D-Lexis: Alphabet Mobile Learning Application for dyslexia Based on Slingerland Methods of Learning

By

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the requirements for the
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to

Computer Information System Programme

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Approved by,

_____

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UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

JANUARY 2013

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 references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(NOR NADIA BT JAMAL ABD NASIR)

ABSTRACT

This dissertation reports on the development of D-Lexis, a mobile application with android platform to help dyslexic students in alphabetical learning based on Slingerland methods of learning. Dyslexia is a medical condition that hinders reading, language and spelling skills of a student which effects their learning performance and makes dyslexic students hate conventional classroom methods. Therefore, learning modules for dyslexia learning must be in sequence, structured and applies multisensory approach with focus on alphabet learning as fundamental of literacy to overcome problems of phonological processing that leads to offenses in reading, writing, memory retention and spelling. The project focus at overcoming 3 offenses such as reversal and inversion of letters while writing, short memory retention and 'dancing letters' conditions as well as confusion of letters while reading through 5 modules- recognizing capital and lowercase letters, tracing capital and lowercase letters and exercise.The development of the system is based on rapid prototype methodology which is flexible for author to ensure the application meeting user's requirements. An interview with the dyslexia practitioners, 3 observations through videos, 5 qualitative surveys and 3 revisions on design of the system are conducted to ensure the application is meeting requirements and needs of a dyslexic. The application is developed in 2 phase with 3 amendments on designs and 2 amendments on the development process which results in 5 interactive modules aims on enhancing writing and recognition of letters according to dyslexic needs and requirements. The proposed system not only suitable for dyslexic but also can be used as a pre-literacy learning application for pre-schools students or primary students.

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CHAPTER 1
INTRODUCTION

1.1 Background of study

Ministry of Education (MOE) classified dyslexia as a type of learning disability together with Attention Deficit Hyperactive Disorder (ADHD), autism and Down syndrome. Dyslexic is defined as who possess normal or greater intelligence level than normal students but have difficulties or disabilities in spelling, reading and writing (Maklumat Pendidikan Khas,2005). In 2005, there are 51 primary schools are identified and equipped with dyslexia training program named "*Program Rintis Dyslexia"* (MOE, 2005). The current approach used in teaching dyslexia is through use of multimedia and animation such as games and interactive courseware. This is to attract dyslexic attention to learn as this group is not attracted with conventional classroom.

The main problems of dyslexic is failure of phonological processing where they cannot associates what they see with sounds that resulted in impaired reading. Therefore, it is importance to have an approach that integrates the use of visual part with phonological and auditory part. Kinaesthetic approaches in learning also help dyslexic to overcome problems of poor short term memory and failure of matching words with their meanings. The suitable approach identified is the Slingerland approach. A method derived from the Orton-Glingham approach is more structured and student's condition oriented because it focus on the overcoming the problem from basic and depends on the patient's capabilities.

Therefore, this application is developed in objectives of using Slingerland approach in improving dyslexia problems with android platforms applications.

1.2 Problem Statement

Dyslexia is a learning disability that hinders children's capability. A dyslexic child may fail to attain to the language of reading, writing and spelling parallel to their ability that makes them to find conventional classroom experience is not interesting and decrease their levels of self-esteem. A dyslexic child may struggle with auditory, kinaesthetic or vision dyslexia that caused due to failure of brain to recognize images received from eyes or ears into an understandable language. Therefore, an approach using 5 human senses such as sight, say, hear, touch and feel together as a direct approach to help in learning process of dyslexic child.

In Malaysia, the current approach used under Program Rintis Disleksia by Ministry Of Education is an inclusive learning where using traditional approach and focus on language learning. There are 51 primary schools equipped with facilities such as class and learning medium for Program Rintis Disleksia (Manual Disleksia, 2012), which are:

State	Name of School
Perlis	Sk.Kayang, Kangar
Kedah	Sk.Sultan Ahmad Tajuddin,Jitra Sk. Jln Datuk Kumbar, Alor Setar
Pahang	Sk.Sulaiman, Bentong Sk. Semambu, Kuantan Sk. Fakeh Abdul Samad,Kuantan
Terengganu	Sk. Padang Hiliran, K.Terengganu Sk.Tengku Mahmud 2, Besut Sk.Cukai, Kemaman
Johor	Sk.Taman Muhibbah, Kulai

	Sk. Simpang 5 Pekan Bukit Gambir, Muar Sk. Pasir Gudang 3, Johor Sk. Taman Seri Kluang, Johor
Negeri Sembilan	Sk.Temiang, Seremban Sk. Kota Negeri Sembilan Sk. Serting (F) Sk.Tunku Besar, Tampin
Melaka	Sk.Alor Gajah 1 Sk.Batu Berendam Sk. Padang Temu Sk. Merlimau
Pulau Pinang	Sk. Bayan Baru Sk.Seberang Jaya Sk.Bukit Minyak
Selangor	Sk.Bandar Tasek Puteri, Rawang Sk. Bukit Cerakah Sk. Ss17, Subang Jaya
Sabah	Sk.Kibabaig, Kota Kinabalu Sk.Kelombong Inanam Sk. Muhibbah Sandakan Sk.Pekan Tambunan Sk.Bukit Padang KK Sk. Pekan Tamparuli KK Sk. Pekan Lahad Datu Sk.Kampong Selamat Kunak
Sarawak	Sk.Perbandaran 2, Sibu Sk Laksamana, Kuching
Perak	Sk.Seri Kepayang, Ipoh Sk.Sultan Yussuf, Batu Gajah
Kelantan	Sk.Kuala Krai Sk.Tanah Merah 1 Sk. Kubang Krian 3 Sk. Sultan Ibrahim 1, Pasir Mas

	Sk. Gua Musang
W.P. Kuala Lumpur	Sk.Taman Tun Dr.Ismail Sk.Jalan Air Panas, Setapak Sk.Taman Maluri Sk.Yaakob Latif
W.P. Putrajaya	Sk.Putrajaya 9 (2)
W.P.Labuan	Sk.Pekan Satu Sk. Ranca-ranca

Table 1.1: List Of Schools With Program Rintis Disleksia

However, this number is limited to support the number of dyslexic in Malaysia. The Star (2010) reported that there are 314,000 school-going dyslexics in Malaysia in 2009. MOE under their unit Badan Penyelidikan & Perancangan Dasar Pendidikan (BPPDP) reported that in 2010, approximately 270,846 dyslexics from 500,000 on-going school children.

According to Fadilahwati, Fattawi, Nor & Ronaldi (2011)

> A study on identifying dyslexia symptoms among forty pre-schoolers from selected kindergartens in Negeri Sembilan has been carried out and according to Rohayati & Shafie (2005), the findings of this study indicated that 27.5% of the pre-schoolers have dyslexic symptoms; 15% were identified as having high risk dyslexic symptoms…..They reported that urgent need to train parents to interact with dyslexic children at home. (p.446).

Education for All policy by MOE has address of increasing human capital potential through education which also equal chances of education to all children including dyslexics. It is crucial for giving equal chances of learning to all students for equal development and growth of nations.

1.3 Objectives and Scope of Study

1.3.1 Objective

The objectives of the study are:

a. To survey on existing media and modules for dyslexia alphabet learning.
b. To develop a mobile play tool for dyslexia alphabet learning based on Slingerland's approach.
c. To design mobile interfaces for dyslexia language learning based on dyslexic needs and requirement
d. To explore the use of mobile multi-touch capabilities in supporting learner's interactive learning

1.3.2 Scope of Study

The scope of the study involved focus of the project, platform of development, domain case study and target user of the project. The project will be focus on developing a mobile based Android application that focuses on dyslexia alphabet learning and Slingerland learning approach. The application will be develop with Unit Pendidikan Disleksia, Sk. Sultan Yussuf, Perak as the domain case study and the target users are young dyslexic age between 8 to 10 years old.

CHAPTER 2
LITERATURE REVIEW

2.1 What is Dyslexia?

Dyslexia or developmental reading disorder is literally defined as ‘difficulties of words’. The term derived from two Greek words, ‘dys’ which means abnormal or impaired and ‘lexis’ means language or words (McNair, 2009). Dyslexia is not a disease but a medical condition (News Straits Times, March, 16, 2009) which hinders language disabilities of a children such as reading, writings and spelling commensurate with their intellectual abilities as defined by World Federation Neurologist, 1986 (Devaraj & Roslan, 2006).

Dyslexic is referred as an individual who suffers from dyslexia (Oxford Fajar, 2000). A dyslexic is not poorly taught, lazy or stubborn in fact they possess general or sometimes above the level of intelligence but experience a learning disorder (Maklumat Pendidikan Khas, 2005) that they may find conventional classrooms is not interesting (Devaraj & Roslan, 2006).

2.2 Condition of a Dyslexic.

Dyslexia is a medical condition that involves nervous system. According to Hattum (1980), it is identified that dyslexia is a neurobiological problem (Modul Kursus Pendedahan Disleksia,2006) that a dyslexic inherits the symptoms from families and only 12% diagnosed with the condition due to brain injury or context of dementia (Devaraj & Roslan, 2006). A dyslexic child may struggle with auditory, kinaesthetic or vision dyslexia that caused due to failure of brain to recognize images received from eyes or ears into understandable language. This is because an individual with dyslexia incline have

difficulties with spelling, phonological processing or visual-verbal processing (Wikipedia, May, 2012) and the condition of their brain is difference compared the normal person in terms of coordination and process of input to output (Galaburda & Tallal, 1991).

A study has been made by comparing the normal individual's brain with brain of individual who has reading disabilities to study on impaired condition of dyslexia by Yale Schools of Medicine, headed by Dr. Sally Shaywiltz in 2002. Several phonological tests are conducted on 29 dyslexic and 32 normal individuals ranging on difficulties and their brain condition are observed through functional Magnetic Resonance Imaging (fMRI).

There are four test conducted in objective of studying the phonological processing difficulties between two types of brains such as:

a. Identifying patterns of lines by identifying similarities or difference between upper and lower-case alphabets.
b. Linking the structured of letters to it sounds by identifying rhyme of single letters such as "T" and "V".
c. Differentiate pronunciations of almost similar rhyme like "Leat" and "Jete" which has same long-e sounds which ends with silent 'e'.
d. Putting words into meanings by classifying two words like "Rice" and "Corn" whether they belong in the same groups or not. (Saltus, 2002).

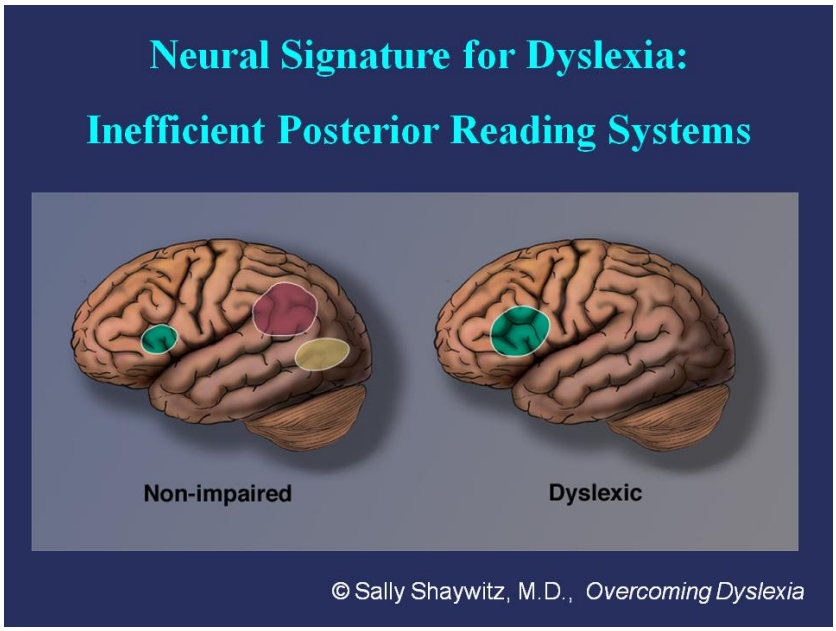


Figure 2.1: Comparison of Brain Condition between Dyslexic and Normal Person.

The scanned brain as visualised in the figure1 showed that as the challenge gets tougher, the area of the brain centre that controls visual fail to response more actively with phonological task though the regions at the front of the brain becomes overactive. This condition is abnormal (as shown in figure1 below) compared to the condition of a normal person because the studies revealed that the area of their brains becomes greater as the task gets harder (Yale Scientific, 2011). Shaywiltz's study proved that dyslexic unable to link structure of the letters or words with sounds. Graph in diagram 2 below visualize the difference in interconnections of intelligent and reading.

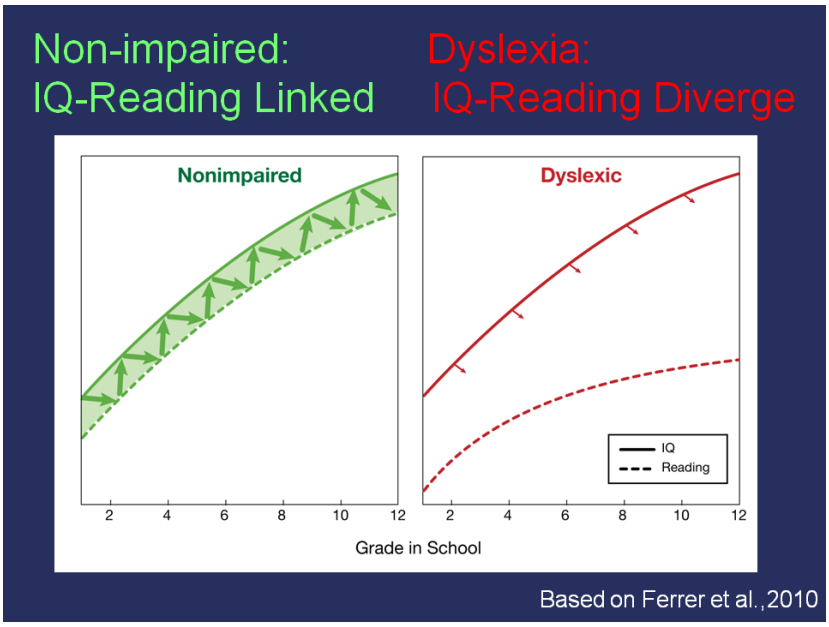


Figure 2.2: Comparison of Graph of IQ-Reading Diverge between Normal person and Dyslexic.

Graph in figure 2 shows that IQ and reading pattern of a dyslexic compared to the non-impaired individual. Reading skills and IQ level are intertwine or 'kissing cousin' as labelled by Shaywiltz that intelligence of an individual increases proportionally with their reading skills and it is interconnected, however in reading impaired condition, it diverged. Scientist believed this condition is a factor of why dyslexic may have low reading score even they possess a high IQ level.

This condition is further explained by Dr.Hornsby, 1995 in his research of 'confusing traffic jam of nerve signals' in the brain. Human brain is divided to two hemispheres, left brain and right brain that are connected to one nerve named corpus callosum located at the centre of the brain. The left hemisphere functioned as verbal, logical and controlling half of the body while the right brain functioned as non-verbal, practical and intuitive area. Part of the brains that controls phonetics at the right hemisphere labelled as Wernicke is smaller than the Broca which functioned as language expression at the left hemisphere. A dyslexia brain showed that both

regions are at the same size which caused confusion resulted from unparalleled data transmission from visual nerve to Wernicke and Broca (Devaraj & Roslan, 2006). This is agreed by Lerner (1997) that transmission of visual and audio nerve happen simultaneously between two hemispheres but left hemisphere response to linguistic such as words, symbols and thinking.

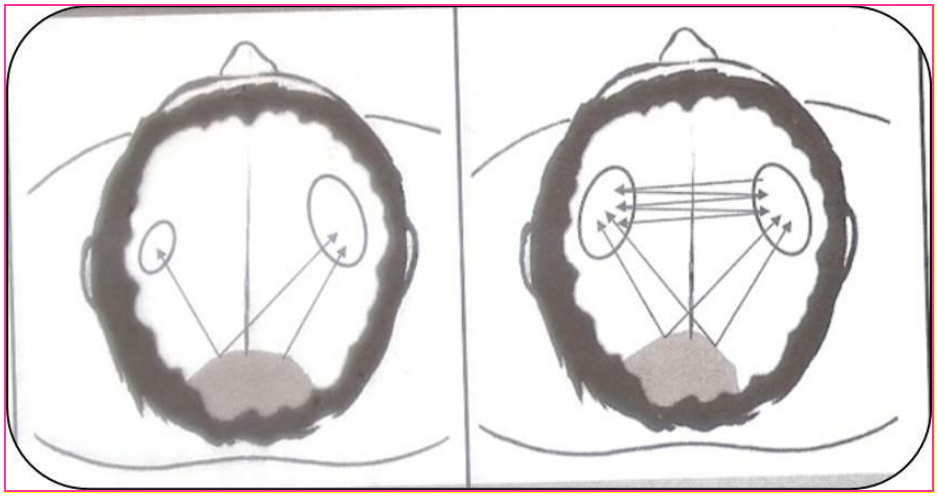


Figure 2.3: Unparalleled transmission of information from left hemisphere to right hemisphere

This explains why most dyslexics are left handed because of active information process on the right hemisphere. These individuals are dominants on spatial abilities, face recognition, visual imaginary and music (Chudler,2011) which reflects the definition that a dyslexic is an individual who possess intelligent in creativity, innovations, arts and music but experience difficulties in spelling, reading and calculations. It can be clearly seen on individuals such as Wright Brothers, Leonardo Da Vincci, Agatha Cristie, Albert Einstein and Tom Cruise.

2.3 Characteristics and Offenses Committed by a Dyslexic (Instrumen Senarai Semak Disleksia,2011).

2.3.1 General characteristics of a dyslexic (Davis,1992) :

a. Appears to be bright, highly intelligent and excellent student.
b. Difficulties in spelling, writing and pronunciation words at their grade level.
c. Possess difficulties in language: spoken, understand and expressing words.
d. Talented in drama, music, story-telling, designing, drawing, sports, building or engineering.
e. Talented in story-telling and creatively create stories from single or sequence pictures.
f. Difficult to give attention in class, appears to be a hyperactive and always 'zone out' or daydreaming.
g. A highly potential student but may not score well in test especially writing test but excel in oral test.
h. High curiosity, always asked questions, full of ideas and shows interest on learning something new.
i. Possess high general knowledge.
j. Poor self-esteem, easily frustrated, emotional about school reading or testing and always find excuses for not going to school.
k. Learns best through experiments, demonstrations, hands-on exercise and observations.

2.3.2 Memory and Cognition (News Straits Times,2009)

a. Difficulties of understanding rapid instructions
b. Difficulties of remembering sequence of things.
c. Poor short-term memory
d. Excellent long-term memory of face recognition, experiences and locations.

e. Problems with directions and prepositions; confuse between right or left and over or below.

2.3.3 Health and Personality (Modul Kursus Pendedahan Disleksia,2006) & (Devaraj & Roslan,2006)

a. Left Handed
b. Unusual developmental stages such as progress slow speech for pre-schools dyslexic.
c. Inconsistent behaviour, may become too quiet, sometimes hyperactive or a trouble-maker.
d. Messy appearance.
e. Prone to ear infections and other diseases.
f. Problems in time management and appears to be clumsy in actions.

2.3.4 Vision (Coventry, 2008)& (British Dyslexia Association)

a. Has a vision of words don't stay still
b. Letters and words appears to move to different area of pages
c. Words appears to become block of colours
d. Background of text may appear to change colour
e. Their eyes can jump to different lines of pages
f. Oversensitive to bright lights
g. Headache from reading

2.3.5 Speech and Reading (Devaraj & Roslan, 2006) & (Davis,1992)

a. Unable to link letters with sounds
b. Unable to read unfamiliar words
c. Wrongly reads the conjunctions or prefixes in a sentence
d. Difficulties in putting thoughts into words and writings which makes them unable to express their bright ideas.

2.3.6 Writing and Motor Skills (Modul Kursus Pendedahan Disleksia,2006)

a. Tend to reversely write shape of letters such as “b” for “d”
b. Problem of writing and copying from whiteboard or audio test.
c. Extreme problems of learning italic words
d. Confusion letters
e. Omissions and substitution letter.
f. Weak in gross motor skills such as catching or throwing balls.

2.4 Treatments of Dyslexia

Dyslexia is a medical condition where despite a normal or above level of intelligences, an individual has a lower level of reading skills (News Straits Times, 2009) that the conventional classroom method is not suitable for their development. A neuroscientist of Rutger's University, Dr. Paula Atlall believed on the significant approach of a phonetic instances able to overcome the phonological processing difficulties of a dyslexic (Saltus, 2002). There should be an approach that can attract dyslexic's attention to study as well as helping them to study. According to Devaraj & Roslan, 2006 the learning modules of dyslexia must include elements of games and short teaching approach that involves movements, music and rhymes. This approach is parallel to the approach proposed by Dr.Samuel Orton, a multisensory approach.

2.4.1 Multisensory Approach

Multisensory approach is a concept of teaching using auditory and visual concept with the integration of movement-based (kinaesthetic) and sensory-based learning (tactile). This idea is developed from Orton's studies in 1925 on the occurrence of language disabilities in children who had not suffered brain injury yet displayed symptoms similar to those exhibited by adults who had sustained language loss (Duchan, 2011).

Orton's studies showed that students labelled as "retarded or failing in their school works" is actually have a nearly-average, average and above-average IQ scores but do not establish hemispheric dominance in particular area of the brain due to disabilities of supporting the association of visual words with their spoken words. Therefore, he introduces the multisensory teaching approach which later developed by Anna Glingham, Orton's research

assistants in 1930's, known as Orton-Glingham Approach to teach dyslexia.

2.4.2 Slingerland Approach

A method developed by Slingerland Institutes of Literacy. Adapted from Otto Glingham Classroom Method, Slingerland applies use of structured, sequential, simultaneous and multisensory approach in teaching to help struggling children with speaking, reading, writing and spelling (Slingerland Institute of Literacy). It is one of the methods of helping dyslexic child to learn through active associations of auditory, visual and kinaesthetic (Hurley, 2011).

2.4.2.1 Principles of Slingerland Approach

There are 6 principles applied in Slingerland approach (Slingerland Methods of Teaching, 2011) :

a. it is an oral- language based
b. the approach applied multisensory- teaching techniques
c. must begin with single units before proceeds to the complex
d. the approach is success oriented
e. the teaching approach on the understanding of the concepts rather than relying on the rote memory
f. carrier skills to functional use

2.4.2.2 Methodology of Slingerland Approach

Slingerland method works with four concepts, “see it, say it, do it and retain it”. Started with the smallest unit, students are taught of recognizing letters through writings (do it) associated with phonetics (say it), sounds (retain it) and visuals (see it). All steps are doing simultaneously where students write the letter at the

same time say it and visualize the rhyme of the letter by matching it with words or pictures.

The steps are visualized in the figure below:

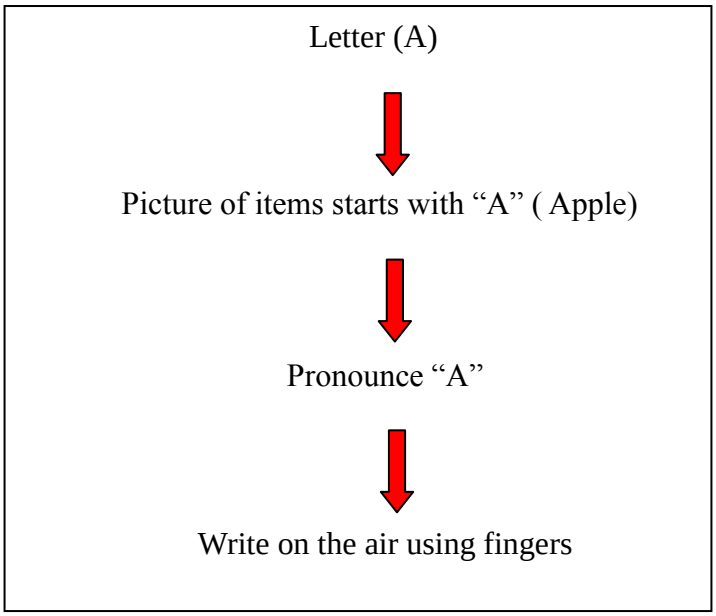


Figure 2.4: Steps of Slingerland Approach

Then, students are taught on putting these letters together to form words before expanded to add of suffixes and prefixes and writing paraphrase to form sentences and paragraphs (Slingerland Methods of Learning, 2011).

2.5 Alphabet Learning

2.5.1 What is alphabet learning?

Alphabets defined by Wikipedia as a set of basic written symbols or letters that represent phonemes or basic significant sounds of spoken language which used to write one or more languages. It consist of vowels such as a, e, i, o, u and consonants ; b, c, d, f, g, h, j, k, l, m ,n, p, q, r, s, t, v, w, x, y, z. Alphabets knowledge is a simple concept as defined by Bradley and Stahl (2004) as knowledge that consist of “letter shape

recognition, letter name knowledge, letter sound knowledge, ability to print letters and rapid letter naming" while Johnston (2004) deny the ability of recognizing letters through sounds as one of alphabetic knowledge. However, both agree that alphabet knowledge is a fundamental knowledge in literacy. Bradley and Stahl (2004) believed that "without firm knowledge of letters, children will have difficulty with all other aspects of early literacy and Mascle (2007) agree that alphabets is a building blocks of language and literacy where " once armed with that knowledge, then a child is well on road to reading and literacy". Learning alphabet through recognizing letters through sounds, prints and names in uppercase as well as lowercase forms is importance where it predicts the success of a child's reading skills and language (Johnston, 2004).

2.5.2 Learning of Alphabet

It is known that alphabets knowledge is a fundamental is literacy and knowledge. Bond & Dykstra (1998) believed that early letter name knowledge before formal introduction or learning process is one of the predictors of children's reading ability and it agreed by Johnston (2004) who claimed that " recognizing the alphabets is one of the most accurate predictors of early reading success". They believed that alphabets knowledge should start from early stage development which is in pre-literacy learning as describe by Mascle (2007) that children should be exposed to this fundamental knowledge as early as before preschool age. Readings showed that scientist believe that a child should be exposed to alphabet learning at least on the letter-name knowledge before age 3 where Johnston,Anderson & Holligan (1993) claimed that this element facilitate phonological learning in literacy and "… may be proxy for rich "school-like" literacy experiences" (Smolkin & Yaden, 1992).

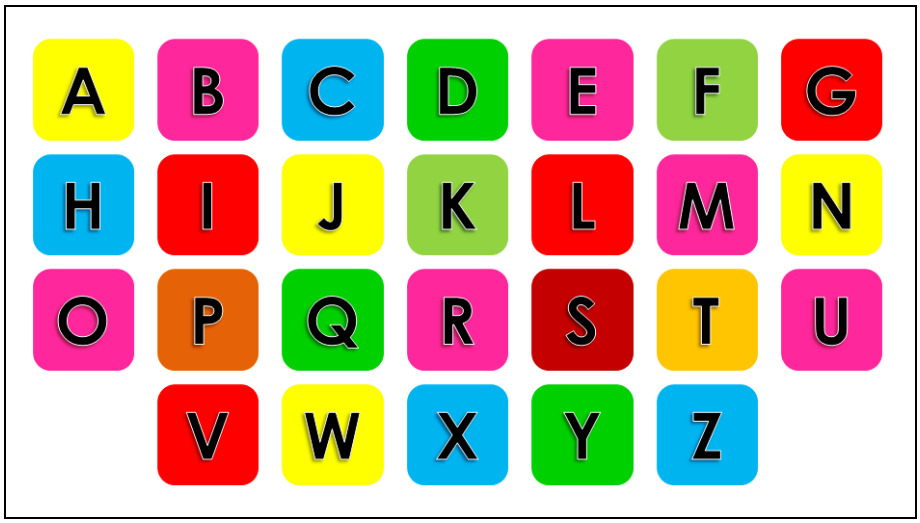


Figure 2.5: Alphabet knowledge is the fundamental of language and literacy

2.5.2.1 Learning Techniques

Learning techniques for alphabet knowledge are different according to parents or teacher's creativity but Bradley & Stahl (2004) highlighted in their journal Learning the Alphabet about the use of pictorial mnemonic to associates letters with sounds. Ehri, Deffner et.al (1984) studied on the function of mnemonic pictorial in reading by comparing three controlled condition which are integrated picture, disassociated pictures and no picture condition and results shown that "children taught with integrated mnemonic learned more letter-sound associations and also more letter-picture association that the other two groups, which did not differ. Integrated pictures were effective because they linked two otherwise unconnected items in memory. The shapes of letters included in pictures reminded leaners of previously seen pictures with those shapes whose names began with the relevant letter sounds". It approved by Mascle (2007) on the importance of applying multiple senses in alphabet learning for children. "They do learn in the more traditional ways -- seeing and hearing -- but often prefer a more tactile approach that includes touching, smelling, and tasting" (Mascle,2007). It can be concluded that multisensory approach facilitate efficiency of alphabets learning.

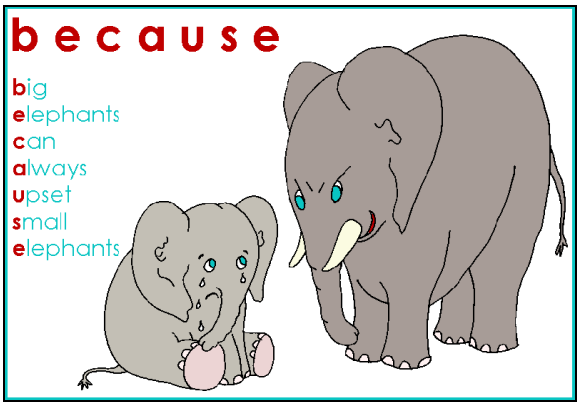


Figure 2.6: Example of mnemonic pictorial

Figure 2.7: Example of disassociated mnemonic devices

2.6 M-Learning

2.6.1 What is m-learning?

M-Learning or mobile learning is "..any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" (Wikipedia) while Caudil (2007) define m-learning as "..mobile: an educational method in a new and more flexible than previous e-learning application". It can be concluded that m-learning is actually a learning process through mobile technologies which made it as a new flexible medium of learning.

It should be taken in to consideration that the hardware used to utilize the learning must be a mobile devices which defines as "..hardware had to advance to a point at which people would carry and access the devices on a regular basis. It is generally accepted that devices like mobile phones, PDAs, and MP3 players fit into catergory of mobile devices (Mellow,2005;Andronico, Carbonaro,Casadei,Colazzo, Molinari & Ronchetti,2003). Sources disagree on the status of laptop and notebook computers as mobile devices". Caudil (2007). Mobile technologies defined as technology for cellular communication (Wikipedia) this are one of aspects that laptop or notebooks not fit into category though they are portable to be carry and able to be access without cable plugin. However, Caudil (2007) claimed that notebooks or laptops as "not devices that people can carry everywhere and can access at any time due to factors of size, configurations and time required to boot up and shut down".

2.6.2 M-learning in Malaysia.

Mobile technologies are new developed technologies in the world according to statistics published by UNESCO, there are over 5.9 billion smart phones user in the world and the ratio of people accessing the internet on laptop compare by accessing on the smart phones are 1:2. In Malaysia, the number of smartphones user as reported by Nielson Insight (2012) in Q1 of 2012, 27% of the penetration of smartphones user where 34% of them are youth age range from 25 to 31 years old. According to statistics published by Malaysian Communications and Multimedia Commission, in Q3 of 2012, approximately 39,826 mobile phone users and the number exceed 100% penetration rate per inhabitants due to multiple subscriptions.

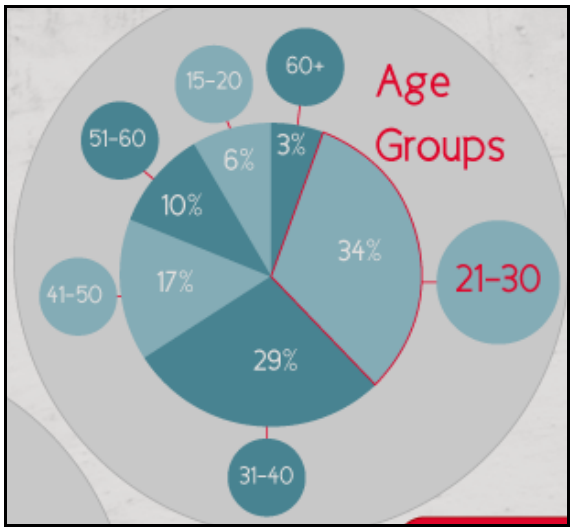


Figure 2.8: Statistics of smartphone according to age level.
Sources: Nielson Insight (2012).

These numbers are one possibility of utilizing learning through mobile technologies and UNESCO saw these opportunities as good advantages in terms of high accessibility of literacy in this modern era. Issham, Rozhan,Azidah & Munirah (2010) reported that used of m-learning as assistive medium of learning in Malaysia as "..methods of learning that were used to make their study more interesting and the learners can easily get any information that they need". Flexible, portable and can be accessed anywhere, everywhere are advantages of m-learning besides this new technologies produce interactive and enjoyable environment of learning for students. However, the adoption of m-learning in Malaysia is still in research and unproven statistically. In adopting m-learning in schools may difficult as governments maintained their actions of banning mobile phones in schools and the needs for IT devices in school is still in discussion in cabinets, The Star (2012).

2.7 Multi touch Screen

Multi touch screen is a capability of a touch system to recognize at least 3 multiple touch points on a surface simultaneously, 3M (2010). Touch system are labelled as touch screen or track pad according to Wikipedia. Multi touch screen is an evolution from single touch screen system whose idea initiated from Hugh Le Cane and Bob Moog in their study of touch-sensitive of capacitance sensors. The idea is then implemented by IBM to invent first touch screen (Wikipedia).

The evolution of multi touch screen are summarize in the table below:

Year	Revolution	Remarks
1960	IBM created the first touch screen implementation of sensitive capacitance sensors.	
1972	Control Data released PLATO IV, a singke touch-points terminal at 16x16 array of user interface	Bent Stumpe proposed the idea of capacitive touch screen to fixed number of programmable button in his research
1977	CERN developed a mutual capacitance touch screen technology based on Stumpe works to invent a Human Machine Interface (HMI) for Super Proton Synchroton particle accelerator.	
1982	University Of Toronto developed a pressure sensitive touch screen using camera attached at the back of the screen as input for the prototype.	
1985	Universiti of Toronto developed	

	new multitouch tablet that used capacitance technology.	
1991	Pierre Welner published a thesis on 'Digital Desk' a multi finger and pinching motion function touch screen.	
1999-2005	Fireworks Company developed many touch screen devices including iGesturePad and Touchscreen keyboards.	Apple takeover Fireworks in 2005
2007	[January] Apple introduces iPhone, the new touch screen mobile phone. [May] Microsoft introduces Microsoft Pixel Sense	
2008	Diamond Touch, a capacitance multi touch, multi-user system by Mitsubishi that enable differentiation of multiple simultaneous users.	

Table 2.1: Revolutionary of multi touch screen.

Multi touch screen enable direct contact between user and the system. According to Fadilahwati et.al (2011) in the research of New Approach for Learning in Disabilities through D-Mic (dyslexia mobile-based application for mathematics learning) proved that 80% students don't have problem of reading numbers and alphabets on the smartphones. This is a new approach of interactive learning compared to the mouse navigation medium of learning.

2.8 Android

Android is an operating system for mobile based platform. It developed based on Linux (Wikipedia) and a free open-source mobile based development for smartphones and tablets. Applications of Android are available to be downloaded free or paid from Google Play.

In 2012, Android has been the number one operating system mostly used by Malaysian overtake Symbian (Nokia), iPhone (Apple) and Blackberry OS (Blackberry) by 43.16%.

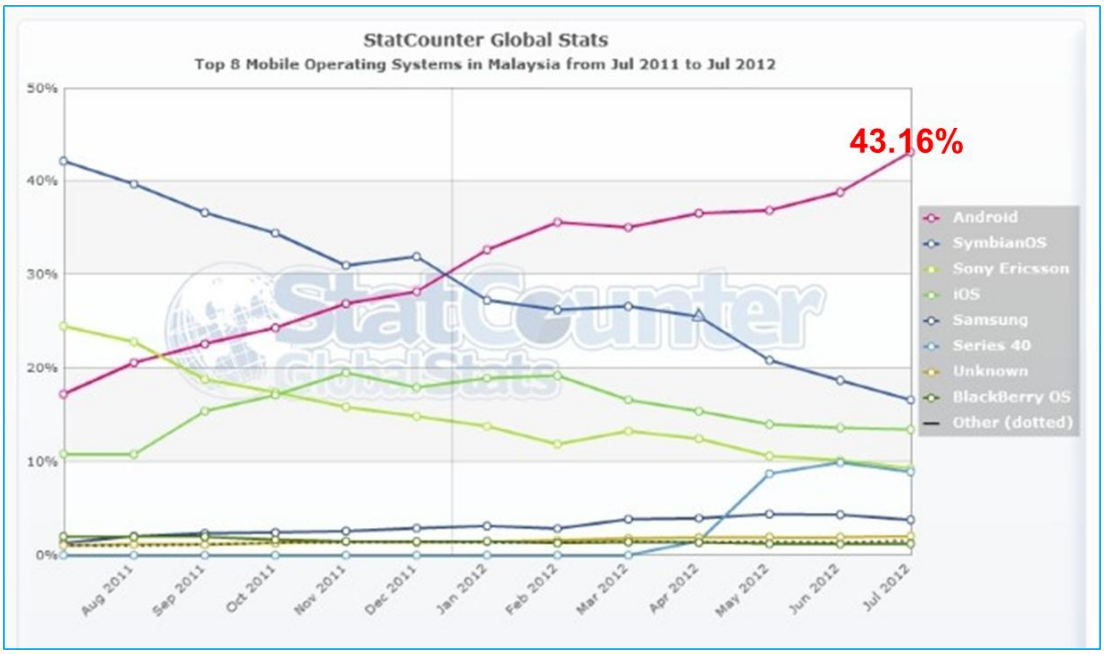
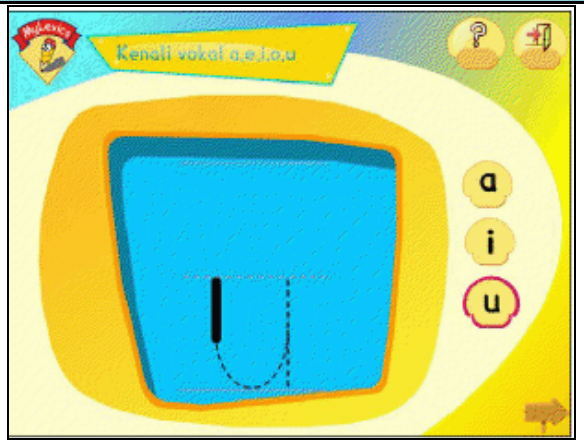


Figure 2.9: Q3 2012 Android becomes first mobile based operating system in Malaysia.

2.9 Review of Application and Courseware

2.9.1 Review of Courseware for Dyslexia Learning.

Focus Category	Application Name	Details and Reviews	Platform	Screenshots
Reading, Writing	MyLexics	The courseware use Bahasa Melayu as the medium of learning. It applies concept of multisensory learning for dyslexic through interactive learning using mouse control navigation. The module for this courseware applied the Otto-Glingham and Slingerland methods of learning where it started from the single to multiple learning lesson. Students are taught to recognize single alphabets through audio and visual before combining letters into syllable. Then, students are taught on joining syllables to form words before combining words to	courseware	 *Figure 1: Vocal Writing Lesson*

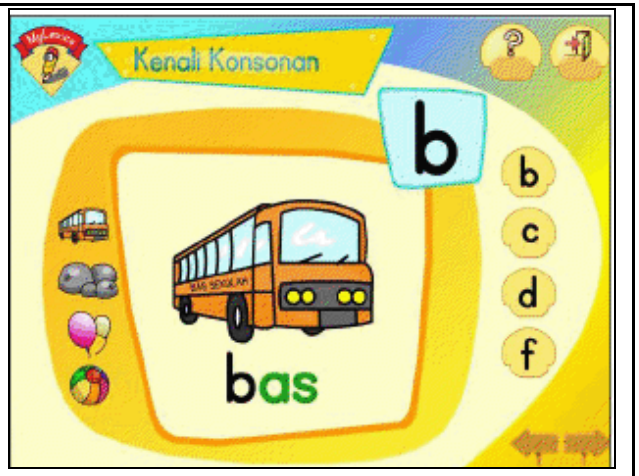
		form sentence. This is a good courseware to teach dyslexic on reading, writing and spelling. It also has modules of assessing and evaluating student's performance by teachers and parents. Developer should make this courseware available in dual-language; Bahasa Melayu and English. Other than that, developer should also insert rewards-incentive concept where rewarding students with marks, or stars when they successfully completed the task. As the technology now is focusing on m-learning (mobile-learning) developer should also expand their courseware to be available to view on smartphones or tablets.		 *Figure 2: Student is taught on spelling word according to syllable.*

Table 2.2: Review of courseware for dyslexia learning

2.9.2 Review of Mobile Based Application

Focus Category	Application Name	Details and Reviews	Platform	Screenshots
Spelling				
Spelling	American Wordspeller	This application focus on dyslexic to overcome struggles in spelling. Functioned as a dictionary and enable user to search words phonetically. User enters 2 to 3 letters to spell words and the application will search for correct spelling and suggest to user. When user clicks on the word, dictionary will shows definition, suffixes and prefixes of the word. It also supports Japanese and Spanish phonetics. It is very useful for dyslexic and learning disabilities to improve their spelling skills.	iOS for iPad and iPhone	 *Figure 3: Identify Words Phonetically*  *Figure 4:Definition, Suffixes and Prefixes*

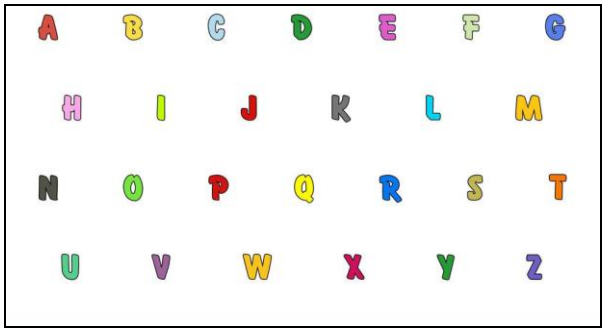
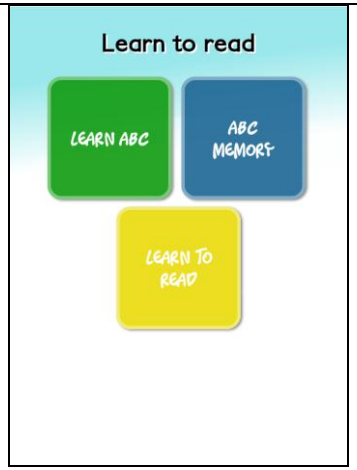
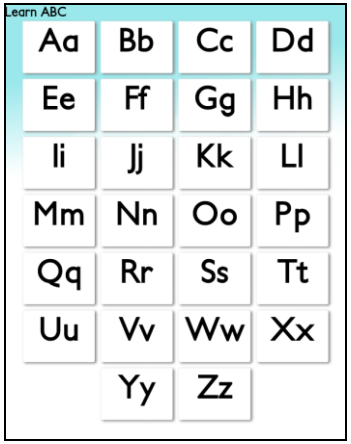
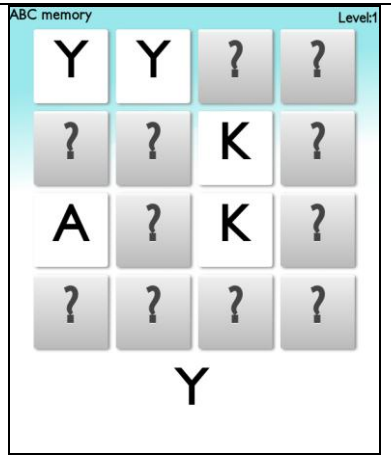
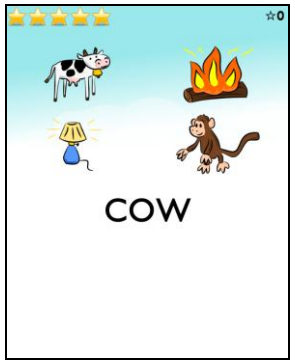
<table>
<tr><th colspan="5">Reading</th></tr>
<tr><td>Reading</td><td>ABC For Kid</td><td>ABC For Kids is a pre-literacy application developed to teach children to recognize alphabet through visuals and sounds. This application has 26 uppercase letters on the menu where toddlers can tap on the letters and it will lead to flashcard that shows picture to represent the letter and audio on the pronunciation of the letter. This simple app only focus on recognizing uppercase letters for toddlers with plain pictures and words with no 2-way interactions between toddlers and the application. Word used to represent letters also is not spelled according to syllable which made it inefficient for dyslexia learning modules.</td><td>Android for tablets and smartphones.</td><td> 

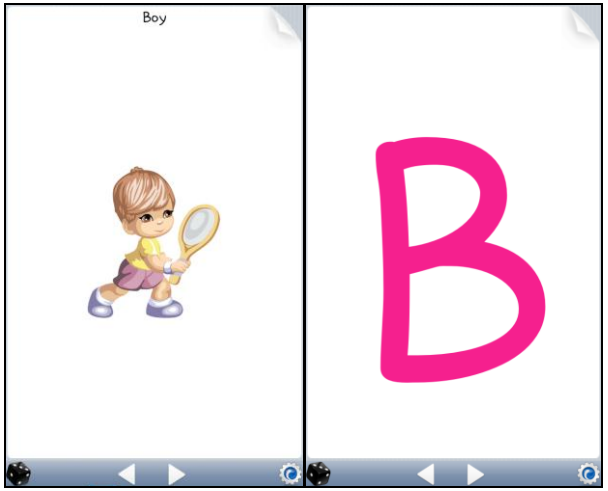
Figure 5: 26 Uppercase letters for the lesson. User can tap on the letters to be direct to the lesson.

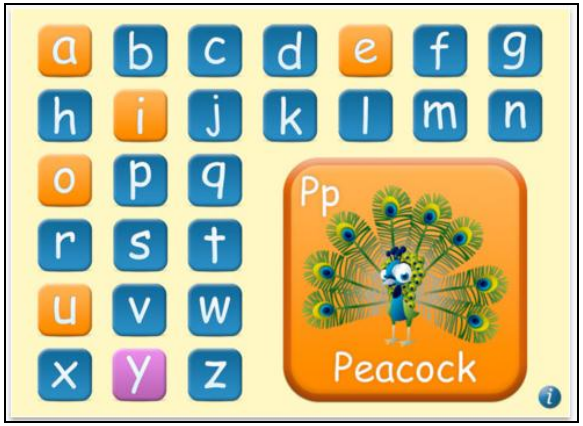
 

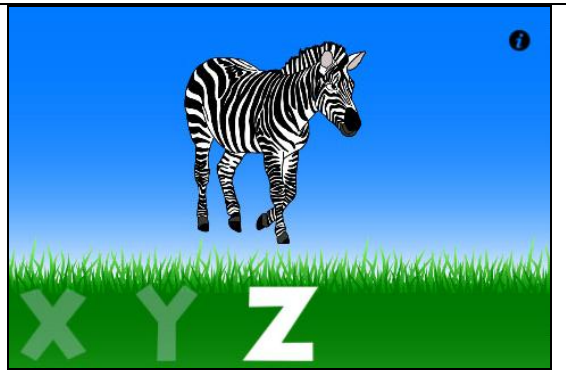
Figure 6: Picture used to represent the letter. User can opt for audio-manual lesson.</td></tr>
</table>

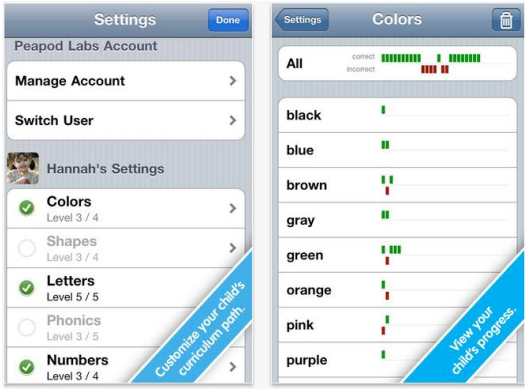
Reading	Learn To Read	Learn To Read application has three modules or menus ; Learn ABC, ABC Memory and Learn to Read modules. This simple application focus on reading through recognizing ABC. In the first module, Learn ABC toddler is exposed to uppercase and lowercase letters. When toddler tap on each letter, (Figure 8) the pronunciation of the letter through audio. There are no pictures to represent each letter and the arrangement will made dyslexic confuse to recognise and differentiate each letter. It also has minimal illustration which is quite dull and boring for dyslexic. The second module ABC Memory, a module to test on the performance of student through memory and recognition. This is a	Android for tablets and smartphones.	 *Figure 7: There are three menus available.*  *Figure 8: Learn ABC Module*

		good module to apply in the developed application as it can overcome problem of short memory retention in dyslexic. User must find the match for letters shown at the screen (Figure 9). The level of difficulty increases as the level increases. In every task completed compliments given to enhance user's or student's productivity. The next module, is Learn To Read Module. This exercise-based module test on student's or user's reading skills. User must choose or tap on the correct picture of words shown on the screen (Figure 10) such as in the example, the screen showed word of "COW" so, user must tap on the correct picture of cow. If user tap on wrong answer, system will eradicate the wrongly		 *Figure 9: ABC Memory Module*  *Figure 10: Learn To Read Module*

		chosen answer until the correct answer chosen. The mark symbolised by stars also decreased proportionate to number of wrong answers tapped.		
Reading	ABC Flashcards for Kids	Basically, this application only focus on reading and recognizing uppercase letters. Simple illustration is used to represent the letter. Every flashcard has audio function which produce pronunciation of the letter and sounds of the picture. It is interactive 2 way lessons between user and the application. However, the module is ineffective for dyslexia learning as the module is not widely focus on dyslexic's need and development in learning.		 *Figure 11: Simple illustration to represent the letter.*

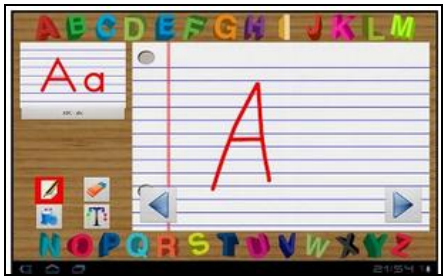
Reading.	ABC's For Kid	This application is developed for pre-literacy education which in aim of helping toddlers to recognize uppercase and lowercase letters phonetically with flashcards. User can choose either to learn on uppercase or lowercase letters. Sound and pictures of animals appeared when children click on each alphabet. Although there are spelling of each animal represent in the cards but it is not spells according to syllable. This is an interactive application that attracts children to learn but there are no evaluations or exercise to monitor children's performance and evaluate the effectiveness of this application.	iOs for iPad	 *Figure 12: Attractive Pictures with Sounds of Animals.*

Reading.	Alphabet Zoo	Developed for interactive learning pre-literacy, it focuses on recognizing alphabets through illustrations of various animal flashcards and phonetics. User can choose for uppercase or lowercase letters lesson. Picture of animal is use to represent each letter which also comes with sounds of the animal to make it more interactive. However, it does not have module on evaluating user's performance such as small quiz or exercise. Other than that, this application also does not focus on spelling lesson which on every animal used to represent the letter, it does not shows the word to represent the animal.	iOs for iPad	 *Figure 13: Module to Recognize Letter*

Reading.	Bugsy Pre-K	An application to teach children in recognizing letters, numbers, shapes and colours. It also has modules on spelling and recognizing words and alphabets through phonetics. This is an interactive application with interesting illustrations and sounds. It also offers evaluations functions for parents to monitor children's learning progress and at every successful completed task there are rewards given in terms of toys and marks to enhance children's enthusiasm towards learning.	iOs 4.0 for iPhone, iPod, iPad	 *Figure 14: Rewards for Completed Task*  *Figure 15: Performance Evaluations*

Writing				
Writing	iWrite Words Lite	iWrite Words Lite is a game based application that teach children to write alphabets while playing games. This application senses user's hand movement and it has interesting illustrations to attract their attentions. User has to complete a mission given by collecting numbered balls. In order to collect the balls, user must track them using patterns given. When they have successfully completed the pattern, an alphabet appears. After completed all task, a flashcards that shows words spelled and it picture. This approach made children learn to read, write and spell at the same time enjoying the game. This is an interesting to attract dyslexic's attention but ineffective for handwriting medium because it neglects factors of spatial in handwriting.	iOs 4.0 for iPhone, iPod, iPad	 *Figure 16: Attractive Tracing Function..*  *Figure 17: Interesting Illustrations*

Writing.	ABC: Looks, Listen and Write	This application has interesting illustrations that teach children new words instead of simple and common words. Children being introduces to alphabets through illustration of flashcards and controllable audio before tracing them using the patterns provided. This is an interesting and interactive application that exposes children to new interesting words at the same time recognizing letters. However, the italic font, uncommon words and too fancy illustrations used may be a distractive to dyslexic to read, understand and memorize the letter. The writing module also does not focus on spatial concept which made it ineffective to overcome dyslexic handwriting problems.	iOs 4.0 for iPhone, iPod, iPad	 *Figure 18: Writing Module*  *Figure 19: Attractive Words and Picture.*

Writing	Script To Schola	This application developed in objectives of teaching children to write letters. User can choose their letters and copy the shapes of the letter in space provided. The single line interface illustration is a great practice for dyslexic to write in lines and fix size in real workbook. It also enable user to correct their mistakes and record their correct writings and pronunciations for performance monitoring. However, it does not have modules of introducing the letters or tracing the letters that may be a pressure for dyslexic to start to write the letter. Dyslexic also may have difficulties of remembering the letter because it only focuses on individual kinaesthetic instead of visual or auditory. Other than that, there is no specific learning method approaches used as it independently relies on parent's teaching skills to teach and monitor children's performance.	Android 2.2 and above tablets and smartphones.	 *Figure 20: Single Line Interface Writing Module*  *Figure 21: Erase and Record Function for Monitoring*

Writing.	Tracing ABC	Tracing ABC is an application that focuses on pre-literacy learning development that teaches children to write and recognize letters, numbers and shapes. User must follows the stars and complete tracing the patterns then flashcards of pictures and words appears. Praises will be given on every completed task to enhance user's motivations. However, the module does not focus on spatial writing concepts and words spelled are ineffective for dyslexic because it does not focus on spelling phonetically.	Android 2.2 and above tablets and smartphones.	 *Figure 22: Alphabets with Flashcards*  *Figure 23: Tracing Stars to Write Letter*

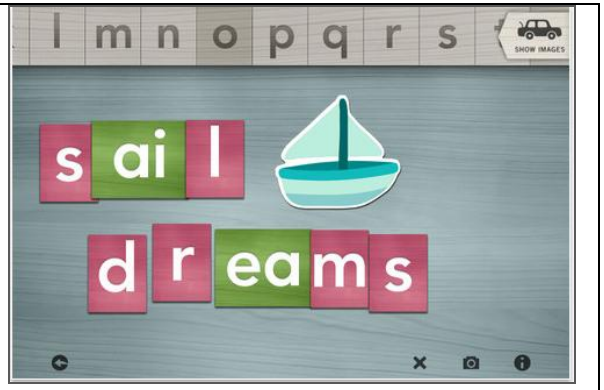
Reading, Writing and Spelling	Alpha Writer	An interactive application for early learning development which enable children to recognize letters through sounds, pronunciation and composition. The application also teaches writing alphabets, spelling simple phonograms by composing words and creates stories with drag and drop functions. Children can compose stories of their own interest by drag and drop illustrations and words which improve their motor skills through dynamic and interactive learning. This attractive application applies Montessori methodology which focuses on development from phonetics to phonograms .However, it only focuses on toddler learning development and does not applies concept of spatial dyslexia in dyslexia learning.	iOS for iPad and iPhone	 *Figure 24: Differentiate between Consonants and Vocals*  *Figure 25: Exercise to Evaluate User understanding and Performance*

Table 2.3: Reviews of mobile application for learning

2.10 The integration of alphabets learning, multisensory approach, dyslexia learning, Slingerland methods of learning and mobile learning.

Dyslexia as described by World Federation Neurologist as a medical condition of an individual which effects their nervous system that hinders ability of reading, writings and spelling corresponds to their intellectual abilities (Devaraj & Roslan,2006). This condition which often happens on children due to inheritance compared to adults results offenses in language learning and literacy, self-management and emotions and health. A dyslexic may posses general characteristics and offenses such as poor short-term memory but excellent long-term memory and recognition, difficulties of processing rapid and long instructions but high curiosity and creativity, poor self-esteem especially in conventional classroom but may posses higher intelligent level than their peers, confusions of directions and prepositions as well as difficulties of estimations distance, confusion letters and unable to link letters with words (Modul Kursus Pendedahan Disleksia,2006 ; Devaraj & Roslan,2006; Coventry,2008; Davis,1992; News Straits Times,2009).

Research conducted by Dr.Samuel Orton produced method of learning of dyslexic is Otto-Glingham methods which is an approach of multisensory (Duchan,2011). Multisensory approach or concept of integration of multiple senses such as kinaesthetic, visual and auditory simultaneously in learning is also a fundamental concepts of Slingerland methods of learning. Slingerland methods of learning, a development of Otto-Glingham method applies four concepts of learning that are writings (do it), phonetics(say it), sounds (retain it) and visual (see it). (Slingerland Methods of Teaching, 2011). These four concepts of learning are integrated together simultaneously in a learning process.

Multisensory approach is also compliance to the technique of alphabet learning for preschools age. As emphasized by Mascle (2007) on the importance of using multiple senses in literacy learning to

enhance and retain children's attention towards the learning process. It is importance as alphabet knowledge that covers not only letter-name recognition but also letter-shape knowledge, letter-sound knowledge, ability of printing letters and rapid letter naming (Bradley & Stahl, 2004) is a fundamental of literacy which becomes predictors of reading skills of an individual. (Johnston,2004).

In advance of technology development in Malaysia, especially multi touch technology, government emphasized on the application of smartphones and tablets in learning which is also known as mobile learning or m-learning. M-learning is a new flexible medium of learning (Caudil,2007) that have potentials to be widely developed and practiced in Malaysia compliance to governments initiatives under The Youth Communication Plan tabled on Malaysian Budget 2013 (The Star, 2013). The program entitled youth age 21 to 30 years old with income less than RM3,000.00 a RM200 rebate for smartphones and tablets (Malaysian Communication and Multimedia Commission, 2013) which opens up high accessibility to knowledge for every individuals.

As a conclusion, the developed application which focus on overcoming reading and spelling offenses in dyslexia starting from alphabet learning as the fundamental concept of literacy should apply the concept of Slingerland methods of learning which focus on multisensory approach, single to multiple units, oral based learning and success united. In advance to the development of multi touch technology in Malaysia, it is a good opportunity for dyslexic to utilises resources as well as benefited from it through mobile learning. This proposed solutions also should solved the problems of limited facilities for dyslexia in Malaysia (The Star,2010), which is 51 schools equipped with Program Rintis Disleksia (Manual Disleksia,2009) compared to 270,846 on-going school dyslexic children (BPPDP,2010).

CHAPTER 3
METHODOLOGY

3.1 Research Methodology

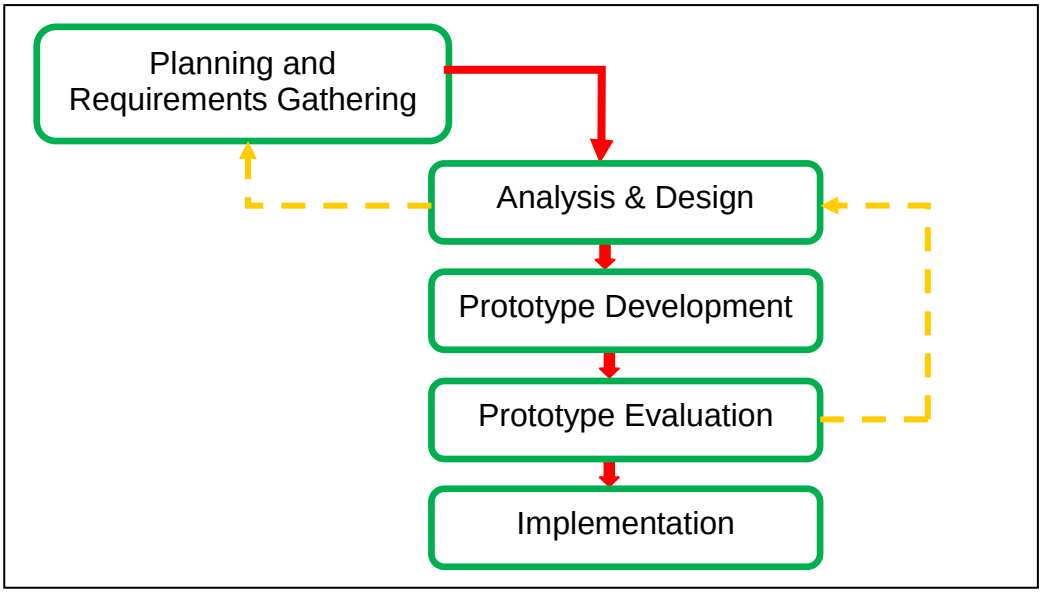


Figure 3.1: Research Methodology Diagram

Type of research methodology used in this research is rapid-prototyping methodology. Rapid- prototyping is chosen so that the proposed develop projects will meet user requirements and needs when implementation phase is conducted. Requirements gatherings and planning will take part at the start of the projects and continues to design and analysis. Proposed functions and requirements gathered will be analysed to design a prototype for the project.

In this methodology, the project manager can easily go back to first phase if the requirements gathered are insufficient for the projects or the proposed plan does not meet design capabilities. Prototype will then be evaluated and feedbacks will be enquired for improvements. Improvements are made based on feedbacks and evaluations from users so that it meets user's expectations. The

finalised prototype will then be implemented as a system for user. Rapid prototyping methodology is more flexible for developer to develop the system.

The project is divided into 5 phases:

i. Planning and requirements gathering **(section 3.1.1)**
ii. Analysis and design **(section 3.1.2)**
iii. Prototype development **(section 3.1.3)**
iv. Prototype evaluation **(section 3.1.4)**
v. Implementation **(section 3.1.5)**

3.1.1 Planning and Requirements Gathering

Planning phase of the research started with surveys on the media such as online research and surveys, reviewing current issues on education and health, reading journals and references, and observations on current trends and environment to identify problem statement, scope of the study **(section 1.3.2)** and objectives of the study. Scoped identified is to study on education system in Malaysia that involves in interactive learning for students. As furthered surveys and discussions are conducted, specific focus are identified that is dyslexia condition in primary education. Dyslexia is a new issues highlighted by Ministry of Education in Malaysia, vast improvements and modules are developed in the learning syllabus to overcome the problem of difficulties of engaging in language of learning in primary learning.

In this phase, the author also managed to identify the problem statements **(Section 1.2)** before identifying the objectives **(section 1.3.1)** of the project. As the author have the general scope of study for the project, author then conducted more surveys on the current problems involving dyslexic learning. The main problem statement is then identified that in Malaysia, there are lack of facilities for dyslexic learning in literacy compared to the increase

number of dyslexic students in Malaysia. The author also has the idea and view on background of area of research such as knowledge of dyslexia, Slingerland methods approach, alphabets learning and androids development which as explain in **section 1.**

Requirements of the project are gathered through qualitative surveys and interviews. Author has done qualitative surveys on the project through review on references on journals, publications, books and online research to gather the needs for dyslexic learning. Other than that, surveys are also conducted on reviewing videos on dyslexic children behaviours and offenses. The results are reviewed and analyse in literature review **(section 2.0).** The current applications and modules for dyslexia and alphabets learning are also surveyed. The author tried and tested on each application and modules then analyse on the usability, designs, user-friendliness, functionality and the suitability of the application and courseware with dyslexic's needs and requirements in learning. All analysis and reviews are reviewed in **2.9 Review of Application and Courseware**.

Interview is conducted to gather qualitative data for the studies. The interview session conducted at Sekolah Kebangsaan Sultan Yussuf, Jalan Pusing, 31007 Batu Gajah, Perak with En. Abdul Salam. Experience in 10 years of teaching and researching on dyslexia, En.Salam is a trainer or speakers for dyslexia teaching of Ministry Of Education. The interview session is conducted and recorded to gather information about inclusive learning of dyslexic students, learning process, modules and techniques of teaching and learning. The interview also aimed ate approving problem statement of the project and gathered more requirements on the behaviours and offenses made by dyslexic children and the current methods used to overcome these offenses which been discussed in **4.1.1 Pre-survey Results.**

3.1.2 Analysis and Design

Analysis of the requirements gathered is conducted based on the problems statements, scope of the studies and objective of the studies. Objectives are further develop to identify functions added to the system adhere to user requirements. The area of the study is further studied and researched to find gather information for analysis and planning. Reviewed on dyslexia such as condition of dyslexia, type of dyslexia, symptoms, causes and treatments, as well as Slingerland approach proposed in the proposal are conducted so that correct analysis are made. Correct analysis is importance for prototype developments so that it meets user's requirements. Literature review **(section 2.0)** is produced in this phase.

Other than that, project manager also must design the system according to the analysis and requirements gathered in **3.1.1 Planning and Requirements Gathering**. Designs of the system started by drawing on the flowchart of the system. Flowchart or system architecture are designed based on the modules proposed for the project. The modules are arranged according to the level of difficulties and learning needs of the dyslexic. The finalised and approved modules will defined the flowchart of the system. Therefore, there are few designs revised and changed along the projects.

3.1.2.1 Design of the Interface (Version 1)

The first flowcharts proposed for the system is as below:

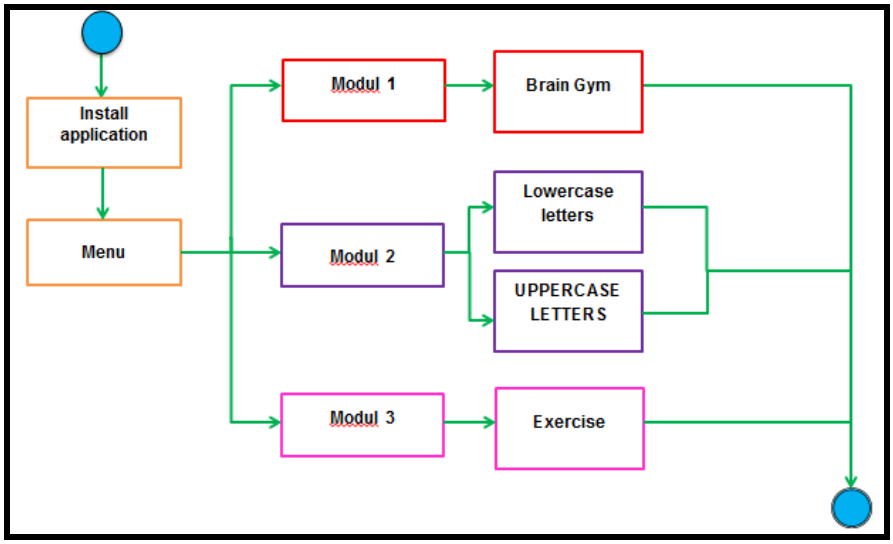


Figure 3.2: The proposed flowchart.

The system have to be installed in the mobile device before used. After the installation finished, there will be menu interface-selection for user to choose the three modules to be conducted. Each module has different function and activities to overcome offenses made by dyslexics. Module 1 focus on preparing students for the learning process. This modules aimed at attracting student's attention at the same time overcoming offenses in directions and prepositions while module 2 focus on developing correct reading and writing technique for dyslexic's students. The third module is an exercise module which aims at improving short memory retention in dyslexic parallel to evaluate and monitor individual's performance after completing the module. Details of each module are describe further in this section.

The proposed flowchart designed with three learning modules that are Module 1, which focus on preparing or attracting student's attentions through Brain Gym activity. Brain Gym activity is a simple exercise module such as tracing patterns or shapes starting from different direction and prepositions in order to prepare student's for the next module as well as overcoming their offenses in

directions. The second module comprises on the recognizing and writing letters which divided into uppercase and lowercase letters.

Module 2 is an implementation of Slingerland methods of learning for dyslexic's students. The module aims at overcoming writing offenses such as reversal and inversion of letters while writing and reading offenses such as 'dancing' letters condition. Module 2 integrates 3 elements in learning that are audio, visual and kinaesthetic. Dyslexic will learn how to write letters in a correct way, through animations shown, accompanied with the phonetics sounds of the alphabet. The designs are illustrated below:

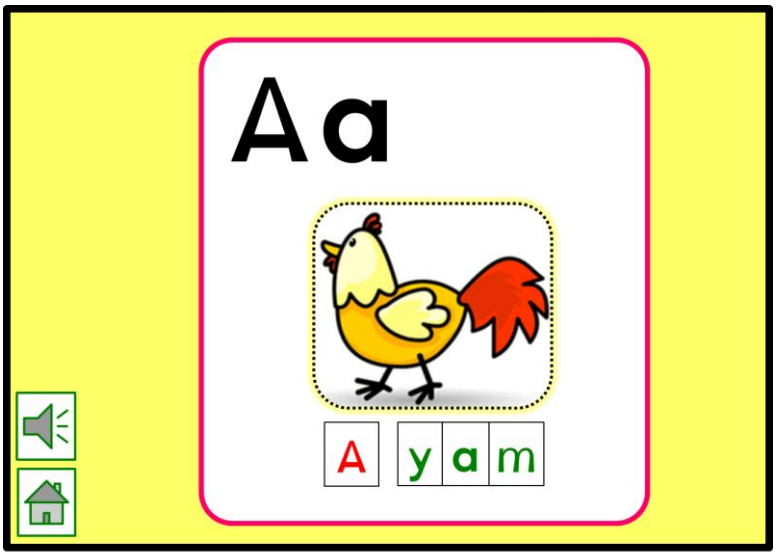


Figure 3.3: The Learning Module

The recognizing module is an introduction of uppercase and lowercase letters through phonetics that are sounds of the letter and the pronunciation of the letter. Spelling of the object is according to the syllable. Bahasa Melayu is used as the medium of learning to have inclusive or specific focus for the dyslexic learning. Other than that, the language is also chosen because it is the main medium of learning used in the current learning process. Type of font used is Open Dyslexic. It is a special bold-strike font used as an alternative to overcome reading offenses in dyslexia.

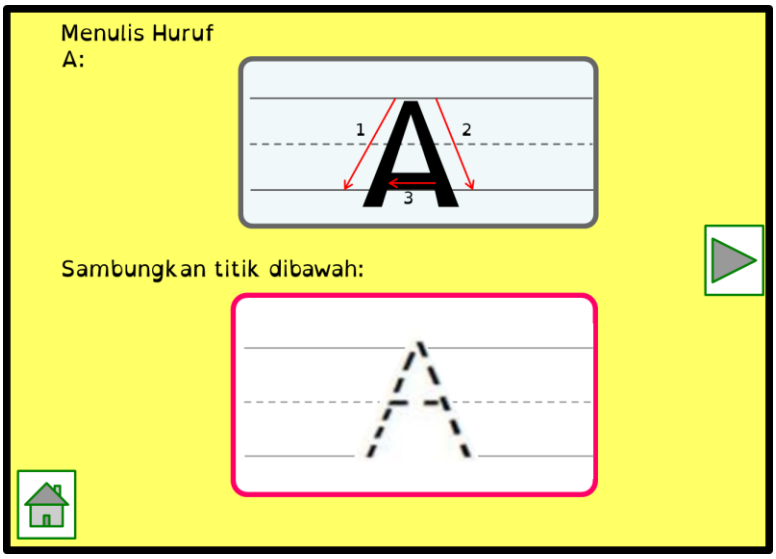


Figure 3.4: The Learning Modules of Uppercase Letter

After user finish the recognizing module, they will be directed to writing module. In the writing module, there will be animation on how to write the letter and in the next box, user must write or practice the writing of the letter by tracing the dotted lines.

The proposed design of the system is not meeting the principles of Slingerland methods of learning where the module does not integrates the elements of audio, visual and kinaesthetic simultaneously. These three elements are focused in two separated modules

Therefore, the proposed module must be reviewed and new designs with the new requirements are produced. Other than that, the design also less attractive with dull colours chosen which made the all designs need to be revised back. These are sketches of the first version of the system.

Figure 3.5.: Menu of the System.

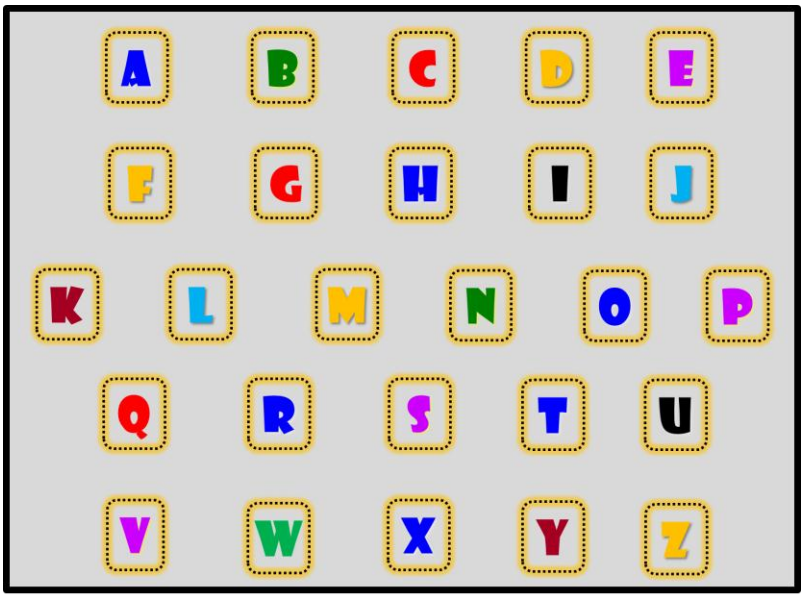


Figure3.6: Alphabet Selection for Uppercase Letters

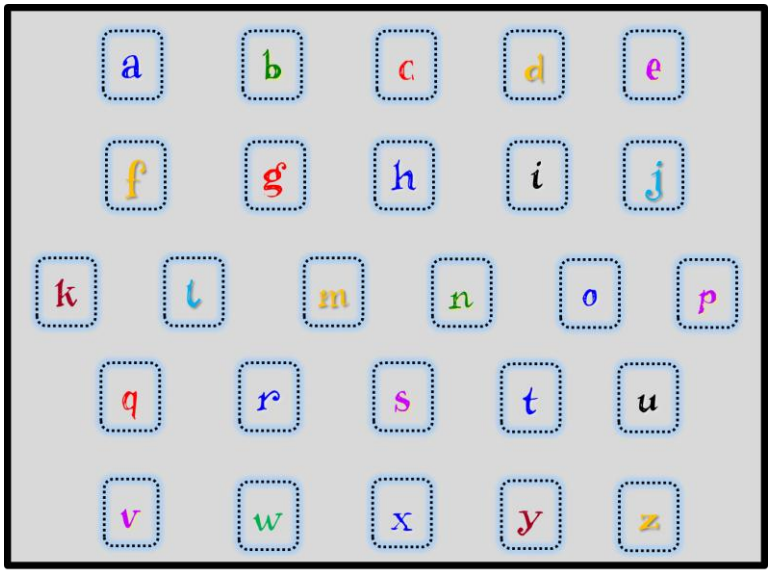


Figure 3.7: Alphabet Selection for Lowercase Letters..

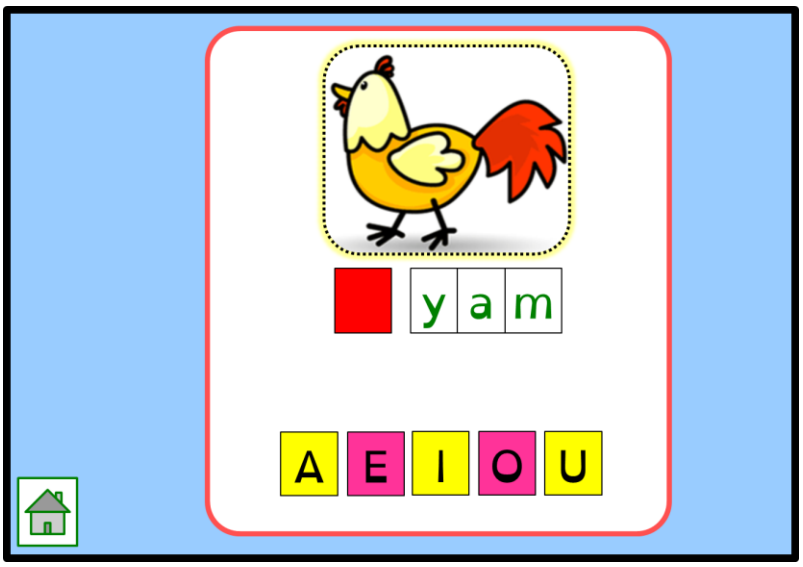


Figure 3.8: The Exercise Module

3.1.2.2 Design of the Interface (Version 2)

The revised design of the system but still based on the proposed flowchart is more attractive with colourful designs and animated object. New designs also improved on the arrangements of the modules. Modules are been revised and the new requirements of the system as suggested in **3.1.2.1 The first version design of the system** are improved.

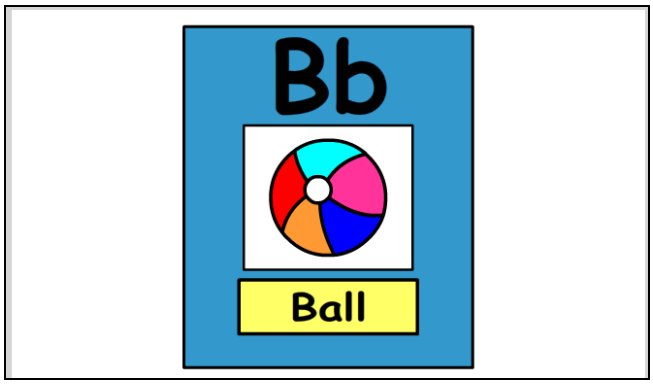


Figure 3.9(a)

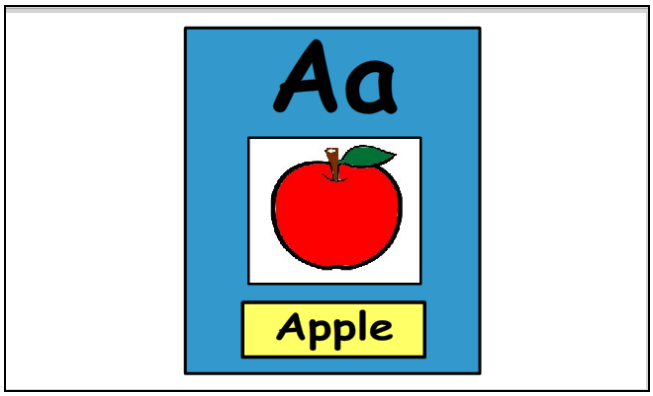


Figure 3.9(b)

Figure 3.9(a) and Figure 3.9(b): Design of The Reading Module

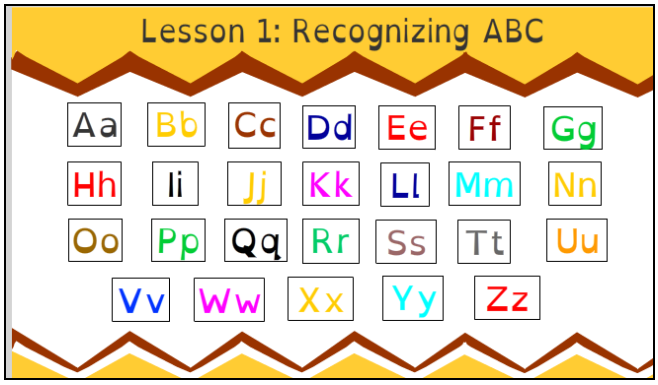


Figure 3.10: Recognizing Letters Design

The revised design include new modules, the recognizing module to introduce letters to user before proceed to the next module, which is writing. The recognizing module used the integration of visual and audio, recognizing through pictures and phonetics sound of the letter. The new designs also improve on the used of colours. Bright colours are used to be more interactive and attractive.

However, to avoid zoning out to make the learning effective, the flashcard used plain colour with simple words and pictures used to avoid confusion for the dyslexic. Therefore, they will have only one focus during the learning process.

However, after revision are made by comparing the designs with the difficulties faced by dyslexic, it is identified that the recognizing modules also does not meet dyslexic's learning needs and requirements. There are heavy information loaded in one module for the learning which make the learning is difficult for dyslexic students. This is because dyslexic has difficulties in digesting or understanding rapid or long instructions as well as loaded information at one time.

Therefore, amendments and changes are made according to improve on the weaknesses highlighted above. All designs are revised and rearrange to produce the new proposed design for the system.

3.1.2.3 Design of The Interface (Version 3)

The third design proposed on the new flowchart and modules as solutions to problems highlighted in **3.1.2.2**. The new flowchart separate recognizing and writing alphabet modules and each modules are then further separated to uppercase and lowercase letters. Module 1 which focus on direction and preposition are revised and decided to be eliminated in this system. This is because there are no kinetic evaluations in the proposed system. Evaluations of kinetics or directions and prepositions in android mobile is ineffective to asses on the performance. This is because, android technology detects only on gestures not the correct prepositions or direction.

Therefore, the new flowchart are proposed as follows:

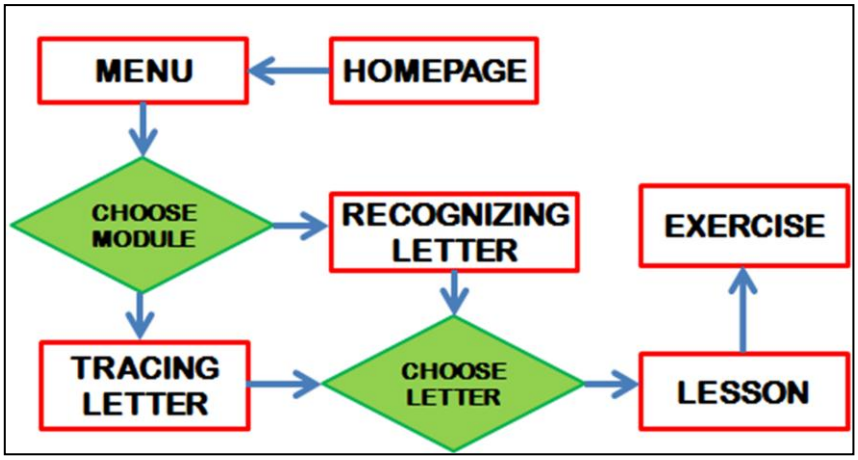


Figure 3.11: New Flowchart

The new flowchart starts with the homepage and user have to choose type of module for learning at the menu interface. There are two modules for the learning that are recognizing letter and tracing letter. If user choose recognizing letter, user will be directed the selection. User must choose letters for the learning process before proceed to the lesson. After user completes the lesson, user will be directed to complete exercise.

If user chooses tracing letter, before proceed to the lesson, user must choose type of letters either uppercase or lowercase letters and then proceed to the lesson. In the end, after completing the lesson, user will have to do exercise.

New designs for the system are showed below:

Figure 3.12: Homepage Design

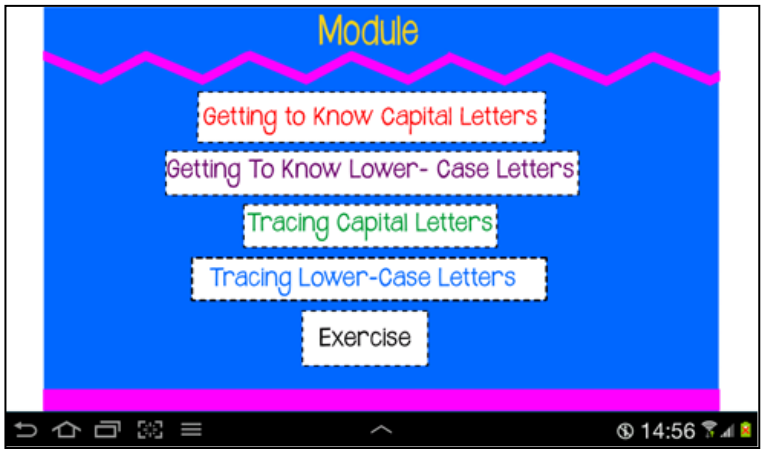


Figure 3.13: Menu Design

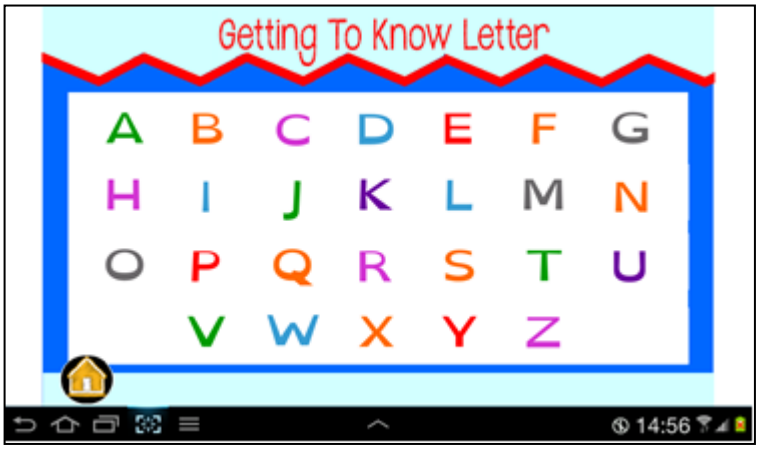


Figure 3.14(a)

Figure 3.14(b)

Figure 3.14(a) & Figure 3.14(b): Letter Selection Interface Design.

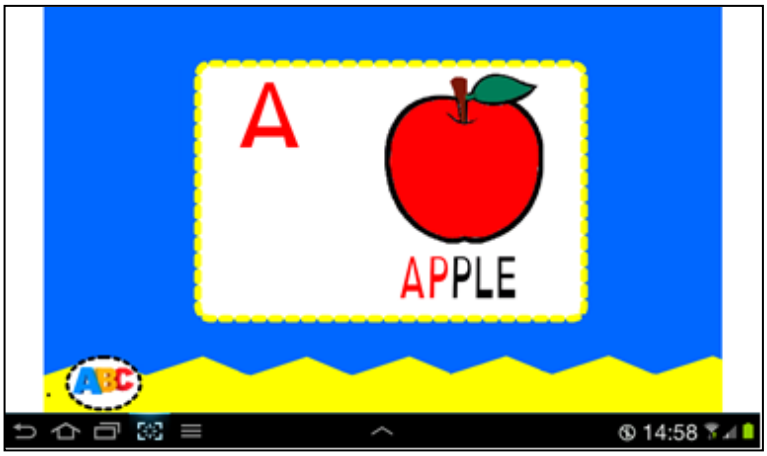


Figure 3.15: Recognizing Uppercase Letter Interface

Figure 3.16: Recognizing Lowercase Letter Interface

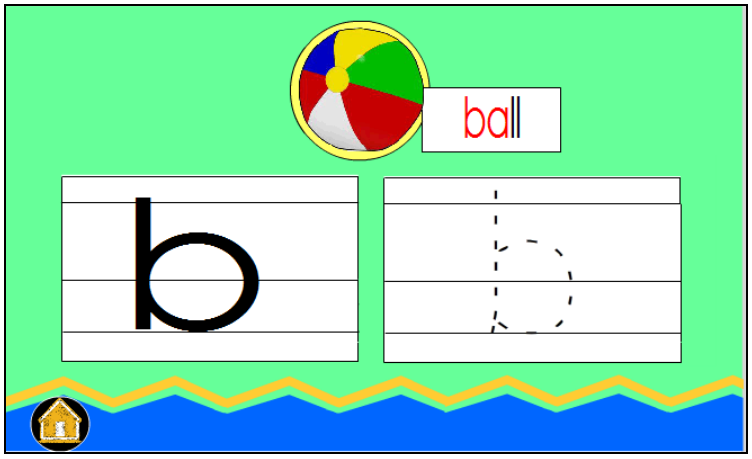


Figure 3.17: Tracing Lowercase Letter Interface

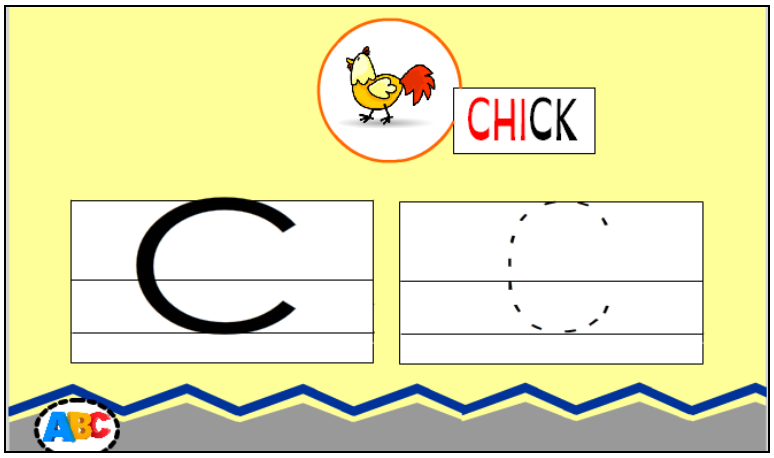


Figure 3.18: Tracing Uppercase Letter Interface

In this new designs, the recognizing module for uppercase and lowercase letters are separated to overcome overloaded information given to dyslexics. The tracing letters module also integrates the elements of audio, visual and kinaesthetic in the module.

Other than that, the new designs used English as the medium of learning because of marketing potentials. Changing of medium of learning for the system is also a needs and requirement of learning for the dyslexic in improving English language as English is an international language and it is also one of medium of language for literacy. Therefore, the third version of the designs are the improvements on recognizing alphabets modules, tracing alphabets modules, medium of learning and designs of the interface to be more creative and attractive for the interactive learning.

3.1.3 Prototype Development

3.1.3.1 Prototype Development Phase 1.

At this phase where prototype are build and develop for testing and evaluated. The system are developed and analysed to make sure the developed system meets user's requirements and needs. There are changes made along the development because of ability of the author, errors and debugs which also resulted in changes of designs and flow of the system. Each changes are to be described later in the reports. Designs and prototype development are illustrated below:

Figure 3.19 (a): Homepage Interface

Figure 3.19 (b): Menu Interface

Figure 3.19 (c) : Alphabet Selection Interface

Figure 3.19 (d) : Alphabet Selection Interface

The proposed software to be used for the development phase 1 are Android Software Development Kit (SDK) with eclipse using java as the programming language. Designs will be using Adobe Phtoshop CS4, Adobe Dreamweaver and Adobe Flash CS4. However, as the development process started, problems arouse that Android SDK does not support much animation effects. Animation is one of the important element in the system as it involve education of pre-literacy for children.

Therefore, the software used for the development changed to Adobe Flash CS4 with Actionscript 3.0, Adobe Photoshop CS4, and Adobe AIR 1.0. Adobe Flash CS4 and Adobe Photoshop CS4 is used to design the interface of the system and integrates the function. The animations are drawn and edited using Bamboo Tablet Mousepen **(Figure 3.20)**, the detail of the hardware will be further explain in **section 3.3 Tools**.

After author integrate all scenes and buttons in the system, author must publish the setting in android for AIR setting. Adobe AIR 1.0 publish the system in Adobe Flash with .fla format into application with .air format. However, the Adobe AIR 1.0 only support desktop application. Author needs to upgrade Adobe AIR 1.0 to at least Adobe AIR 2.5 to publish the system to android application with .apk format. Since Adobe Flash CS4 does not support Adobe AIR, author must manually download extension of AIR for Adobe Flash CS4 from Adobe. Then, author must manually associate the updated Adobe AIR with updated Adobe Flash CS4 by copying the installer of Adobe AIR to the directory file of Adobe Flash CS4.

However, this complicated process is incomplete because Adobe Flash CS4 is incompatible with Adobe AIR 2.5. Although the software are successfully associated but Adobe Flash CS4 fails to load AIR for Android publish settings. Therefore, manual settings of are conducted to publish the system to android application. Author clicks on different authorised format during publishing process that resulted in the program to crash and files lost. Recovery process are conducted and manage to locate the files but in different format which unable to be read by Adobe Flash CS4. The recovered files are able to be read using Adobe Flash CS5.5 but it fails to locate all designs and library. Backups of the program are not available resulted in author to restart prototype development process again.

3.1.3.2 Prototype Development Phase 2

In second phase, the development focus on redesign the interface with available objects drawn earlier in **3.1.3.1 Prototype Development Phase 1**. In phase 2, author used the software from Adobe Flash CS4 to Adobe Flash CS5.5. Adobe Flash CS5.5 supported mobile application development in android platform as well as iOs platform. There are ready-built extension for AIR for android setting in Flash CS5.5 so that author does not have to conduct manual setup and installations.

Besides, Flash CS5.5 provides ready templates, snippet codes and components for mobile application developments. Developer can just click on the required function and provide instance name for the object. Flash CS5.5 is a user-friendly with many interesting motions and functions to be explore. Screenshots of the prototype developed using Flash CS5.5 are describe below:

Figure 3.20 (a): Development of the Homepage

Figure 3.20(b): Development of the Menu Scene

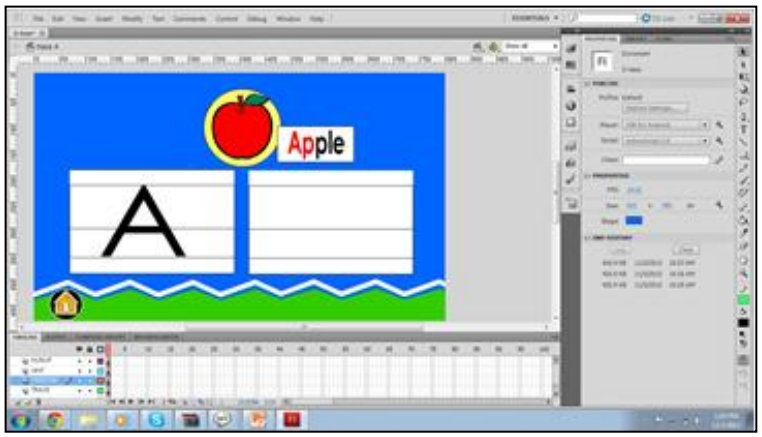


Figure 3.20 (c): Development of the Tracing Module

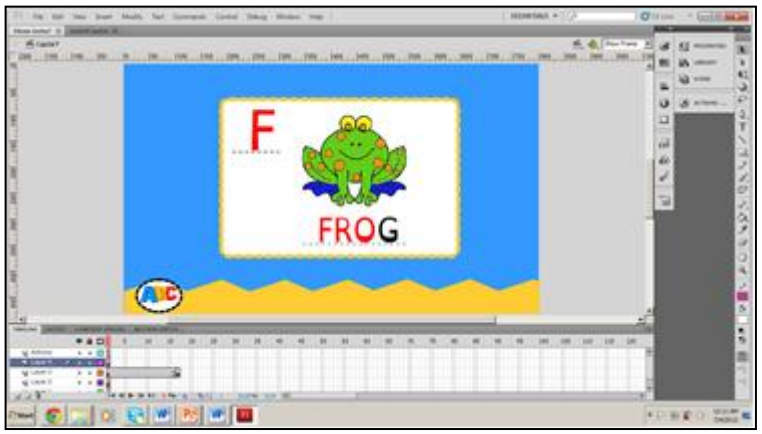


Figure 3.20(d): Development of Recognizing Module

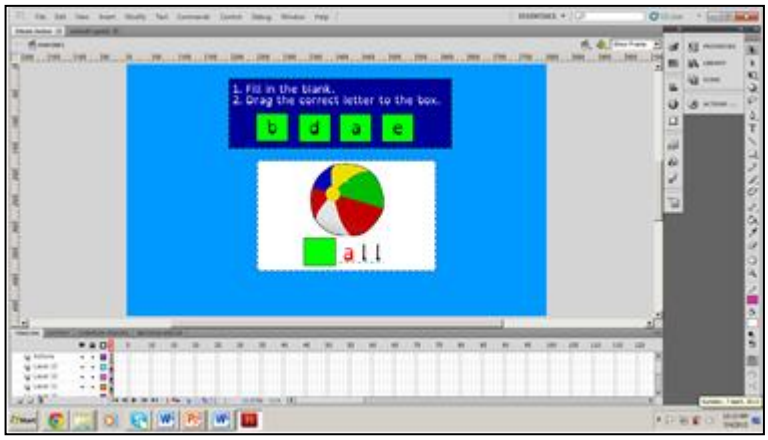


Figure 3.20 (e): Development of Exercise

Development in phase 2 focus on improving the function with improved designs compared to phase 1 of prototype development. Developments are made using Air for Android files and author can directly publish the files in .apk format for android application. Phase 2 enhance on the usage of objects, animations, colours and arrangements of the instances and objects in the interface. In phase 2, testing are conducted directly after the implementation of the code to ensure systems are valid and usable. Testing are conducted using Galaxy Tab2 7.0. Details of the hardware are explained in **section 3.3.**

The development is still in the final stage on completing the tracing alphabet module. Development stage is delayed than the expected time of completion due to the complications faced by author. Therefore, the progress in this stage is slower compared to the previous stage. However, the project development progress is still feasible to the time allocated for the completion of final year project.

3.1.4 Prototype Evaluation

The developed prototype will be tested and evaluated by target user. In this project, target users are dyslexia student age range between 8 to 9 years. Their response will be observed and recorded for improvements. Other than that, feedbacks from teachers and parents will also been gathered for marketing proposed and system improvements. When there are feedbacks, steps three will be conducted again for improvements and evaluated back either the application satisfies user's needs or not.

However, as described in **3.1.3 Prototype Development,** evaluations are delayed because of complications in prototype development. Therefore, for the time being, evaluation will be conducted through developer's personal assessing on usability and user-friendliness of the project. User's testing and evaluations will only be conducted after the completion of the system.

3.15 Implementation

Implementation phase will be conducted after the evaluations and assessing of the system by target user. If the system meets user's requirements and needs, system will be implemented in the real market.

3.2 Gantt Chart

A gantt chart (Appendix1) is prepared to guide author on development of the project. Deliverables and key-milestones are attached together with the gantt chart.

3.3 Tools

3.3.1 Hardware

In this project, personal computer will be used as the workstation to develop the application. The workstation must be compatible with android development requirements that are minimum 32-bit operating system with minimum 2.00 GB Random Access-Memory (RAM) installed memory. It is installed with software described in **3.1.3 Prototype Development** for the development of the application.

Other than that, designed of the graphical user interface (GUI) for the application used BAMBOO Pen and Touch Tablet **(Figure 3.21)**. BAMBOO Pen and Touch Tablet is compatible with the personal computer and user's pencil gripping style. The device suits for left-handed as well as right-handed user as user will be guided to suits their pencil gripping style with the tablet positions for better performance. Four buttons at the left side of the tablet provide user flexibility to edit their design directly from the tablet.

Figure 3.21: BAMBOO Pen and Touch Tablet

The application will be installed and tested using multi touch device. The device will sense motion of user and control the programme. The device used is tablet PC or smartphones that

supports android platform range from Android 2.2 Froyo to Android 4.2 Jelly Bean operating system.The device used in this project is Samsung GT-P3100 Galaxy Tab2 7.0 powered with Android 4.0.4 Ice Cream Sandwich operating system. Galaxy Tab 2 7.0 is an android tablet device with touch capabilities. The size of the screen is 7 inch with dimension of 1024pixel x 600pixel LCD screen made it suitable for the testing. It is a suitable device for learning medium.

Figure 3.22: Testing Device

3.3.2 Software

The main platform for development phase 1 consists of:

a. Adobe AIR

b. Adobe Flash CS4

c. Adobe Photoshop CS4

The main platform for prototype development phase 2 consists of:

a. Adobe Flash CS5.5

b. Adobe Photoshop CS4

CHAPTER 4
RESULT AND DISCUSSION

4.1 Preliminary Survey Result.

In order to design the system architecture and interface for the system, an interview has been conducted with the Mr. Abdul Salam, coordinator and teacher of Unit Pendidikan Disleksia, Sekolah Kebangsaan Sultan Yussuf, Batu Gajah, Perak. The interview session managed to come out with proposed interface and idea for the development of the system. It is further discussed in this section.

4.1.1 Current Approach

The current method of teaching is through inclusive classroom learning where maximum of 8 people in a class with one teacher. This inclusive learning only focuses on two languages Bahasa Melayu and English which involved spelling, reading and writing. The aim of this inclusive learning is to overcome writing, reading and spelling offenses of a dyslexic through close monitoring by teachers.

In this discussion, the current methods of overcoming offenses will be divided and discussed according to the type of offenses. The discussion is summarized in the table below:

Category	Offenses	Methods
Reading and spelling	i. Students ignored punctuations during reading. ii. Wrongly read the	• Name the letters and say the keyword. • Sound of the letter • Write the letter down on

	conjunctions and prefixes. ii. Left out few words during reading especially when involving lengthy sentences. v. Wrongly read the words written in the books. v. Not confident to read long paragraphs.	structured item e.g.: Sand, flour, kinaesthetic board, sand paper, rope and plasticine. • Other method: big arm movement • Use flashcard, bigger font size and bright colours.
Writing	i. Concept of spatial in writing. ii. Reversal and inversion of letters ii. Confusion letters v. Omissions and substitution letters	• Pre-writing. • Use correct tools and stationery e.g.: single line books, correct pencil grips. • Teach on the correct writing methods steps by steps. • Use of uppercase and lowercase letter. • Introduce punctuation and conjunction. • Cursive writing.
Learning		• Class arrangement: U-shape, C-shape, H-shape or L-shape. • Use storytelling, drama, game based or singing elements in teaching and learning. • Reduce work tension. • Edu-trip.

Table 4.1: Methods of Teaching Dyslexia.

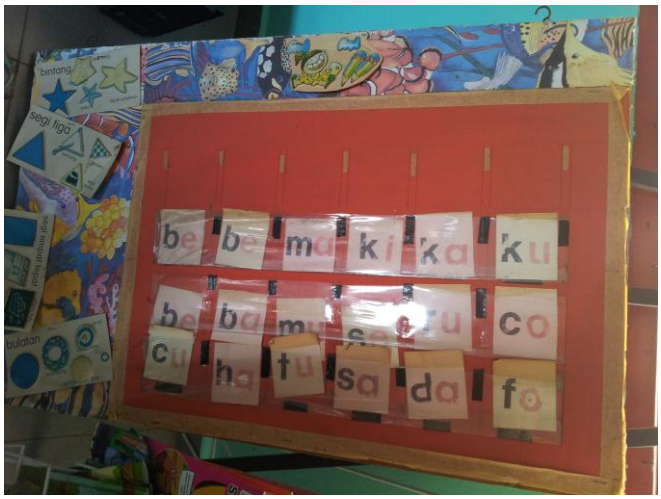


Figure 4.1: Use of colourful flashcards and cards to enhance spelling

Figure 4.2: Storybooks with large fonts are used for reading

4.1.2 Proposed Methodology

Proposed methodology is the methods of learning through coordination of audio, visual and kinaesthetic focus on alphabet learning.

There are three learning modules covered in the application:

a) Reading and recognizing alphabets.
b) Writing lowercase and uppercase letters
c) Exercise

Interface of each module will be designed according to dyslexic needs and requirement (Section 4.2) . The system flowchart are visualize in the Figure 4.3:

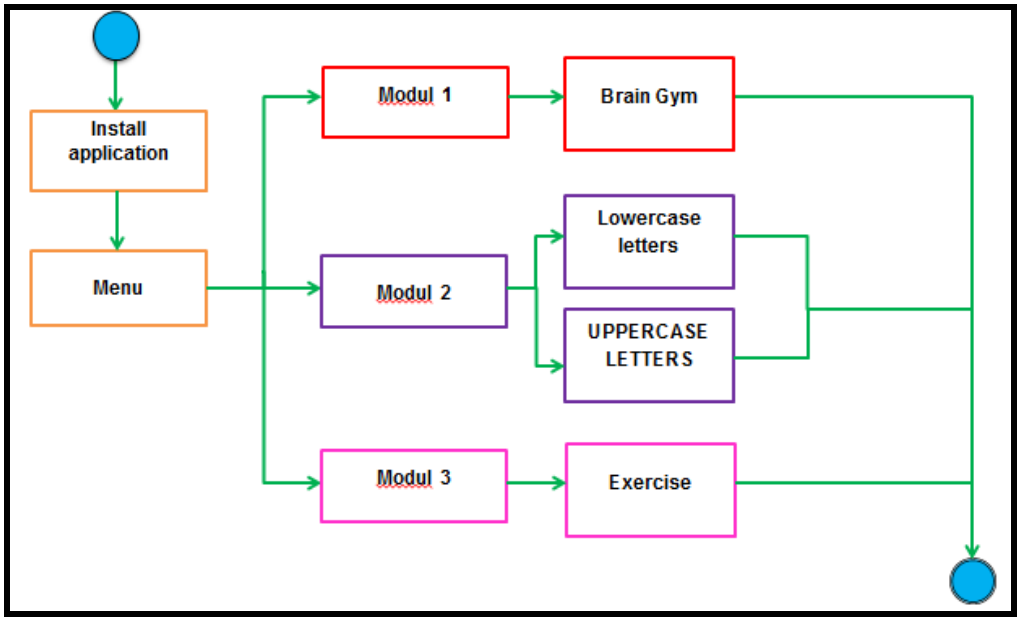


Figure 4.3: System flowchart

4.1.3 Interface Design

All interface designed for the system based on two objectives:

a) To overcome offenses of a dyslexic.
b) To meet the requirement of a dyslexic in learning.

Therefore, based on offenses of a dyslexic, 10 elements are identified as based of the interface design.

There are:

1. Bold strike fonts.
2. Start small to largest unit.
3. Recognizing with phonetic & pronunciation
4. Spelling according to syllable and phonetic.
5. Step by step writing.
6. Phonetic, pronunciation and word audio enable.
7. Interactive animation
8. Flexibility
9. Color suitability
10. Structured surface.

Each element is discussed according to modules and offenses in the table below:

Module	Elements	Offenses overcome
Menu (Figure 4.4)	i. Used of boldstrike fonts ie. Opendyslexic font for the menu. ii. 4 menus arranged in sequence according to level of difficulties.	• Font with strikes and wider at the bottom part makes letters appears to be stay still. • Modules arrange according level of

		difficulties to retain their attention to the module.
Recognizing Module (Figure 4.5)	i. Comparisons of uppercase and lowercase letters in a module. ii. Recognizing with phonetic & pronunciation ii. Spelling according to syllable and phonetic.	• Introducing difference between uppercase and lowercase letters. • 4 concepts of Slingerland approach used in learning. • Overcome spelling offenses through breaking down words into syllable.
Writing Module (Figure 4.6)	i. Step by step writing through animation. ii. Phonetic, pronunciation and word audio enable. ii. Join the dots function to trace the letters. v. Touch sensitive writing.	• Introducing correct steps of writing letters. • Include Slingerland approach in the module. • Guideline for dyslexic during writing. • Structured writing surface to overcome offenses and one of Slingerland approach module.
Exercise Module (Figure 4.7)	i. Drag and drop function. ii. Words tested based on words shown in the module.	• Interactive medium for dyslexic. • To overcome short memory problem of a dyslexic, used same words to increase

		memory retention.
General	i. Boldstrike font ii. Interactive animation and colours ii. Flexible font size, pinching motion in multi touch enable zoom in zoom out function. v. Colour setting changes enable. v. Malay language as medium of delivery.	• To make sure dyslexic able to read menus and instructions. • Learn through automaticity, their needs for size of fonts and colour preferable differ according to individual. • Inclusive learning for Malay language and focus on mother's tongue language to ease learning delivery.

Table 4.2: Module descriptions.

4.2 The Finalised System

4.2.1 Flowchart

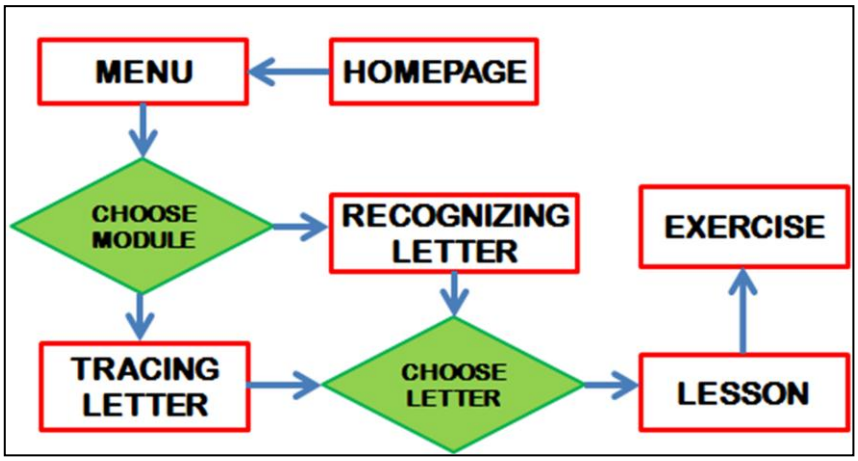


Figure 4.4 Finalised Flowchart of the System

When system are installed in the device, user will be directed from homepage to the menu. User must choose module of learning either recognizing letters or tracing letters. If user choose recognizing letters modules, user will be directed to choice of letters between lowercase or uppercase letters before proceeds with the lesson. After completed recognizing letters lesson, user will proceed to exercise to test on their understanding and memory retention.

If user choose tracing letters, user will be directed to the page of selection letters, user may choose to learn on lowercase or uppercase letters and letters they want to trace. Then, user will be directed to tracing letters lesson. User must complete the lesson by tracing letters before proceed to exercise. The system is flexible where user can choose to proceed with exercise or repeat the lessons for practice. User also may choose the lessons according to their preferences so that learning will be effective and reduce tensions for dyslexic that lead to ineffective learning.

4.2.2 Screen Shots of The System.

4.2.2.1 Homepage

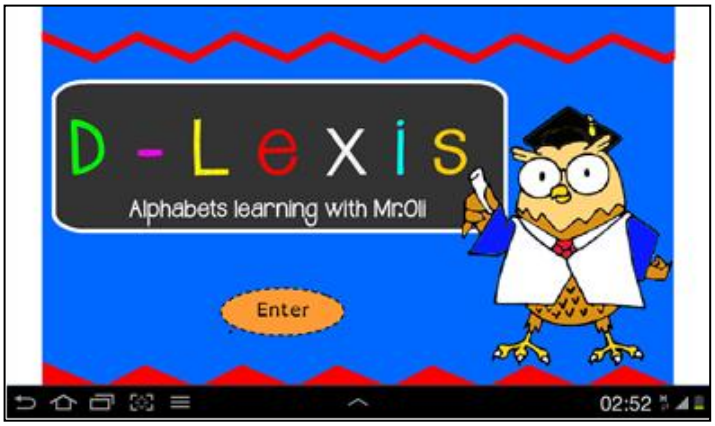


Figure 4.5 : Screenshot of the Homepage

After the installation of the application in the device, user will be directed to homepage as the first scene for the application. In

this page, user will be introduced to the name of the application, D-Lexis. D-Lexis assemble the focus and scope of the application, an alphabets learning application focused to dyslexic students. The animation of Mr.Oli, the owl as the trainer or guidance for the application. In order to start the learning process, user must tap once on the 'Enter' button. It will direct user to the next scene.

4.2.2.2 Menu/ Module

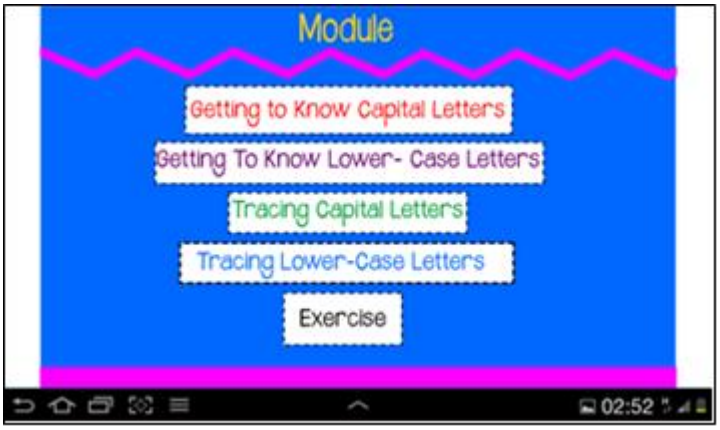


Figure 4.6: Screenshot of the Module

When user tap on Enter button in homepage scene, user will be directed to the Menu/ Module page. In this page, there are 5 menus for user to choose:

1- Getting To Know Capital Letters
2- Getting To Know Lower-Case Letters
3- Tracing Capital Letters
4- Tracing Lower-Case Letters
5- Exercise

If user tap on first module, Getting To Know Capital Letters, user will be directed to recognizing upper-case letters learning module. When user tap on the Getting To Know Lower-Case Letters, user will be directed to recognizing lower-case letters learning module, and when user tap on the menu for Tracing Capital Letters, the system will direct user to writing or tracing upper-case letters

lesson. User will be directed to tracing lower-case letters learning module if user tap on Tracing Lower-Case Letters and if user tap on the Exercise menu, user will perform exercise provided in the application. Modules in this application is very flexible that user can choose for the module according to their level of understanding and preferences.

4.2.2.3 Getting to Know Capital Letters

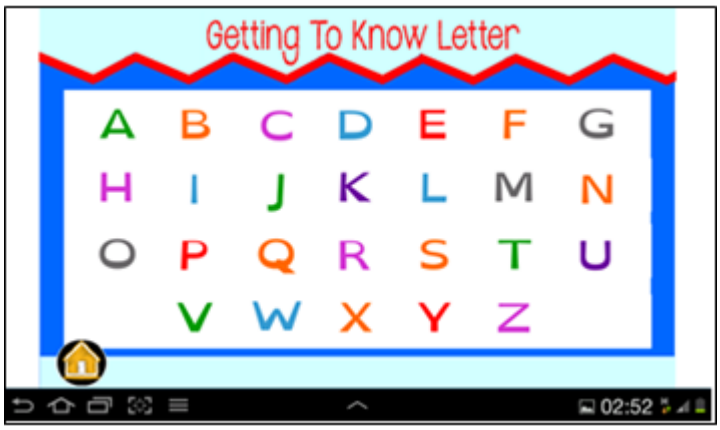


Figure 4.7: Screenshot of Getting To Know Letter Selection

If user choose Getting To Know Capital Letters in the Menu page, user will be directed to capital letters selection. User can choose letters for them to learn. This is because each dyslexic has different offenses in recognizing and reading letters. Therefore, the letters selection page is created so that user has flexibility to choose their learning module. The Home button in the left corner will direct user to the Menu page.

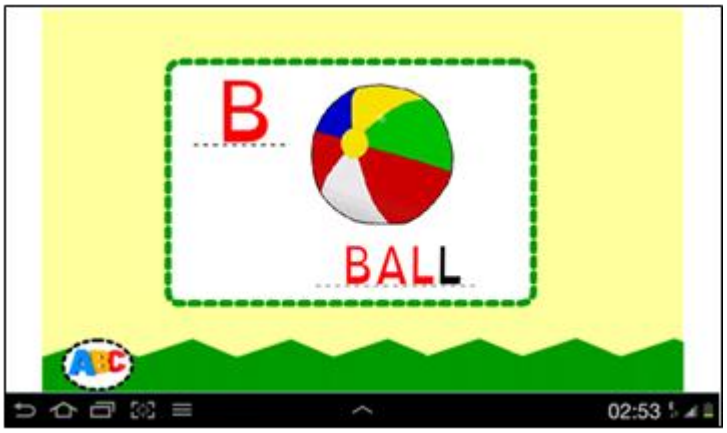


Figure 4.8: Screenshot of Recognizing Capital Letter Learning Module

In the learning module, there will be flashcard to show the object represent by the letter shown. In Figure 4.8, the letter shown is capital B which and the object starts with letter B is Ball and object is represented to improve the efficiency of learning. There are lines at the letter and the words to guide user in reading so that condition of 'dancing letters' can be overcome.

Other than that, user can also go to the letter and perform pinch to zoom at the screen to zoom in or zoom out the letter. The picture, spelling and letter can be adjusted to the size preferred by user for reading and recognizing. Only one object with less animations or designs are illustrated in the module to avoid 'zoning out' condition for dyslexic and retain their attention and focus.

When user enter the learning module, they can just swipe to the next scene and learning will be continue in sequences. As an example in figure 4.8, user can swipe to the right and the page will be directed to next module that is capital C or swipe to the left to go to capital A module. In the left corner of the scene, there are a button that direct user to the Getting To Know Capital Letter Selection once tap.

4.2.2.4 Getting To Know Lower- Case Letters

Figure 4.9: Screenshot of Getting To Know Lower-Case Letter Selection

If user choose Getting To Know Lower-case Letters in the Menu page, user will be directed to lower-case letters selection. User can choose letters for them to learn. This is because each dyslexic has different offenses in recognizing and reading letters. Therefore, the letters selection page is created so that user has flexibility to choose their learning module. The Home button in the left corner will direct user to the Menu page.

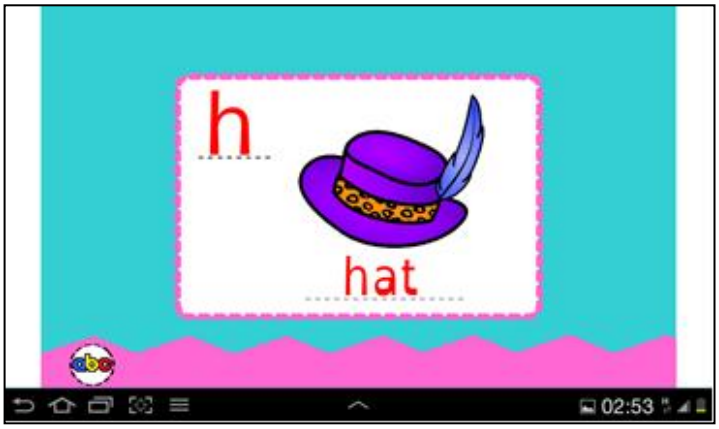


Figure 4.10: Screenshot of Recognizing Lower-Case Letter Learning Module

In the learning module, there will be flashcard to show the object represent by the letter shown. In Figure 4.10, the letter shown

is lower-case H and the object starts with letter H is Hat and object is represented to improve the efficiency of learning. There are lines at the letter and the words to guide user in reading so that condition of ‘dancing letters’ can be overcome.

Other than that, user can also go to the letter and perform pinch to zoom at the screen to zoom in or zoom out the letter. The picture, spelling and letter can be adjusted to the size preferred by user for reading and recognizing. Only one object with less animations or designs are illustrated in the module to avoid ‘zoning out’ condition for dyslexic and retain their attention and focus.

When user enter the learning module, they can just swipe to the next scene and learning will be continue in sequences. As an example in figure 4.10, user can swipe to the right and the page will be directed to next module that is lower-case I or swipe to the left to go to lower-case G module. In the left corner of the scene, there are a button that direct user to the Getting To Know Lower-case Letter Selection once tap.

4.2.2.5 Tracing Capital Letters

Figure 4.11: Screenshot of Tracing Capital Letter Selection

If user choose Tracing Capital Letters in the Menu page, user will be directed to tracing capital letters selection. User can choose

letters for them to trace. This is because each dyslexic has different offenses in writing letters. Therefore, the letters selection page is created so that user has flexibility to choose their learning module. The Home button in the left corner will direct user to the Menu page.

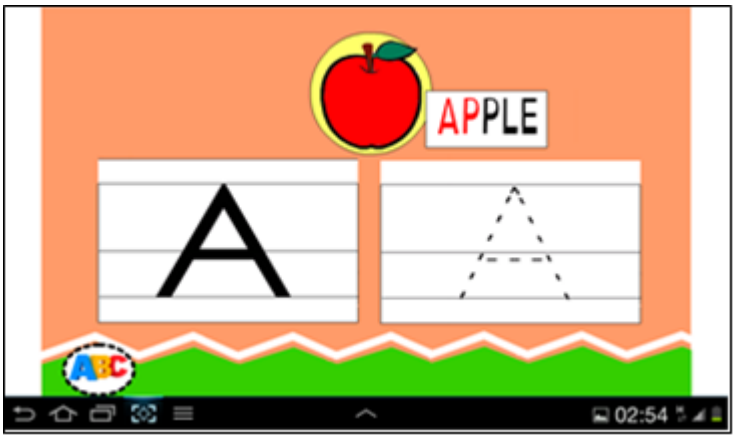


Figure 4.12: Screenshot of Tracing Capital Letter Module

In the learning module, there will be flashcard to show the object represent by the letter shown. It is to remind user on the previous learning module. In Figure 4.12, the letter to be traced is capital A. In the right side, there are animation on how to write capital A and in the left side, there are space for user to trace the letter. User are guided by dotted- lines to trace the letter.

When user enter the learning module, they can just swipe to the next scene and learning will be continue in sequences. As an example in figure 4.12, user can swipe to the right and the page will be directed to next module that is capital B. In the left corner of the scene, there are a button that direct user to the Tracing Capital Letter selection once tap.

4.2.2.6 Tracing Capital Letters

Figure 4.13: Screenshot of Tracing Lower-case Letter Selection

If user choose Tracing Lower-case Letters in the Menu page, user will be directed to tracing lower-case letters selection. User can choose letters for them to trace. This is because each dyslexic has different offenses in writing letters. Therefore, the letters selection page is created so that user has flexibility to choose their learning module. The Home button in the left corner will direct user to the Menu page.

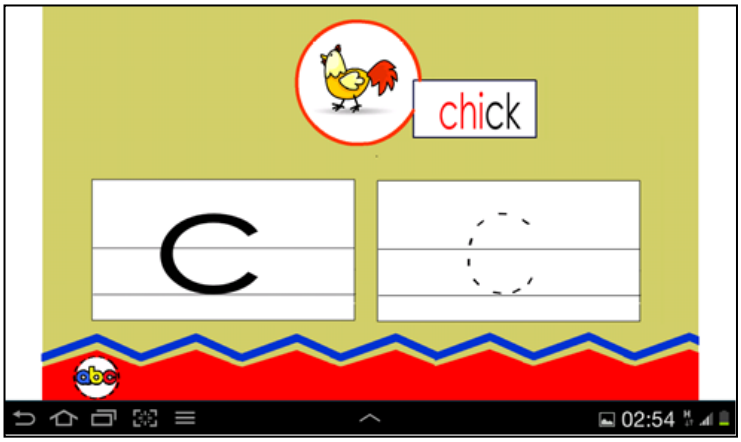


Figure 4.14: Screenshot of Tracing Lower-case Letter Module

In the learning module, there will be flashcard to show the object represent by the letter shown. It is to remind user on the

previous learning module. In Figure 4.14, the letter to be traced is lower-case C. In the right side, there are animation on how to write lower-case C and in the left side, there are space for user to trace the letter. User are guided by dotted- lines to trace the letter.

When user enter the learning module, they can just swipe to the next scene and learning will be continue in sequences. As an example in figure 4.14, user can swipe to the right and the page will be directed to next module that is lower-case B and swipe to the left and the page will be directed to tracing lower-case D. In the left corner of the scene, there are a button that direct user to the Tracing Lower-case Letter selection once tap.

4.2.2.7 Exercise

Figure 4.15: Screenshot of Exercise

If user choose Exercise in the Menu page, user will be directed to Exercise page. There will be simple exercise for user to enhance their learning for recognition.

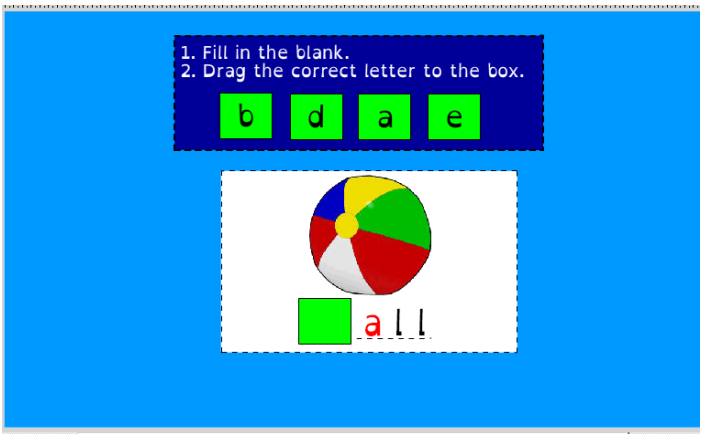


Figure 4.16: Screenshot of Exercise

In the exercise module, there will be simple exercise which require user to drag and drop the correct letter to the blank box. Clue or guidance are given for user to answer the exercise. The aim of the exercise module is to overcome short memory offenses in dyslexic as well as measure their performance.

The application is developed with dyslexia learning as a focus of the development. It follows requirements and needs of a dyslexic as discussed in preliminary surveys results. However, it needs to be testing to evaluate on the feasibility, acceptance and user-friendliness of the application. The testing to the target user, a primary dyslexic students age from 9 to 11 years old and gained feedbacks from students, teachers and parents. Feedbacks and comments need to be analyse and improvements are made for betterments.

CHAPTER 5
CONCLUSION

Dyslexia is a disorder that inhibits learning disabilities of students where it causes them to feel demotivated with learning and not attracted with schools. This learning disability can be overcome with suitable approach because dyslexics actually have normal or above average intelligence level compared with normal students.

Multisensory approach has been identified as one of steps of overcoming this disability. Multiple applications of sensors in teaching actively can help dyslexics in learning. Therefore, the Slingerland approach is proposed so that this structured multisensory approach can help dyslexics learn started from the basics like recognizing letters and matching letters with sounds and rhyme. As studies by Shaywiltz concluded that dyslexic will become poorly response when they are challenged with greater tasks so, Slingerland approach with principles of starting from smallest units and task given getting tougher according to their ability. Due to development on current mobile technologies, this paper are proposing on adoption of mobile learning as assistive learning module for dyslexia learning focus specially on alphabet learning.

Development of the application are reported in this paper as a reference and guidance for developers to continue on the recommendation and suggested improvements on the project. Author realised the importance of good work practice and project management in development of the project. Author has learnt skills of conducting qualitative surveys, interviews, managing task and resources of the project, managing debug and errors, report writing as well as development of the system through java language. These skills are importance and valuable for author to be applied in daily

life or during working. It is hoped that many people will be benefitted from this development.

It is hope that the developed system will benefited not only the dyslexic but also other children on pre-literacy learning as it is also suitable for literacy learning in toddler or pre-schools children. This new development hope to increase motivations of a dyslexic so that they are not left out in this fast growing world and it would enhance their enthusiasm towards learning with interactive and flexible environment. This is because dyslexia is a condition that can be treated with correct methods and a dyslexic is an individual that posses great intelligence in certain field especially creative and arts.

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APPENDIX 1

No	Activities	Deliverable/ Dates	Duration
			Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr
PLANNING & REQUIREMENTS GATHERING			
2	Preliminary Research		
3	Submission of Proposal of Research Cluster	Form 1 3rd Oct 2012	
5	**[FYP 1] Work In Progress:** 5.1 Problem Statement 5.2 Objective & Scope 5.3 Research Questions 5.4 Literature Review		
ANALYSIS & DESIGN			
7	**[FYP 1] Work In Progress :** 7.1 Literature Review 7.2 Methodology 7.3 Project Design		
9	**[FYP 1] Work In Progress :** 9.1 Report Writing 9.2 Result & Discussion		
10	**[FYP 1]** Extended Proposal Submission	Extended Proposal 24thOct 2012	
12	**[FYP 1] Work In Progress:** 12.1 System Design & Architecture		
13	**[FYP 1]** Proposal Defense	Presentation Slide 12th Dec 2012	

PROTOTYPE DEVELOPMENT																		
14	Design and Coding																	
15	**[FYP2]** Progress Report	24th Jan 2013																
16	**[FYP2]** Poster Presentation	20th Mar 2013																
	PROTOTYPE EVALUATION																	
17	Evaluation and Testing																	
18	User Testing																	
IMPLEMENTATION																		
19	Market Implementation																	