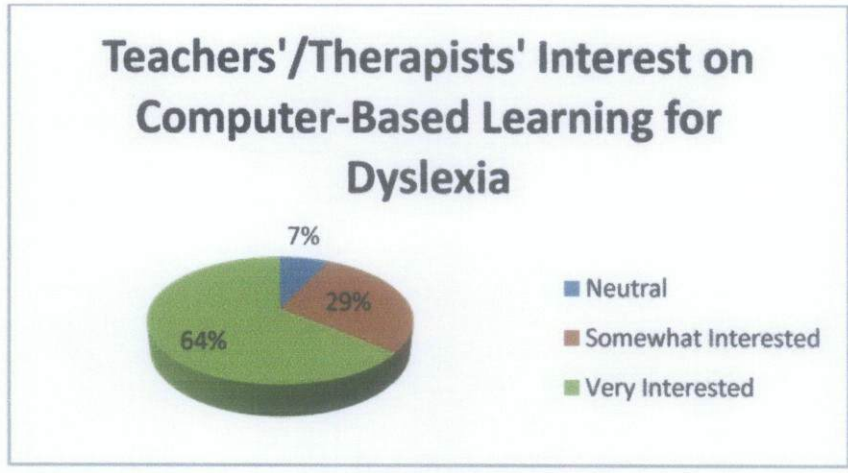
Question 4: What is the language that is being used during the treatment session?



- Question 5: From being "Not-At all Effective" to "Very Effective", what do you think about the effectiveness of the learning session for dyslexia carried in your class?



- Question 6: How do you feel about computer- based learning games for children with developmental reading disorder or dyslexia?



4.2 Data Analysis

4.2.1 Analysis on Questionnaire Result

Based on the questionnaires result, it shows that most of students with dyslexia are aged from 7 years old until 9 years old. The questionnaires also proved that the implementation of computer-based speec learning in Malaysia is not really wide, as according to Question 3, only 36% of the special education teachers and therapists are using the computer-based learning approach at the remedial classes. The regular usage of Malay language during the therapy session also shows the importance and significance of developing SpleXia in Malay language. Besides that, most of the teachers and therapists are showing high level of interest towards computer-based learning for dyslexic children and they are looking forward for the development and production of SpleXia as it provides new learning techniques for children with reading disorder. SpleXia might be able to capture the interests of the target users (dyslexic children) and enhance the effectiveness of the common learning approach practiced by the special education teachers in remedial classes and speech therapy centres in Malaysia.

4.3 Modelling

4.3.1 SpleXia UML - Sequence Diagram:

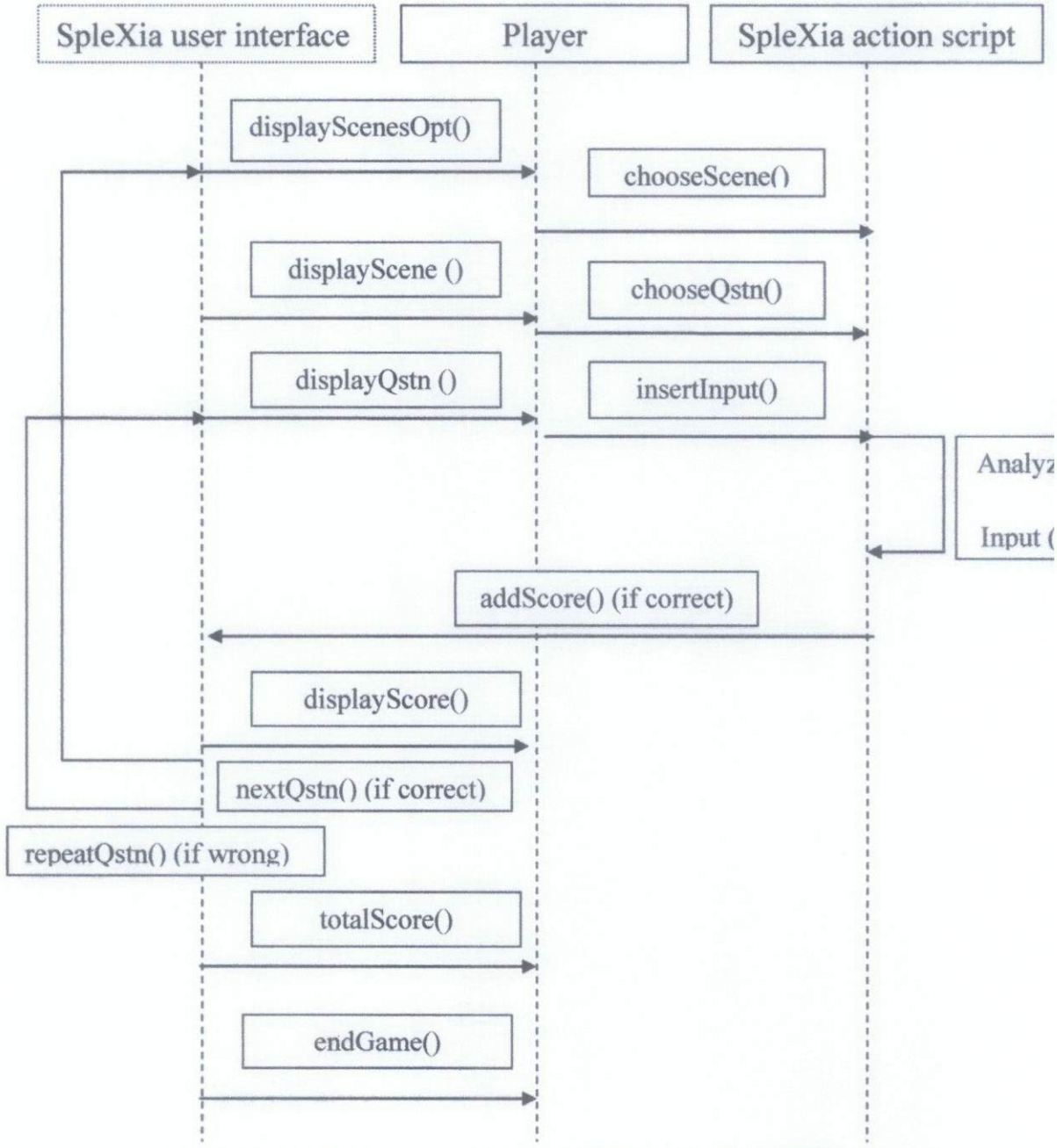


Figure 5 (a): UML diagram (sequence diagram) for SpleXia

4.3.2 SpleXia UML - Use Case Diagram

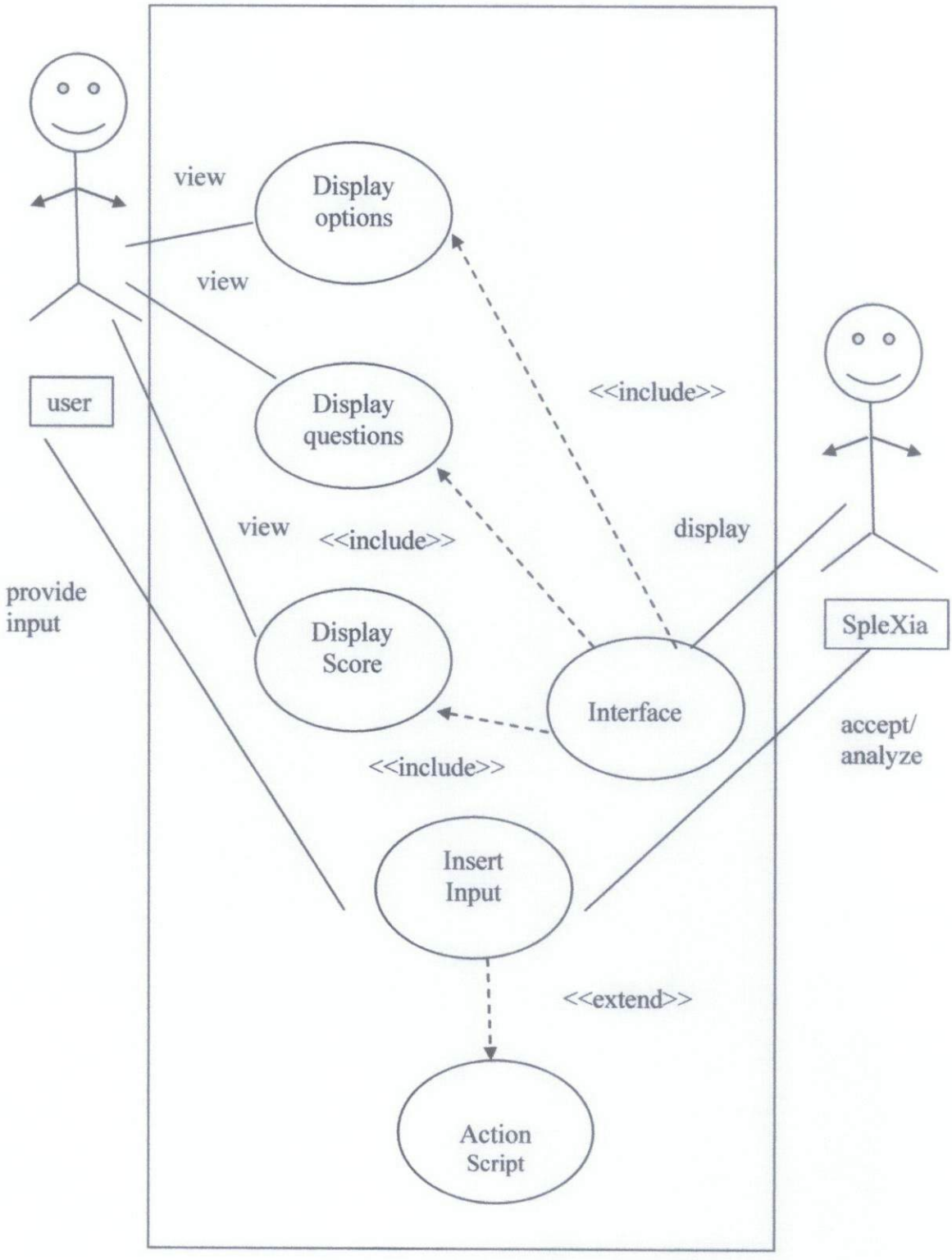


Figure 5(b): UML diagram (use case diagram for SpleXia)

4.4 Experimentation

After the completion of SpleXia, a testing session had been conducted in order to determine the efficiency of Splexia. Three dyslexic children aged 9 years old had been chosen to undergo the test and each child was assigned to complete the tasks inside the "pantai", "rumah" and "taman" scenes respectively. These children were given 3 trial attempts to do the task so their potential can be compared after they completed all trials.

- ***Users' potential evaluation***

  There are two aspects that were being evaluated during this evaluation, which are users' ability to recognize and replicate alphabets. Figure 5 shows how the evaluation session was conducted.

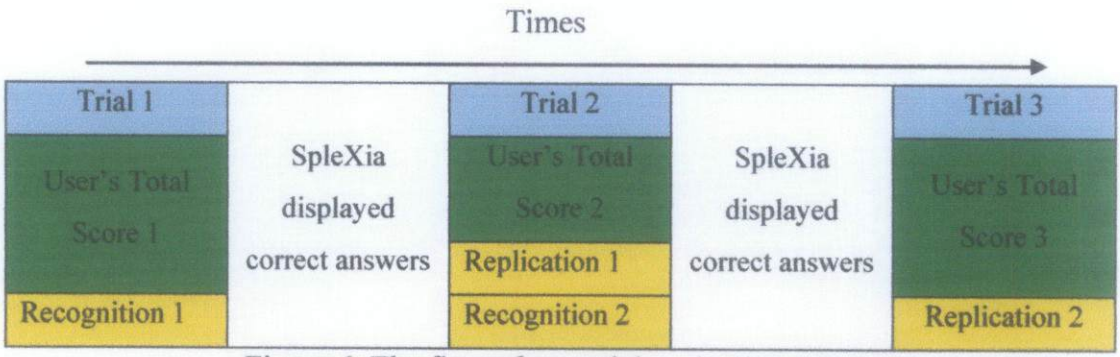
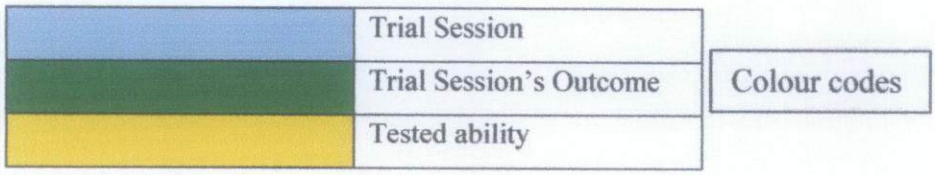


Figure 6: The flow of potential evaluation process



Trial 1: Trial 1 is user's first attempt to use SpleXia. After the first session, the total score of user were recorded. This total score determine the user's ability to recognize alphabets on the keyboard. (Recognition 1)

Trial 2: Trial 2 is when the user needed to repeat the same task as Trial 1. The tested ability during Trial 2 is replication and recognition ability.

Replication ability (Replication 1) here means the user ability to recall the answers that already being displayed by SpleXia and use them to complete the task in this second trial. Replication ability does not being tested during the Trial 1 as the user was not being displayed with answer before the trial session started. Meanwhile the recognition ability (Recognition 2) is being tested for the second time during this session.

Trial 3: Just like the previous trial sessions, user need to repeat the task and only replication ability (Replication 2) will be tested during this session.

Comparison Process: Finally after all result from 3 trial sessions were gathered, comparison will be made in order to determine user's improvement in their recognition and replication ability. User's total score from Trial 1 and Trial 2 are being compared in order to see whether their recognition ability is improving while comparing their total score from Trial 2 and Trial 3 will determine their improvement on their replication ability.

- ***Result of users' potential evaluation***

User 1, "pantai" scene

Table 1 (a): User 1 input

User input / answer	Trial 1	Trial 2	Trial 3
payung	daung	dayung	dayung
pokok kelapa	dokk klada	dkok klada	dkok kelada
lukisan	lukisan	lukisan	lukisan
makanan	wakanan	wakanan	wakanan
kerusi rehat	krusi rhat	kerusi rehat	kerusi rehat
belon	belon	belon	belon
Total Score	2/6	3/6	3/6

User 2, "taman" scene

Table 1 (b): User 2 Input

User input / answer	Trial 1	Trial 2	Trial 3
lampu	lampu	lampu	lampu
buaian	buayan	buayan	buayan
gelongsor	glongsor	gelongsor	glongsor
pondok	donpok	ponpok	donpok
Total Score	1/4	2/4	1/4

User 3, "rumah" scene

Table 1 (c): User 3 Input

User input / answer	Trial 1	Trial 2	Trial 3
televisyen	telivvisen	telivisyen	televissen
meja	meje	meja	meja
kerusi	kerusl	kerusl	kerusi
gambar	gambar	gmbar	gmbar
pintu	dlntu	dintu	pintu
tingkap	tingkat	tingkad	tingkad
Total Score	1/6	1/6	3/6

- ***Analysis on the Initial Potential Evaluation***

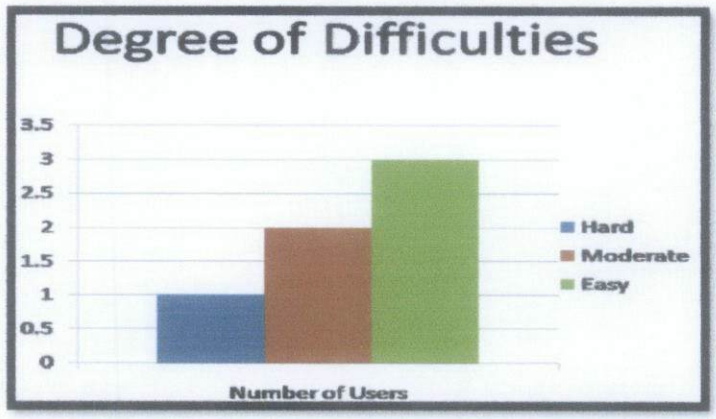
Based on the initial potential evaluation, it shows that the dyslexic children are having problem in spelling and inserting the correct input, while the kindergarten children shows a remarkable spelling and reading ability, means they might not have dyslexia. All these children were showing classic symptoms of dyslexia where they were not able to recognize alphabets or spell accurately. From the overall result of this evaluation session, it can be

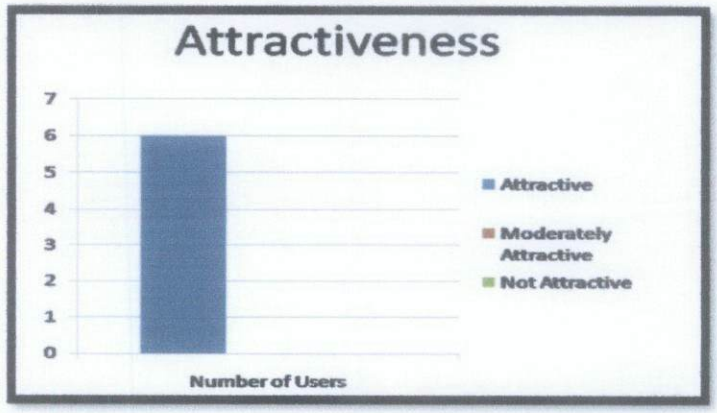
conclude that after one administration-trial, the word recognition ability improve as much as 14% while the word replication improved by 8%.

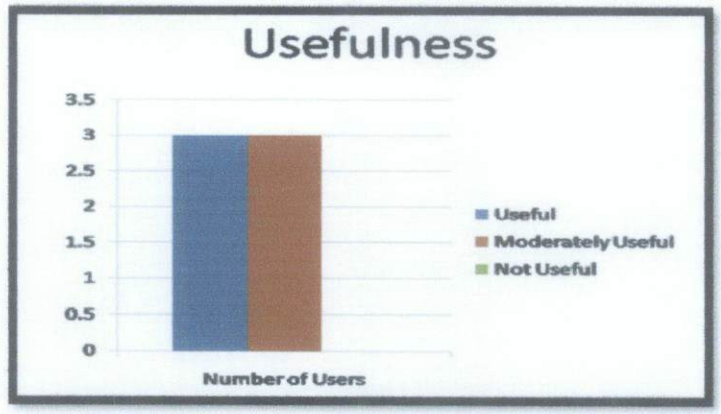
4.5 Finding

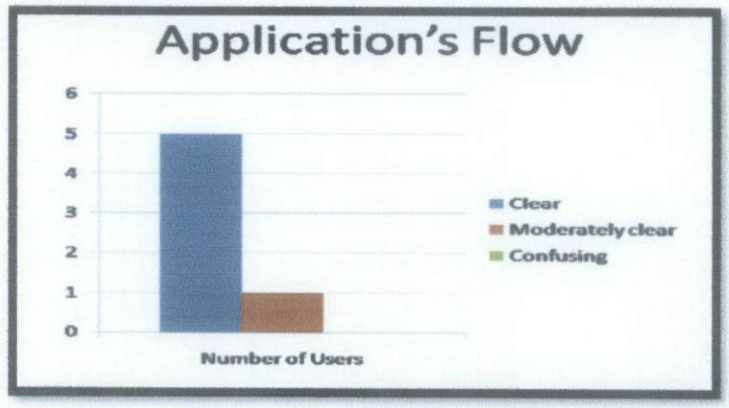
4.5.1 User Acceptance Test (UAT)

After each child completed their task using SpleXia, they were required to answer a set of questions asking their opinion about SpleXia in term of the degree of difficulties, attractiveness, flow of the game, usefulness and their tendency to recommend SpleXia to others. The results of this feedback survey are represented in bar graph as below:









The survey on user's feedback about SpleXia is showing a positive sign and these children seemed to enjoy learning using SpleXia. The reasons might be because of SpleXia's approach that is different from the conventional method, whereby it is emphasizing on interactive self-learning style with attractive environment as being mentioned in Chapter 3.

4.6 Prototype

Figure 7(a): Start Screen

This is the start scene of SpleXia. User can click on the "MULA" button to starts.

Figure 7(b): Option Screen

This is the scenes option screen, where user can choose from main 3 scenes. In this example, "taman" scene is chosen.

Figure 7(c): "Taman" Scene

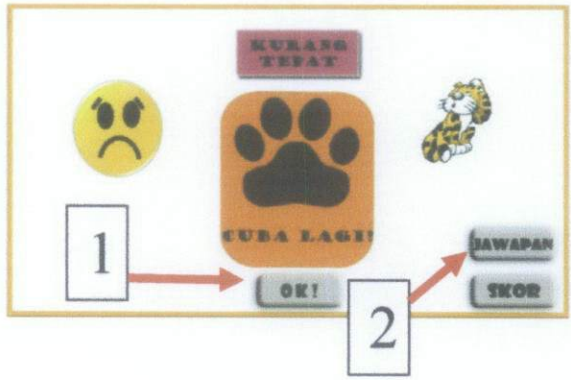
Figure 7(c) is the "taman" scene. There are few objects inside this scene. User can point at any objects, and the red glow around pointed objects indicates that they are clickable. The "skor" will display user's score for the particular scene.

Figure 7(d): Sub scene of "taman" scene

This is a sub scene of "taman" scene. User will be navigated to this scene if they click on glowing objects inside the main scene. For example, if a user clicked on the slide or "gelongsor", this scene will be displayed showing the enlarge image of the "gelongsor". This is where the application played, and user need to understand 5 elements inside this scene. (1) is the picture of the clicked object and (2) is instruction set for the user. Then, (3) is audio button and user can click on this button to listen to how the object inside the picture (1) is being pronounced. User then can try to spell the object inside (1) and insert their answer into (4). Finally, to check whether the inserted answer is correct, the user can click on the check button at (5.)

If the answer inserted by the user is correct, this animation and screen will be displayed. The user's score will be increase by 5 points

Figure 6(e): Correct screen



If the answer inserted by the user is incorrect, this animation and screen will be displayed. The score will not be increased. User can choose to try again by clicking "ok" (1) or obtain the answer by clicking the "jawapan"(2) button.

Figure 6(f): Wrong screen

Figure 6 (g): Answer screen

Figure 7(g) is the answer scene where it will be displayed if the player clicked on the "jawapan" button. The relevance of this scene is to teach the player if they are not able to provide the correct answer themselves. As being mentioned, SpleXia is not a drill-based application, therefore player can opt to go to this scene in order to learn the correct answer (1). The audio button (2) also enables the player to listen to how

the word is being spelled, syllable by syllable. If the player wants to repeat the question again, they can click on "cuba lagi" (3) button or they may return to the main scene by clicking on "kembali" (4). In order to ensure the readability of the answer, the font is being design in white colour with a black background. According to [12], dyslexic children will find difficulties reading from black-coloured handwriting with bright background as they will see as if the alphabets are moving, and this condition is called Scotopic sensitivity [24].

Figure 7(h): Score Scene

Figure 7(h) is the score scene, which is also the final scene for SpleXia. After the player has completed the entire question inside all 3 scenes, this scene will appear and display their scores in every scene and also their total scores for the games.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Relevancy to Objectives

As being mentioned in Chapter 1.3, the objective of this research as a whole is to develop a multimedia learning aid that can be used to help children with developmental reading disorder and demonstrate 15% of improvement in dyslexic children ability in reading after 2 weeks of its implementation. Computer science has a lot to offer in order to achieve this objective thus this research is utilizing available tools, resources and information; with the initiative and hope that the integration of knowledge between Language Pathology and Information Technology area could help to realizing this.

All the project activities that had been planned and carried out throughout the completion of this research are all being done accordingly, whereby after each activity had completed, a reflection and revision will be done to see whether the output that gained are the same as what had been expected and not astray from the main objectives of this research. Besides, all the variables that are necessary for this research are being controlled, trained and observed so that the errors or mistakes can be minimized.

Chapter 3 had shows the development process of SpleXia, and it was designed and developed according to the rules of multimedia. The target users' suitability with SpleXia is another priority that taken into consideration throughout the development process. SpleXia is especially for dyslexic children, and based on the feedback from the target users, SpleXia seems acceptable and can be used by this target group. Besides that, the improvement of target users' ability to read after using SpleXia also supports that the project activities of this research is relevant to the main objectives.

5.2 Suggested Future Works for Expansion and Continuation

5.1.1 Conduct Further Research

Further research in the future is necessary, especially in the main area of this project which is dyslexia and multimedia learning aid development. One of the reason is because the new the experts in the Speech and Language Pathology might come out with new theory or founding about dyslexia. Current version of SpleXia might not be suitable or against these new founding. Therefore, SpleXia might need to be adjusted and redeveloped so that it will always be compatible with the condition of dyslexic children. Besides that, new multimedia tools that can help enhance SpleXia's feature might be available in the near future. These tools can be used to develop a more current and effective version of SpleXia.

5.1.2 Build SpleXia using Mobile Platform

Nowadays the technology is shifting to mobile approach. Even young children are familiar with devices such as smart phones or tablets computer. Therefore, mobile version of SpleXia can be developed in order to keep pace with this ever changing technology.

5.1.3 Develop a Bilingual Version of SpleXia

Besides from targeting to aid dyslexic children to read in Malay, it would be a remarkable added feature for SpleXia if it also available in English. The importance of English for children nowadays is high as English is the international language and also widely used in Malaysia. Therefore, developing bilingual features for SpleXia can help dyslexic children to improve their reading in both Malay and English.

CHAPTER 6

REFERENCES

[1] *"The difficulties with words: dyslexia"*, Specialized Language Development Centre, [Online], Retrieved on November 24th 2011, Available: http://www.sldread.org/information.taf?topic=tendencies

[2] *"Frequently asked questions about dyslexia"*, The International Dyslexia Association, [Online], Retrieved on November 24th 2011, Available: http://www.interdys.org/FAQ.htm#

[3] G. Gomez, I.Smythe *et al.*, (2004), "Dyslexia in Malaysia" in *International book of dyslexia: a guide to practice and resources,* 1st ed. West Sussex, England, 2004

[4] *"Keperluan guru pendidikan khas meruncing"*, Berita Harian, May 27th 2011.

[5] D.Daniel. (2011, June 10*)."Sarawak kekurangan guru dan kelas pelajar disleksia"*, Free Malaysia Today, [Online], Retrieved on November 24th 2011, Available: http://www.freemalaysiatoday.com/2011/06/10/sarawak-kekurangan-guru-dan-kelas-pelajar-disleksia/

[6] Huitt, W., & Hummel, J. (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University. [Online].Retrieved on November 26th 2011, Available: http://www.edpsycinteractive.org/topics/cogsys/piaget.html

[7] *"Dyslexia statistic"*,Nemours a Children's Health System.[Online]. Retrieved on November 24th 2011, Available: http://www.nemours.org/service/preventive/brightstart/dyslexia/statistic.html

[8] *"About dyslexia"*, British Dyslexia Association. [Online]. Retrieved on November 24th 2011, Available: http://www.bdadyslexia.org.uk/about-dyslexia.html

[9] Christine G. (2003, September 8), *"The new science of dyslexia"*, Time Magazine Business, [Online], Retrieved on November 25th 2011, Available: http://www.time.com/time/magazine/article/0,9171,480332,00.html

[10] *"Dyslexia in Japan"*, Dyslexia new stories.[Online]. Available: http://www.dyslexia-parent.com/z118.html

[11] L. Moats *et al*, "*Knowledge and practice standards for teachers of reading*" International Dyslexia Association, 2010.

[12] Umar *et al*, "Menggunakan animasi di dalam instruksi khas untuk kanak-kanak disleksia", in Jurnal teknologi pendidikan Malaysia, Volume: 3, No.2, June 2011.

[13] *"Literacy and numeracy"*, National Key Result Areas.[Online]. Retrieved on November 25th 2011, Available: http://nkra.moe.gov.my/

[14] A. Jaffar. (2011, September 28). *"Perlaksanaan LINUS beri impak positif"*,Berita Harian Online.[Online].Retrieved on November 25th 2011, Available: http://www.bharian.com.my/bharian/articles/PelaksanaanLINUSberiimpakpositif/Article/index_html

[15] N. Ahmad (2010, September 28). *"15,500 guru selesai jalani kursus LINUS"*,Berita Harian Online.[Online].Retrieved on November 25th 2011, Available: http://www.bharian.com.my/bharian/articles/15_500guruselesaijalanikursusLinus/Article/

[16] R.Ramasamy, "Masalah disleksia dalam kalangan murid-murid pemulihan di sekolah rendah, Pulau Pinang.", M.S thesis, Arts (Education), USM, Penang, Malaysia, October, 2008

[17] P. Hodge, *"A guide for teachers and parents"*, Dyslexic child in the classroom. [Online]. Retrieved on November 25th 2011. Available: http://www.dyslexia.com/library/classroom.htm

[18] A. Marshall, *"Can dyslexia be treated with medication?"* Methods and therapy to help with dyslexia [Online]. Retrieved on November 25th 2011, Available: http://www.dyslexia.com/library/dyslexia_methods.htm#medication

[19] J. Reed, *"5 reasons to develop computer based learning"*, Child neuropsychology. [Online]. Retrieved on November 25th 2011. Available: http://www.drjonathanreed.co.uk/wordpress/2009/09/5-reasons-to-develop-computer-game-based-learning/

[20] Daniil Umanski, Walter Kosters, Fons Verbeek, and Niels Schiller, "Integrating computer games in speech therapy for children who stutter", In *Proceedings First Workshop Child, Computer and Interaction*, October 2008, Chania (Crete, Greece)

[21] Murray, T, "Integration of computer-based technology into speech-language therapy", Valdosta State University, Valdosta, Georgia, United States of America.

[22] Cotton, K. (1991, May). "Computer-assisted instruction." Northwest Regional Educational Library: School Improvement Research Series, 19.

[23] Parrete *et. al,* "Using animation in Microsoft power point to enhance engagement and learning for young learners with developmental delay", in *Teaching exceptional children,* 2011.

[24] Mahidin *et. al,* "Preliminary testing on interactive Bahasa Melayu reading courseware for dyslexic children", in 2nd International Conference on Education and Management Technology IPCSIT, Volume:13, IACSIT Press, Singapore, 2011

[25] Abdullah *et.al*, "MyLexics: an assistive courseware for dyslexic children to learn basic Malay language" in *AGM SIGACESS Accessibility and Computing Newsletter(2009)*, Issue 95,September 2009, D.O.I: 10.1145/1651259.1651260

[26] Kast *et.al,* "Computer-based learning skills for children with or without dyslexia", in Ann. Of Dyslexia, The International Dyslexia Association, February 2011.

[27] *"Undoing dyslexia via video game"*, American Psychological Association. [Online]. Retrieved on November 25th 2011, Available: http://www.apa.org/research/action/dyslexia.aspx

[28] Mortimore *et al*., Dyslexia Learning Style: Practitioner's Hand Book, 2nd ed. , England, John Wiley & Sons Ltd.

[29] J. Makar, "*Macromerdia Flash MX Game Design Demystified*", 1st ed. United States of