

Designing Mobile Application for Dyslexia in Reading Disorder Problem

Siti Khatijah Nor Abdul Rahim, Nur Hasni Nasrudin, Anis Zafirah Azmi, Rosida Ahmad Junid, Zainab Mohamed, Ini Imaina Binti Abdullah

To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v8-i1/3836>

DOI:10.6007/IJARBSS/v8-i1/3836

Received: 20 Dec 2017, Revised: 12 Jan 2018, Accepted: 15 Jan 2018

Published Online: 03 Feb 2018

In-Text Citation: (Rahim et al., 2018)

To Cite this Article: Rahim, S. K. N. A., Nasrudin, N. H., Azmi, A. Z., Junid, R. A., Mohamed, Z., & Abdullah, I. I. B. (2018). Designing Mobile Application for Dyslexia in Reading Disorder Problem. *International Journal of Academic Research in Business and Social Sciences*, 8(1), 619–636.

Copyright: © 2018 The Author(s)

Published by Human Resource Management Academic Research Society (www.hrmars.com)

This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this license may be seen

at: <http://creativecommons.org/licenses/by/4.0/legalcode>

Vol. 8, No.1, January 2018, Pg. 619 - 636

<http://hrmars.com/index.php/pages/detail/IJARBSS>

JOURNAL HOMEPAGE

Full Terms & Conditions of access and use can be found at
<http://hrmars.com/index.php/pages/detail/publication-ethics>

Designing Mobile Application for Dyslexia in Reading Disorder Problem

Siti Khatijah Nor Abdul Rahim¹, Nur Hasni Nasrudin², Anis Zafirah Azmi², Rosida Ahmad Junid³, Zainab Mohamed⁴, Ini Imaina Binti Abdullah²

¹Faculty of Computer & Mathematical Sciences (FSKM), Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia, ²Faculty of Computer & Mathematical Sciences (FSKM), Universiti Teknologi MARA, Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia ³Academy of Language Studies (ALS), Universiti Teknologi MARA, Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia, ⁴ Faculty of Civil Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.

Abstract

Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. Dyslexia is due to the disability and difficulty in recognizing or identifying the shape and sound of character. Dyslexia can hardly be cured as a result of neurological defect. Nevertheless, with early detection and effective teaching approaches, dyslexia persons can improve themselves in overcoming their problems. In Asia, it was estimated that about 15 percent of the children are having learning difficulties in some forms. Out of these children, 60 or 80 percent of them are suffering from dyslexia. In Malaysia, it has been estimated that up to half a million children in every generation are facing numerous types of dyslexia. It was discovered that a multi-sensory method, if it is adopted in the learning strategy, it could really help dyslexia persons. Various efforts have been made to help dyslexia students in overcoming their reading disorder problems, however it was made mentioned that a huge number of students suffering from this problem are still having trouble in reading properly. The objective of this study is to confirm the theory on Dyslexia in terms of the definition, characteristics of the people with Dyslexia specifically children, learning style of Dyslexia children and to identify the suitable and effective learning materials for Dyslexia children by doing research field works at selected schools and association. In our preliminary work, we have developed a prototype for a mobile application to assist reading in dyslexia children. The intention was to demonstrate the prototype to teachers, parents, and dyslexia children, in order to get their feedbacks and responds for future improvement. Based on the field works, we have obtained valuable information on the improvements that need to be

done on the proposed mobile application. The new requirements and characteristics of improvements have been presented in this paper.

Keywords: Learning Disability, Learning Materials for Dyslexia, Mobile Application Improvement.

Introduction

The word “dyslexia” is defined by English Oxford Living Dictionaries as “a general term for disorders that involve difficulty in learning to read or interpret words, letters, and other symbols, but that do not affect general intelligence” [7]. According to the International Dyslexia Association [8], dyslexia is defined as below:

“Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.”

Based on the two definitions above, it is clear that a person with dyslexia will have a reading disorder problem. Since reading is a fundamental skill for every student to succeed in learning, the problem of dyslexia students having trouble in recognizing, remembering and understanding a character during reading process are considered serious issues. In Malaysia, dyslexia problem is quite crucial. According to Subramaniam [18], based on the statistics reported by the International Dyslexia Association (2010), dyslexia are being suffered by about 10% - 15% of the world population. In his paper, Subramaniam [18] also stated that Ministry of Education Malaysia estimated about 314,000 children in Malaysia are suffering from dyslexia and it was made mentioned that one case of dyslexia is detected in every 20 students. The research done by Malaysia Harmonic Social Association (PSHM), found out that 10% - 15% of the primary school children are suffering from dyslexia problem. It was reported that 25% out of 2 million dyslexic persons in entire Malaysia are students [18].

Reading disability is seen as a major factor for learning disability, in which 80% of dyslexics are learning disable [10]. In many reports or research, the term dyslexia and reading disabilities are used interchangeably [10]. Various efforts have been made to help dyslexia students in overcoming their reading disorder problems, however it was made mentioned that a huge number of students suffering from this problem are still having trouble in reading properly. Literacy or reading and writing skill is the foundation of learning for primary education and upper levels, thus lacking of these abilities or skills will result in difficulties in attaining higher education [14]. Realizing that fast actions need to be done as soon as possible in helping these children to remedy their disabilities, this study is proposing to design a mobile application for dyslexia children in reading disorder problem. The study aims to confirm the theory on Dyslexia in terms of the definition, characteristics of the people with Dyslexia specifically children, learning style of Dyslexia children and to identify the suitable and effective learning materials for Dyslexia children by doing research field works at selected schools and association.

Literature Review

Background

Dyslexia happens due to the disability and difficulty in recognizing or identifying the shape and sound of character. The brain of dyslexia persons mixes and jumbles up letters and words they encounter and normally dyslexia persons have a poor memory of spoken and written words [3]. In 1986, W. Pringle Morgan, a general practitioner reported the very first case of dyslexia problem in a 14-year-old boy, who he described as a bright and intelligent boy, but somehow was unable to read [17]. According to Morgan [17] dyslexia can hardly be cured as a result of neurological defect. Nevertheless, with early detection and effective teaching approaches, dyslexia persons can improve themselves in overcoming their problems.

Recall that according to the definition given in the previous section, the problem in dyslexia person does not affect their general intelligence. This is supported by a statement by Brain Foundation: *“Although the outlook for people with dyslexia depends on the severity of the disorder, the majority live normal, productive lives”* [12]. In the world of science for instance, there were many well-known people with dyslexia who have contributed their knowledge and ideas which have benefitted the world, for example, Alexander Graham Bell, who invented the telephone, Steve Jobs co- founder of Apple Inc., and Albert Einstein a physicist who developed the general theory of relatively.

In Asia, it was estimated that about 15 percent of the children are having learning difficulties in some forms. Out of these children, 60 or 80 percent of them are suffering from dyslexia. In Malaysia, it has been estimated that up to half a million children in every generation are facing numerous types of dyslexia [18].

According to the literature, it was discovered that a multi-sensory method, if it is adopted in the learning strategy, it could really help dyslexia persons. The teaching or learning strategies here refer to teaching the dyslexic persons to learn spellings not as the normal way they were done, i.e. only by hearing and saying the sounds of the letters, but by utilizing their tactile and visual memories. For instance, the dyslexia persons are encouraged to write letters on a surface other than paper such as carpet or sand, and writing the letters in the air or using clay. Through this method, their brain can have a tactile and visual memory of the word, as well as the memory of the sounds of the letters. Sometimes in learning how to write and spell, dyslexia persons are trained to write joined letters or practice joined handwriting on a large piece of papers. According to Liz Burton [11], this approach is very effective such that it helps the brain to remember the arrangements of the letters in a word.

Besides the creative teaching and learning strategies mentioned above, recent research reveals that with the advancements of information and communications technologies, smartphones and tablets have become the favorite devices in learning, among the majority of dyslexia persons. Overwhelmingly, a website on the internet (<http://www.app4learning.com/>) suggested about 45 apps using IOS platform support the learning strategies mentioned. In all these apps, English is widely used, and only a small number of apps are using Malay language. This trend is making sense since English is the mostly chosen or regularly used by the Apple users.

Based on our literature search, downloadable apps that are using Malay language as the medium are very limited. The apps are BacaMAX and D_mic (Dyslexia Mobile Interactive Comic) [4], [5]. Apparently, these apps are neither not focusing on applying the multi-sensory learning strategy, nor enhancing the writing skills, whereas they are just focusing on the phonics or sound of the character.

Common Characteristics of Dyslexia Person

There are many common characteristics that are exhibited by dyslexia persons. However, dyslexics often are inconsistent in their traits or behaviors, thus changes in characteristics can be observed from minute to minute or day to day. The characteristics can be categorized into general; vision, reading and spelling; hearing and speech; writing and motor skills; math and time management; memory and cognition; and behavior, health, development and personality [13]. In this study, since the focus is on reading disorder, therefore characteristics that will be described herein are general; vision, reading and spelling characteristics; and writing and motor skills.

In terms of general characteristics, dyslexics appear bright and have high Intelligence Quotient (IQ), but they are unable to read, spell or write at an early age. They are sometimes labelled lazy, careless, immature and 'not trying hard enough'. They have difficulties in maintaining their focus or attention, thus are easily get lost and often seem to be daydreamer. Most of dyslexics are talented in art, drama, sports, music, designing and story-telling. They learn best through hands-on experiences and activities [13].

For the visioning, reading and spelling characteristics, dyslexics can be seen struggling with activities involving these doings. They seem to have difficulty with vision, but surprisingly eye exams with the optometrist do not reveal any problems. Dyslexics are confused by letters, words, numbers, sequences or even verbal explanations. They often complain of headaches, dizziness and stomach aches while reading. Reading or writing shows repetitions, transpositions, additions, omissions, substitutions, and reversals in letters, numbers, and/ or words. Any readings done will always understood with very little comprehension. Spellings are usually done phonetically and inconsistently [13].

Writing and motor skills are another challenge for dyslexia persons. They have problems with writing or copying. Holding pencils are always appearing as problems to them, especially in gripping. Their handwritten always varies (not consistent). In terms of their motor skills, they are very uncoordinated and sort of clumsy, i.e. having difficulties with fine and / or gross motor skills or tasks [13].

Efforts in Improving Literacy Skill in Malaysia

In Malaysia, various efforts have been made to help in improving literacy skill in children at an early stage. According to Jabatan Pendidikan Khas (JPK), Malaysia, there are quite a number of schools involved in the (LINUS) programme, namely the Literacy and Numeracy Screening. This program was introduced by the Malaysian government in 2010, with the aim to ensure that all Malaysian children acquire basic literacy skill and numerical skill after the first three years of the primary education. The screenings for written and oral are conducted by the school teachers in

March, June and September yearly. The instruments for the screenings composed of 12 constructs which are prepared by the Malaysian Examinations Syndicate. During the screenings, teachers are permitted to provide guidance to students by giving examples and rewording questions. The students who fail the screenings will have to attend remedial classes for literacy and numeracy of 10 weeks and 7 weeks respectively. Students who failed the construct 1 and construct 2 are classified as LINUS Tegar (hardcore) and they are required to attend remedial classes. So far, the outcome of the LINUS programme are very encouraging, where significant improvements in students' performance can be seen [14] [15].

Another effort made by Jabatan Pendidikan Khas (JPK), Malaysia is by introducing the 'ISD', an acronym for Malay term '*Instrumen Senarai Semak Dyslexia*'. This effort is dedicated to do screenings on school children to identify whether a student has a possibility of having a dyslexia problem. Normally, the students who failed the LINUS screenings will be screened using the ISD instrument. Early detection of students having dyslexia problems can be detected via this instrument [16].

Preliminary Work

Prototype Development of a Mobile Application to Assist Reading

In our preliminary work, we have developed a prototype for a mobile application to assist reading in dyslexia children. The intention was to demonstrate the prototype to teachers, parents, and dyslexia children, in order to get their feedbacks and responds for future improvement.

In brief, the mobile app was named CInTA (a Malay acronym for Cara Interaktif Tulis Abjad). The main features provided by the app are modules to learn alphabets and writing. The app was developed based on the understanding that children with writing ability have higher chances to recognize any alphabets and therefore will be able to read earlier than those who are unable to write [2]. We believe that by improving the writing ability of the dyslexic children, specifically in writing alphabets, the children can improve their recognition towards the alphabets or letters and therefore will eliminate or at least reduce the reading disorder problem.

Some of the important interfaces of the app are illustrated in the following figures below. Figure 1 and Figure 2 show the special writing techniques demonstrated in the app via video, in which, letter 'C' and letter 'l' are used as the base in writing another alphabet or character. For example, starting from the shape of letter 'C', it can be further 'evolved' into letter 'a' and 'd'. Another example is the 'l' letter was the base of writing other alphabets such as 't', 'p' and 'b'. These techniques are the most effective techniques in teaching writing skills for dyslexia children [2].

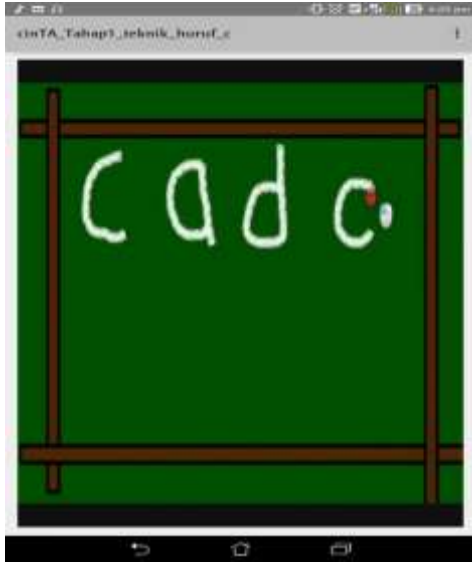


Figure 1: App demonstrating a writing technique which start with “c” shape. From “c” shape it became “a”, “d”, “g” and “q”.



Figure 2: Demonstrating a writing technique which start with “l” shape. From “l” shape it became “t”, “p”, and “b”.

In the next few figures (Figure 3 until Figure 6), interfaces for learning alphabets module are illustrated. In this module, the children can learn alphabets which were categorized according to ‘vokal’ (vowel) and ‘konsonan’ (consonant). In each category, the audio of the sound and phonics of the alphabet will be played to the children.



Figure 3: Welcome Interface To Learn Alphabets

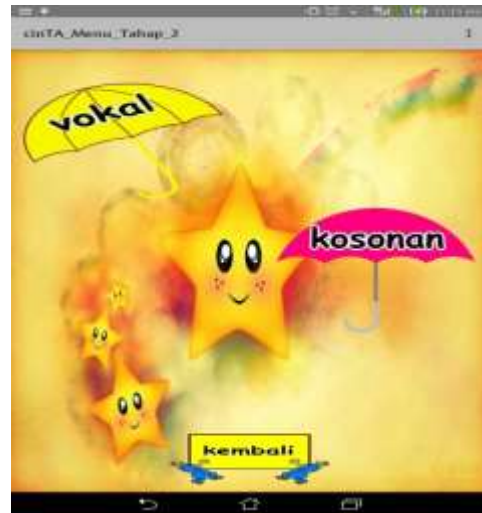


Figure 4: Two Categories of Alphabets: Vowel and Consonant



Figure 5: Demonstration of Writing the Chosen Vowel Alphabet Assisted with the Audio of Sound and Phonic



Figure 6: Demonstration of Writing the Chosen Consonant Alphabet Assisted with the Audio of Sound and Phonic.

Field Work (To Confirm the Insights Gained from the Literature and Initial Understandings)

In order to design effective learning materials for dyslexia children, we have conducted some field works which include interview sessions at a special school, hospital, and Dyslexia association. This is with the objectives in mind to gather as much as information through real experiences among teachers, parents, children or students, doctors, and some experts, that can be used as input in designing the learning material for dyslexia with reading disorder problem.

In the early stage of this research, we have conducted a few interview sessions to obtain the real pictures of the reading disorder problem in dyslexia persons. We intend to get this information from the people that have real experiences in dealing closely with dyslexia persons. As such, we have arranged to conduct some interviews with teachers at a special school that has dyslexic students, namely Sekolah Kebangsaan Ahmad Tajuddin in Kedah. Apart from that we have also done some interviews with teachers, parents and principal at Dyslexia Association in Ampang, Selangor. Besides, an interview was also carried out with a pediatrician who is specialized in dyslexic children at Hospital Ipoh in Perak.

Interview Session at Sekolah Kebangsaan Ahmad Tajuddin, Kedah, Malaysia.

Sekolah Kebangsaan Ahmad Tajuddin, Kedah, is one of the school in Malaysia that is involved with Dyslexia Programme, initiated by Ministry of Education, Malaysia. During a visit to the school recently, we have managed to interview the teachers who are responsible in managing and teaching students with dyslexic problem at the school. According to the teachers, as of July 2016, there were 10 students with dyslexic problem at that school, whom were identified through the ISD test. We were informed that the number of students normally will increase after conducting

the ISD test. From the interview conducted, the teachers confirmed that learning strategies in a 'multi-sensory' method can really help the dyslexic students, in which visual and tactile memories are used.

Interview Session with Paediatrician at KPJ Specialist Ipoh, Perak, Malaysia

In order to understand dyslexia in terms of medical perspective, we have also conducted an interview with a paediatrician, Dr Wong Woan Yiing, at KPJ Specialist Ipoh, Perak. According to her, dyslexia is a hereditary disease. Dyslexia persons use different brain area while reading or viewing graphics. Thus, dyslexic person normally sees the objects or images differently from a normal people. We were informed that reading disorder problem in dyslexic persons can only be reduced or resolved by frequent trainings. Suitable trainings are needed to train their brains to work properly. There are no specific medications to cure or resolve the disorders in dyslexic persons. Interestingly, despite the disorders that they have, Dr Wong emphasized that dyslexia persons are not disable persons, due to fact that they can live a normal life just as normal people. In fact, as mentioned before, their general intelligences are at par or sometimes even better compared to normal persons.

Based on Dr Wong's real experiences, she has observed that dyslexic students who mixed around and learnt together with normal students have higher potential to overcome their disorder problems faster. Therefore, the action taken to separate dyslexia students from normal students is not really a good idea. During the interview, we have told Dr Wong about our intention in helping people with dyslexic problems, in particular, dyslexia children in reading, by developing a mobile application. She strongly supported the initiative and suggested us to refer to a book entitled "Early Literacy Skills" written by Angella Fawcett which consists of the recommended activities and proposed suitable learning strategies in helping people with dyslexia problems in overcoming their reading disorder problems. Dr Wong has also given an example of a dyslexia person who has proudly become a successful specialist or senior pediatrician, Dato Dr Amar Singh, HSS, in Ipoh General Hospital, Perak. Dato Dr Amar Singh is also the President of National Early Childhood Intervention Council (NECIC).

Interview Sessions with Parents, Teachers, and Principal / Founder at Dyslexia Association, Ampang, Selangor, Malaysia

Apart from the interviews conducted at a special school and hospital, we have also conducted another interview at Dyslexia Association in Ampang, Selangor. We have managed to interview the principal or founder of the association, teachers, and parents of the dyslexia students.

According to Puan Sariah Amirin, the principal and the founder of Dyslexia Association in Ampang, the association was started in 1998. This was before the association has a physical building. At that time, Puan Sariah and the members of the associations had regular meetings on the missions, visions, and directions of the associations. After a lot of hard works and hurdles, the first center was successfully started in Titiwangsa with only 6 students in April 1999. So far, the program offered by the association in helping to remedy the disabilities in dyslexia children are very successful. Normally 90% of the students managed to eliminate problems with literacy

and numeracy skills by attending the program at the center. Proudly to mention, one student from the first batch is now a successful pilot.



Figure 7: During the Interview Session with Puan Sariah Amirin, Principal and Founder of Dyslexia Association, Ampang, Selangor

Puan Sariah mentioned that the number of dyslexia children is raising, and this situation is very worrying because it reflects their future. Up to 2017, the association has received many enrolment of dyslexia children yearly due to the awareness of Malaysian society on the importance of giving trainings and treatments to remedy the disabilities of the dyslexia children as soon as possible, i.e. at an early stage. The association has a strong passion in promoting general awareness to parents and teachers on the dyslexia problems, so that the problems and the needs of the children can be understood better. As such, the association is actively giving talks to parents and teachers, and also trainings to school teachers to help them detect dyslexics children at an early stage.

From the interviews and discussions made, we were informed that dyslexia children are sometimes having other problems, for example hyperactive and autism. Therefore, it is quite challenging to control these kids during lessons in class. According to most of the parents, they were not aware about the dyslexic problems in their children, not until they realized that their children are not able to converse properly and having difficulties in identifying letters and reading (normally between the age of 6 to 9 years old).

Puan Sariah Amirin made mentioned that all (100%) of the children enrolled at the association are having reading disorder problems. One the interesting insights that we gained through the interview is that dyslexics children should be taught on how to read first before they are being taught on how to write. This information is a totally different from our initial understandings and assumptions of the order of the teachings. Recall that in our proposed prototype of the mobile app, we emphasized on improving the writing skill, with the hope it could help them to read better. The reason given by Puan Sariah on why reading should come first before writing is mainly because many dyslexics people have problems with their motor skills. Thus, some cannot even hold the pencil properly. We were informed that all the students at the center are equipped with rubber gadget (as depicted in the figure below) to help them hold the pencil properly. The teachers will ensure that the students will not hold the pencil too high or too

low, because the former will cause the handwriting to be very big, and the latter will cause the handwriting to be very small.



Figure 8: Rubber Gadget to Help Holding the Pencil Properly

Based on the principal, practically, dyslexics children must learn how to read before they are able to write. The rationale behind this is that, if the children are able to read then they will love to write. If the children cannot read, they will think why bother writing. One of the initiative taken by the center in teaching children to read is by using a 3D (three dimensional) board of alphabets. Each alphabet will be associated with a sound; therefore, it will be easier for the children to remember. However, some dyslexics children when it comes to phonics, they are unable to give the sounds of the alphabet. Therefore, during revision the teachers will ask them to point which alphabet gives certain sound, instead of asking them to give the sound of a certain selected alphabet. This is considered acceptable because according to her, knowing is more important than able to point to.



Figure 9: 3D Alphabets Used in Teaching Alphabets to Dyslexia Children

Another interesting finding from the interview that we obtained is the strategy performed by the association in teaching the kids on how to spell. They will start of by selecting an alphabet and pronounce the phonic, and will continue the process for a few alphabets. For instance, alphabet 'b', 'a', 'j', and 'u' are selected and the teacher will ask the kids to guess the sound of

the word 'baju' based on the individual sound of the phonic for each alphabet. Then, they will ask the kids how to obtain the sound of the word 'batu', in which the sound of alphabet 't' can be heard has replaced the sound of the alphabet 'j'. Normally kids will be very excited to use the 3D alphabet to change from one alphabet to the other, depending on the new word given by the teacher. From the word 'batu', kids can be asked on how to spell the word "batuk". Immediately when hearing the sound of the 'k' at the end of the word, they can straight away know that alphabet 'k' need to be added to the original word. It is worth noting here that, according to Puan Sariah, in introducing new words to the children, never change one word to another word which is totally different in the alphabets, for instance, from the word 'baju' to the word 'meja'. Instead, just change an alphabet at a time, for example, from the word 'baju' to the word 'satu', in which only a letter is replaced from the original word. This will give a better excitement and motivation to the kids to learn words in a simpler way. Based on the teachers' experiences at the association, many kids went home happily telling their parents on their achievements in learning a few words (using the mentioned strategy) at a particular class session. It has been observed that the children also tend to remember the words better. Table 1 lists some examples of the formation of some new words from the original word, by substituting one alphabet with another alphabet.

During the interview, we have informed the principal, teachers and parents about our intention to develop a mobile application in helping students or children with dyslexia to improve their reading capability. All of them gave a very positive feedback and supported the idea. They agreed and believed that the mobile application could provide an interactive learning environment and it has an advantage in terms of the portable feature, in which training or teaching the kids could be done at anytime and anywhere easily.

Anyhow, despite the good features provided by the proposed app, we were informed that the learning alphabet module was not really suitable for them. Categorizing alphabets into alphabets and consonants (as depicted in Figure 4, 5 and 6) does not really help in teaching dyslexics children. There is another effective way of grouping the alphabets, in which the alphabets should be grouped according to the structure or shape of the alphabets, for instance, 'c', 'o' and 'a' should be grouped together, whereas 'd', 'g' and 'q' should be in another group. There are other groups of alphabets as listed in Table 2.

On another note, teachers at the association who have been dealing closely with the dyslexia students through their daily activities in managing, teaching, assisting and coaching the children have given us very valuable inputs in improving our mobile app. These inputs will be outlined and discussed briefly in the Finding section.

Findings from the Field Work

From the field works that have been accomplished, some valuable tips and inputs were obtained which will be used as the base in designing and developing the mobile application. Based on the understandings and findings obtained, the followings are the suggested characteristics that can be employed in developing the mobile application specifically for helping dyslexia children with reading disorder problem:

a) Introducing New Words to Dyslexia Children

As mentioned in the previous section, the effective way to introduce a new word to dyslexia children is by substituting an alphabet with another alphabet. This strategy is more effective and is much enjoyed by the kids. Recall that do not introduce a new word which have a totally different alphabets and different arrangements from the previous introduced word.

Table 1: Examples of Suggested and Not Suggested Sequence of Words When Teaching New Words to Dyslexia Children

Word	Sequence of Words (Suggested)	Sequence of Words (Not Suggested)
1	laju	laju
2	baju	bunga
3	batu	daun
4	batuk	burung
5	datuk	laut

The above table illustrates the sequence of words to be taught to the students during class session. The middle column has a better effect on student since it is less confusing because only an alphabet is changed at a time. Students are normally excited with this strategy and have a kind of satisfactions when they managed to learn a few words in a short amount of time in just a simple single alphabet substitution. On a contrary note, the third column clearly shows that the transition of one word to another is a total change. According to Puan Sariah, this will not give any benefits to the kids, rather it will cause confusion and stress to them because the arrangements of alphabets are totally different. This is hard to be accepted by slow learners like them.

b) Grouping of Alphabets

Alphabets should be grouped according to the structure or shape of the alphabet as shown in Table 1. This is the best way for the students to recognize and remember the alphabets better.

Table 2: Alphabets group suggested by Puan Sariah.

Group	Alphabets
1	c, o, a
2	d, g, q
3	e
4	l, j
5	l, t, f
6	l, h, k
7	s, z, x
8	r, n, m
9	u, y, v, w
10	b, p

Other characteristics, requirements and features that need to be considered and implemented in our next improved mobile apps are:

- i. All alphabets or letters in any activities in the mobile application need to be separated and showed separately to the children.
- ii. *Comic Sans MS* is suggested to be the most suitable font type.
- iii. Usage of phonics is encouraged for each alphabet.
- iv. Example for an alphabet should not exceed 5 sentences (if sentences are constructed to demonstrate usage and meaning of alphabet)
- v. Music used as background during learning is encouraged
- vi. Background colour for the mobile application should be from light or soft colour. Red colour should be avoided as the background.
- vii. If any images or icons need to be used, it must be ensured that they are not put at one corner only to avoid the users to be tend to focus more on certain corners only.
- viii. Do not ever use discouraging statements in the application such as "Sorry, your answer is wrong!" or "Wrong", but instead always use encouraging statements such as "Oops, try again!".
- ix. Tips to get dyslexia children's attention during learning is by getting them participated in 5 minutes learning and then 5 minutes activity or assessment alternately.
- x. It is suggested by the teachers and parents to develop a mobile application in Bahasa Melayu (Malay Language), since currently the number of mobile apps using this language is very few.
- xi. Any assessments designed for the children in the application are suggested not to be too difficult. They should be very clear and simple.
- xii. Examples of common type of instructions during quiz which are highly encouraged for the dyslexia students are for instance: "Tap on the letter that has the phonic sound....", "Draw the alphabet for.....", and "Match the name with picture correctly".
- xiii. Learning or assessment activities using puzzles are not encouraged for the dyslexia children because based on observations they tend to be easily get bored through those activities.
- xiv. Any texts shown in the app should come together with audio to assist them in understanding the instructions or notifications
- xv. Any instructions or notifications meant to be given to the kids, for instance "*Sila tekan butang*" (Please click the button) or "*Tahniah!*" (Congratulations!) should use a cheerful voice to maintain their interests and focus

c) Writing Module

If the proposed app is offering a writing module to help the children to improve their writing skill, then the app should provide a mechanism to control the size of the handwriting. In the conventional way, their writing can be controlled through the rubber gadget (as depicted in Figure 8). Thus, in the proposed app it is suggested that the chalk board should have a moderate size, to train them to write properly with a moderate handwriting size.

d) Improving Reading Through Short Story

We have listed the suggested statements to be included in the mobile app under the short story module that is hoped will encourage reading habits among the children. However, after going through some vetting process by the principal and some teachers at Dyslexia Association, Ampang, they have proposed a totally different set of statements as in Table 3.

Table 3: A Comparison of Some Proposed Statements by Our Team and the Final Proposed Statements Approved by Dyslexia Association, Ampang Representative.

Original Proposed Statements	Final Proposed Statements
Ini Abu. Abu ada adik. Adik Abu ada ayam. Abu bakar ayam. Adik dan Abu makan ayam bakar.	Abu ada ayam. Ayam atas atap.
Saya suka main bola. Bola saya bola biru. Bola biru saya besar. Bola biru dalam bakul.	Borhan ada bola. Bola Borhan biru.
Cikgu saya cantik. Cikgu minum dari cawan. Cikgu suka ciku. Cikgu takut cicak.	Cici cuci cawan. Cawan Cici cantik.
Didi suka duku. Didi kumpul duit. Bila duit ada, Didi beli duku.	Didi dalam dapur. Dapur Didi ada donut.
Emak saya cantik. Emak potong epal. Epal itu merah. Empat orang makan epal.	Epal ini enak. Emak ada enam epal.
Gergasi ini gagah. Gergasi suka gasing. Gergasi tinggal di dalam gua. Gua gergasi di atas gunung.	Gopal pergi gua. Dalam gua ada gajah.
Ini harimau bintang. Harimau tinggal dalam hutan. Harimau garang. Harimau kuat.	Hati-hati di hutan. Hutan ada harimau.

Intan ada ikan. Ikan boleh dimakan. Ikan boleh berenang. Intan suka makan ikan.	Intan ada itik. Itik Intan comel.
Jaja ada jam. Jam Jaja baru. Jam Jaja warna biru. Jaja beli di kedai.	Jojo beli jeli. Jojo beli jeli dan jam.
Pak Leman bela lembu. Lembu dalam ladang. Lembu suka lari. Bila lapar lembu makan.	Lili lukis lembu. Lembu lari laju.
Mamat suka masak. Mamat masak ikan. Mamat makan ikan. Mamat gembira.	Mimi masak maggi. Mimi masak maggi kari.
Nabila naik basikal. Nenek marah Nabila. Nabila bawa laju. Nabila jatuh basikal.	Nenek masak nasi ayam. Nasi ayam nenek enak.
Ombak sangat kuat. Omar main ombak. Omar lambung tinggi. Omar rasa takut.	Opah makan oren. Oren opah masam.
Pak Samad beli paku. Paku boleh buat pondok. Dalam pondok ada pisang. Pisang warna kuning.	Papa paku papan. Papan itu patah.

According to the statements suggested by the representative of the Dyslexia Association, it was learnt that the sentences are simple, short, in which there are fewer lines of statements as compared to those suggested by our research team. These newly proposed statements also are somewhat catchy and some have a sense of humor element. According to the representative from the association, this is important to attract the interests of the children, and most importantly they are able to comprehend well, as a result of using simple words or sentences. By having a good understanding of the meanings of each sentence, the kids usually are inclined

towards repeating the statements and thus indirectly can improve their confidence level and conversations skills.

Based on the in-depth discussions with Dyslexia Association in Ampang, we have agreed to develop a mobile application to help dyslexia children to read Malay texts, since as stated previously the number of mobile applications developed to teach Malay language is very scarce. As such, we have come to an understanding to develop a Malay version mobile application that will cater all the characteristics mentioned above. A complete storyboard will be prepared and presented to the teachers at this association in order to get feedbacks and with the aim to ensure the suggested requirements are fulfilled.

Conclusion

Realizing that the number of dyslexia children at a primary level is increasing and their disabilities in reading can lead to learning disabilities, the research teams believe there is a serious call to assist them in improving their reading skills. This is really important because failing to have good reading skills can reduce the capability in attaining education at higher levels. The main objective of this study is to propose a mobile application for dyslexia children in reading disorder problem. The research done is to confirm the theory on Dyslexia in terms of the definition, characteristics of the people with Dyslexia specifically children, learning style of Dyslexia children and to identify the suitable and effective learning materials for Dyslexia children by doing research field works at selected schools and association. In our preliminary work, we have developed a prototype for a mobile application to assist reading in dyslexia children. We have demonstrated the prototype to teachers, parents, and dyslexia children, in order to get their feedbacks and responds for future improvement. Based on the field works, we have obtained valuable information in terms of the requirements and characteristics that can be incorporated in designing the mobile application. In the next stage of the research, it is hoped that by developing the mobile app based on the insights gained through the literature review and the field works, the dyslexics children can benefit from it and their reading skills can be improved significantly. By having the app, with the help of their tactile and visual memories, it is expected that reading and learning can be done just at a fingertip, anytime and anywhere, even outside classrooms sessions.

Acknowledgement

This work is financially supported by the Ministry of Education Malaysia and Universiti Teknologi MARA, Malaysia under iRAGS grant scheme with the number 600-RMI/DANA/ 5/3/IRAGS (51/2015).

Corresponding Author

Siti Khatijah Nor Abdul Rahim, Faculty of Computer & Mathematical Sciences (FSKM), Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia.
Email: sitikhatijahnor@tmsk.uitm.edu.my.

References

Devaraju, A., Yusoh, Z. I. M., Zakaria, M. H., Techanamurthy, U., Bastiaens, T., & Carliner, S. (2017) MyLexic: An Assistive multimedia courseware for teaching and reinforcing basic reading

- skills among Dyslexics. In Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education., 2017, 7058-7063.
- Høyen, T., & Lundberg, I. (2000). What is Dyslexia?. In *Dyslexia: From Theory to Intervention* (pp. 1-20). Springer Netherlands.
- Husni, H., & Jamaludin, Z. (2013). Let's Play with Colours: BacaMAX User Interface for Dyslexic Children. In *International Visual Informatics Conference* (pp. 253-263). Springer, Cham.
- Umar, R. S., & Abdul Rahman & Mokhtar, F. (2010). D-Mic: A mobile learning application for dyslexic children. *Malaysian Journal of Mobile Learning*, 1(1), 1-15.
- Definition of dyslexia in English, *English Oxford Living Dictionaries*, [Online] Available at <https://en.oxforddictionaries.com/definition/dyslexia>
- Definition of Dyslexia, *International Dyslexia Association*. [Online] Available at <https://dyslexiaida.org/definition-of-dyslexia/>
- Dyslexia, *Health and Wellness*. [Online], Available at https://www.blueshieldca.com/bsca//hw/articles/hw_article.sp?articleId=HWTE7211
- Dyslexia and the Brain: What Does Current Research Tell Us?, [Online], Available at <http://www.ldonline.org/article/14907/>
- Dyslexic.com, [Online], Available at <https://www.dyslexic.com/blog/category/dyslexia/>
- Dyslexia: Symptoms, treatments, and diagnosis, [Online], Available at <https://www.medicalnewstoday.com/articles/186787.php>
- Dyslexia matters. [Online], Available at <http://www.dyslexia-matters.com.au/dyslexia-characteristics.html>
- LINUS programme for early learning, [Online], Available at <https://www.thestar.com.my/news/nation/2012/09/05/linus-programme-for-early-learning/>
- Program Transformasi Negara. [Online], Available at https://www.spad.gov.my/sites/default/files/bm_pemandu_ntp_ar2015_260416.pdf
- ISD INSTRUMEN SENARAI SEMAK DISLEKSIA MANUAL, [Online], Available at <https://www.moe.gov.my/index.php/my/pendidikan-khas>
- Shaywitz, S. E. (1996). Dyslexia: A new model of this reading disorder emphasizes defects in the language-processing rather than the visual system. It explains why some very smart people have trouble learning to read. *Scientific American*.
- Subramaniam, V., Mallan, V. K., & Mat, N. H. C. (2013). Multi-senses explication activities module for dyslexic children in Malaysia. *Asian Social Science*, 9(7), 241.