

Developing Reading Skills Using Sight Word Reading Strategy through Interactive Mobile Game-Based Learning for Dyslexic Children

Noor Hazlini Borhan, Hamizan Sharbini*, Chiu Po Chan, Azlina Ahmadi Julaihi

Faculty of Computer Science and Information Technology,

Universiti Malaysia Sarawak,

94300 Kota Samarahan, Sarawak, Malaysia

bnhazlini@unimas.my, shamizan@unimas.my

Abstract

Reading skill is crucial in our daily activities. On the other hand, there are some people who experience difficulties in reading. This is due to the way they see things are different than normal people. This learning disability is known as dyslexia. The symptoms started from young. Children with dyslexia use all of their senses to interact with their surroundings. They are easily attracted to pictures rather than words and are highly imaginative. In this project, a mobile application to help children with dyslexia to develop reading skills is proposed. This paper will discuss about the development of the mobile application. The methodology used in this project will be discussed along with the implementation and testing. The results have shown that respondents gave positive feedbacks prove that the application is effective in developing reading and spelling among dyslexic children. Lastly, limitations, future works and conclusion of the overall project will be discussed. The mobile application is named as "Mr Read".

1. Introduction

Dyslexia is a referring term for learning disabilities within reading, writing and spelling. Children with dyslexia use all of their senses to interact with their surroundings. They are easily attracted to pictures rather than words and are highly imaginative. A good reading skill is gained from the ability to recognize words and decoding the word [1]. Children begin to read by recognizing the whole words and later gradually become aware of the relationship between the letters and sounds presented. There are various approaches to develop a reading success for dyslexic children including repeated reading, sight word drills, development of vocabulary and semantics, and increase speed of processing letter and syllable pattern. Sight words provide an excellent foundation for reading as the higher frequency of child see the word the more they able to recognize and understand the meaning of the word as a whole. Nowadays, technologies such as smartphones and tablets have become our necessity to improve our life style. Therefore, in this project, mobile game-based learning applications will be develop for children with dyslexia to help improve their educational learning. By using mobile devices, they can access the lessons easily and practice at anywhere they want. Implementation of multimedia elements will be integrated into the application to make the learning environment become more attractive and interactive for this group of children.

1.1 Problem Statement

1.1.1. Dyslexic children having problem in expressing their feelings or ideas both orally and writing.

One of the challenges faced by dyslexic children is their difficulties in expressing their feelings or ideas both orally and writing. This is due to the lack of vocabulary growth, causing problem in recognizing letters, sound and meaning of the word as a whole. Children who were diagnosed with dyslexia are referred as an individual

that suffer a condition of word blindness [3]. This means that when a child is seen to spell word wrongly, this indicates that the child suffers a condition of dyslexia.

1.1.2 Dyslexic children who experience learning difficulty also have low self-confidence.

The learning development of dyslexic children is slower than the normal children do causing them to hardly understand and catching up the lessons in class. When there are given tasks, they tend to do a lot of mistakes in the tasks because they do not understand the question. In addition, they are too shy to ask questions to instructor. If this situation continues, they might give up on learning especially in reading. If they receive appropriate resources and support, they are able to blend into their circle of friends and subsequently enhance their inner self.

1.1.3 Reading application that is specially developed for dyslexia is limited

There are still quite a few applications that are specially developed for dyslexic children. Current mobile applications for dyslexia are mostly based on phonics awareness approach and sight words flash cards to teach basic reading. In addition, story-based application does exist in current mobile application store. However some of the features are not suitable for dyslexics. For example the use of font type and background color is not suitable for dyslexics. The solution proposed in this project is by improving their reading skills using sight word reading strategy. In attempt to help dyslexic children to gain their learning spirit and improve their vocabulary as part of their reading development, sight word strategy is use in a fun context through different reading platform. In this project, short story, rhyme and song lyric will be applied.

2. Literature Review

2.1 Sight words and dyslexia

Sight word reading is particularly important for reading English because one-third of written English words such as yacht and great do not follow the letter sound rules, thus, these words have to be learned by sight [4]. Children build up their sight words vocabulary starting from kindergarten. Each stage has a number of sight word lists that are to be memorized and recognized by children. As the children grow, the level of difficulty in terms of syllables and number of words will increase.

Students with learning disabilities and dyslexia are better using sight word since beginning to improve their ability to recognize words and this will likely help him or her with the overall reading speed, accuracy and comprehension [5]. When readers able to recognize words by sight, this will increase their overall reading comprehension as they develop a word bank and their meanings that helps them to understand other words in sentences context [5]. Learning sight words also enhances spelling skills. There are two lists of commonly used high-frequency sight words that are taught to new readers; The Dolch List and Edward Fry List.

In this project, the target age of dyslexic children is from 7 to 9 years old, which in grade 1 and 2. This project will be using Dolch List of Basic Words for grade one and grade two children. Dolch list is widely used and was created in 1936 by William Edward Dolch. It comprises words that need to be easily recognized to achieve fluency in reading. Many of these words cannot be learnt by using pictures or sounded out using phonics. This leads to the term sight words.

2.2 Proposed Solution

Current sight word applications mostly implement direct sight words and games such as flashcards and memory games. There is still limited number of application that features sight word in form of story-based or comprehension approach for dyslexics. Therefore, this project will implement sight words into three types of reading platforms, through short story, rhyme and song lyric. These reading platforms contain a controlled vocabulary set, using the most frequent words encountered in print. The stories will reinforce sight words in sentences rather than in isolation.

Meanwhile the games will test the dyslexics' understanding upon the previous reading in fun environment. Reinforcing sight words in sentences ensures them to make a meaningful association with each word and they are more readily to commit the words in memory. Dyslexic children can read sight words which will be highlighted within the text while enjoying the reading. Each sight words will come with audio to promote spelling and practice read aloud. The Auto Read feature can be enabled or disabled. This feature is to model fluent reading and can be disabled once the user able to read independently. The different reading platforms will give dyslexic children variety learning approach to develop reading skill other than phonics awareness and traditional flashcards, which are very common nowadays.

Proposed features that will be implemented into the project:

- i. Tap each word on a page to help struggling readers listen back the word
- ii. Offers spelling of the sight word
- iii. Vocabulary controlled stories
- iv. Uses OpenDyslexic font type, which is specially designed for dyslexics

1) Sight word through short story

The feature will be using a short story with narration. User also can tap to any of the sight word on the page to help struggling user to hear and pronounce the word. The short story use will be a vocabulary controlled story.

2) Sight word through rhyme

The feature will be highlighting the words line by line during reading the rhyme. Rhyme can teach word families as rhyming words end with the same group of letters [6]. Rhyme helps students learn common spelling patterns, where once student can read the word cat; it is far easier for them to read mat, sat, rat, and bat [7]. Teaching base words and common prefixes and suffixes give students the skills they need to analyze word parts and decode unfamiliar words independently [7].

3) Sight word through song lyric

The feature will be a song that can be sing along and user able to play or stop the song.

3. Methodology

In this project, mobile game-based learning (mGBL) Engineering Model based on the proposed model by Shiratuddin and Zaibon [2] is chosen to develop the mobile application. The major reason this model is chosen because it includes learning content design and development. Other than that, mGBL Engineering model encourage game level and storyboard. Moreover, this methodology also suitable for this project as the phases can be customized according to the project needs.

Figure 1 shows the process of mGBL Engineering Model. The model consists of phases, components, activities and deliverables. The model is divided into two layers. First layer is general phases: pre-production,

production and post-production. The second layer is the components. When the current phase is approved, the next phase can be proceeded.

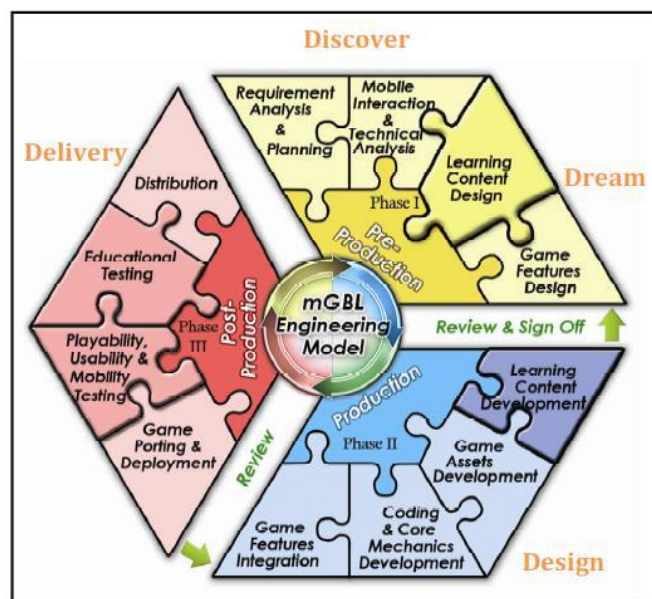


Figure 1. mGBL Engineering Model

3.1 Phase I: Pre-Production

Start with a clear statement of the definition of the project. Then, determine the project concept that covers the scope and how the project does relate to the overall curriculum. Specifications of tools that will be used to develop this application will be determined in this phase. The requirements analysis is defined through the research over the existing systems and online resources related to this project. In addition, collection of data will be using questionnaires, observation and interview techniques to get some ideas from target user before developing the project.

Then, design specifications of the project 'look and feel' will be done. There are three designs come up in this phase. First, mobile interaction and analysis is the workflow that visualizes the sequence of the navigation upon the application. Lastly, game features will be designed. The process starts with the learning content design and followed by workflow and storyboard.

3.2 Phase II: Production

In this phase, the prototype will be developed according to what has been planned from the previous phase. These include learning content, coding and core mechanics development. Then the game features will be integrated. The production of the design includes using digital media such as graphics, text, animation, animation and audio.

3.3 Phase III: Post-Production

The final phase will be the deployment of the prototype. Evaluation will be done based on its functionality, usability and mobility testing. The prototype will be tested with a sample of students and teachers within a period of time. Questionnaire will be given for feedback. Based on the feedback received from the respondents, the prototype will be reviewed and some changes will be done to improve the product functionality. Lastly, a finalized documentation will be submitted and with the final product.

4. Requirement Analysis

4.1 System Requirements

Figure 2 shows the minimum requirements for hardware and software that use to develop the mobile application.

Component	Description
Model Name	Acer Aspire 4750G
Central Processing Unit (CPU)	Intel Core i5-2410M (2.30GHz Processor with Turbo Boost up to 2.90GHz DDR3 1333Mhz 35W, supporting Intel 64 architecture, Intel smart Cache)
Operating System (OS)	Windows 7 Service Pack 1
Random Access Memory (RAM)	2 GB DDR3
Graphics Processing Unit (GPU)	NVIDIA GeForce 520GB
Hard disk Capacity (GB)	500 GB
Display	14.0 inch, 16:9, 1366x768 pixels

Figure 2. Hardware requiremnts

There are three software are required to develop Mr. Read. The first one is Android Studio software to write the full coding of the Android application. This software requires JAVA SE Development Kit Version 7 (JDK7) plug in. JDK7 plug in is used to installed the appropriate API version for the application. The application can only be run or debug in Android Studio by installing the correct API. In this project, the target android platform is Android version 4.2.2. Therefore, API version 17 is used. The language use to develop the application is Java language.

Microsoft Paint and Adobe Photoshop CS6 are used for designing and editing the graphics of Mr Read application. Adobe Media Encoder is used to enhance the sound quality of recorded voice. RealPlayer Trimmer is used to trim the required sound. Smart Voice Recorder application is used to record voices for narration, instructions and sight word spelling. The target device for this project is only tablet. This is to ensure that the development can be focused on the functionality of the proposed features met with the proposed objectives. The medium of the application will be extended only after successfully developing all the features.

4.1.1 User Requirements

In order to gather the basic information of learning approaches used to teach student with learning disabilities, a research is conducted through the Internet, review on the existing applications, collection of questionnaires and interview, and observation. Reviews has been done on the existing application have been done to identify and compare the features that are commonly found in the current mobile application. The common features include the navigation flow, menu selection, text, audio, image and game. Consequently, these features can serve as references to design the user requirements for Mr. Read.

Next, a visit to the Dyslexia Association of Sarawak (DAS) has been done to get further information regarding this project. During the visit, questionnaires are distributed 10 participants, 5 of them are dyslexic students and another half is teachers at the center. Then, an interview has been conducted with one of the teachers and followed by observation to one of the student at the center.

4.1.2 Learning Content

In this project, learning content within Mr. Read is design to teach reading and spelling using sight word reading approach. This approach is incorporated into different reading platforms in this project; story, rhyme

and song. Moreover, the users are able to test their understanding by playing the educational game. The learning is going to be learner's centered.

4.1.3 Interaction Design

A good design helps user to navigate a system without stress. Since dyslexic children have difficulties in some aspects such as visuals, an effective user interaction design is designed for the Mr Read application. Therefore it is important to come up with a design that is useful and facilitate them through the learning process. Interaction design is closely related to user experience. The design is focused on the complex dialog between human and an interactive device, in this case, a mobile device. The interaction design is based on the guideline proposed by Aziz and Husni (2012). The guideline consists of three dimensions, namely, form, content, and behavior. The elements such as typography, color and layout are acquired from the requirement analysis findings and literature review.

Figure 3 illustrates the interaction design dimensions. The combination of three components namely form, content and behavior build up the interaction design.

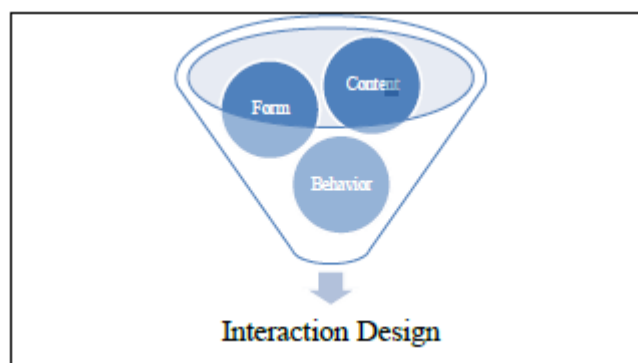


Figure 3. Interaction design dimensions

5. Application Testing

5.1 System Testing

System testing is an important process to ensure the system is performing well. There are two types of system testing that has been conducted.

5.2 Functionality Testing

Functionality testing is carried out to make sure that the proposed functions are working properly. Each function will be reviewed from any aspect to ensure its capability. Based on the table 4.2, most features are working as expected. This testing is carried out since beginning of the production until a satisfiable prototype achieved.

5.3 Usability testing

A usability testing was conducted at Dyslexia Association Sarawak. There are 8 respondents involved in the testing. The respondents consist of 7 teachers and a student. The respondents were given a tablet with Mr

Read installed to play and explore within an amount of time. After that, they were required to fill in the usability testing questionnaire. There are 10 questions provided.

Table 1. Usability Testing Questions

Mr Read is easy to use
Mr Read interface layout is clear and consistent.
Appropriate use of colors and images
Appropriate use of sound
All buttons in Mr Read are labelled clearly.
All the instructions are presented in simple language and easy to understand.
Mr Read can assist the user in reading
Mr Read encourages user to read more
Effectiveness in learning of sight words
Are you interested to download Mr Read in the future

5.4 Evaluation

Figure 4 – 7 shows the evaluations made based on the result in Table 1, which collected from 8 respondents.

5.4.1 Ease of use

Based on the Figure 4, 7 of 8 respondents strongly agreed that the application is easy to use. The high number of feedback of respondents stated the Mr Read application is easy to use proves that the application is easy to use. Besides, 7 out of 8 respondents also agree that all the instructions are presented in simple language and easy to understand. They can navigate the applications easily without much explanation. This is proved that the Mr Read is clear and understandable.

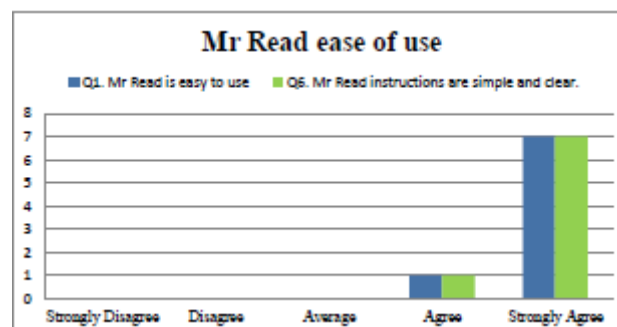


Figure 4. Interaction design dimensions

5.4.2 Interface and multimedia elements:

Figure 5 shows the result of Mr Read application interface and multimedia elements rating. Based on the result, 6 of the respondents are satisfied with the interface layout, color and image used. However, in Story module, two of the respondents stated that the background color has suppressed the texts. Thus, an adjustment has been made with color that is more soothing to the eye. As for the use of sound, based on the figure 1.10, 6 respondents have strongly agreed that the background sounds used are attractive and audio for instruction and narration are appropriate and clear. However, there were sometimes the audio buttons will be either overlapped, or crushed. This is due to the heavy background processing such as queueing the sound in order and loading data from interface components that involving big size images. This issue will be taken into priority to be fixed in the future works as to improve the functionality of this application. Figure 5 also showed that 6 of 8 respondents strongly agreed that the labels on the buttons are simple and clear.

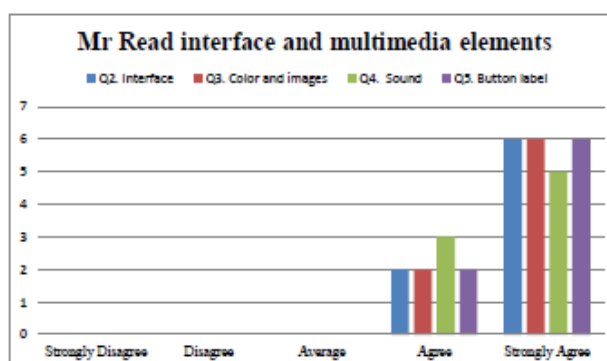


Figure 5. Mr Read interface and multimedia elements

5.4.3 Efficiency in learning:

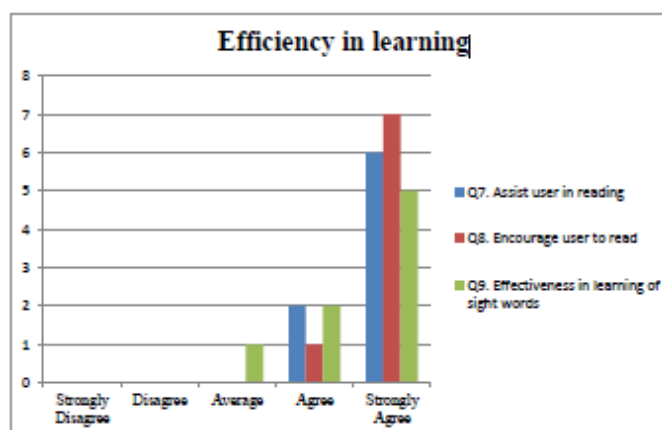


Figure 6. Mr Read Efficiency in learning

In Figure 6, the evaluation is to measure the effectiveness in learning of sight words. It showed 6 of the respondents strongly agreed that Mr Read learning approach is effective. In addition, two respondents have recommended providing the ability for user to sound out the sight words. This can be done by adding new feature, which is, to enable user to record and listen back their voice. This can motivate users to practice more on the spelling and pronunciation of the sight words. This feature is included in future works.

5.4.4 User satisfaction:

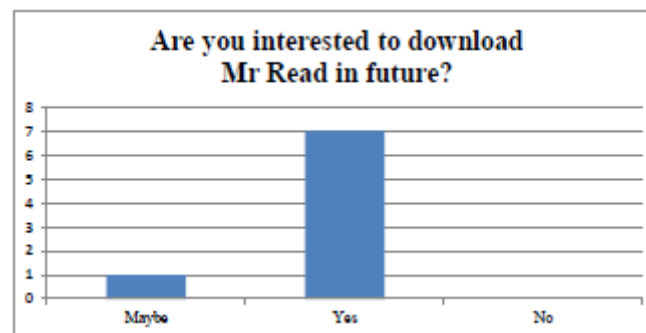


Figure 7. User interest to download Mr Read in future

During conducting the testing, students who testing this application keep playing the game and sing along the song. This shows that the application is able to gain the student's interest. This is because of the use of familiar songs and word game that offers encouraging feedbacks make the student to feel motivated to keep playing and learn at the same time. Based on the Figure 7, it shows 7 out of 8 respondents are interested to download this application in the future. The high number of respondents who are interested to download Mr Read in future proves that Mr Read has the potential to be improved and commercialized. Furthermore, 6 of the 8 respondents, who are teachers, stated that the overall concept of this application is unique since they are usually use flash cards to teach sight words. They also would look forward to the improvement of this application. Thus, the application of sight words in different type of reading platform has brought them to a new experience in teaching and learning sight words.

Overall, a high number of respondents gave positive feedbacks prove that the application is effective in developing reading and spelling among dyslexic children. The use of sight words in different reading platforms can improve the children's reading development. The ease of use and attractive user interface of the Mr Read application in terms of layout, choice of colors, sounds and images makes user, specifically dyslexic children and teachers to navigate the application easily.

6. Summary

6.1 Limitations

Even though the prototype was fully developed according to the specification and objectives, it is found out that there are still limitations that need to be fixed in terms of usability function and performance. Most the limitations exist are due to the lack of project development time. The followings are limitations identified during developing this project:

- i. Currently, this application only supports Android 4.2.2 version (Jelly Bean) and runs in tablet device.
- ii. The orientation of the application is set in landscape mode.
- iii. Noticeable lag in the prototype when transitioning from one screen to another especially in Game module.
- iv. The prototype audio will overlapped when the user tap on more than one button.
- v. As proposed, the applications features are consist of one short story, a rhyme, a song and a game. However, based on the comments and recommendations from the testing, majority of respondents demands more stories, rhymes, songs and games.
- vi. There is no database in the development of this application as it is only focused on teaching the first 20 sight words that are applied in four different reading platforms.

7. Conclusion and Future Works

The application has achieved all the objectives and specification that was specified earlier. Based on the result from the testing conducted earlier, the “Mr Read” application helps dyslexic children to improve reading skills and familiarize the words that often used in daily activities through the use of sight words. Most of the features and functionalities implemented earlier are functioning as expected based on the functionality testing result. However, the success of this project is yet to be determined due to its limitations that have been identified. This application has its own flaws as it is still a prototype with user interface and functionality issues. Thus, it is crucial to solve the issue raised with reference to the future works stated previously. In conclusion, the “Mr Read” application still has the room for improvement to ensure the needs of dyslexic children are met and hoped that they will gain something beneficial from this project.

7.1 Future Works

The following list all of the future works which intends to enhance the application performance.

- i. To add support for different Android versions and mobile environment.
- ii. To implement automated highlighting for each word that is sounded out one by one.
- iii. To add more interesting stories, rhymes, songs and fun games.
- iv. To enable user to record their own voice when reading or singing throughout the four modules.
- v. To enhance game mechanics, such as add timer for each question in the Game module to give more challenges to the user

8. References

- [1] Thomson, M. (Ed.). (2003). *Dyslexia included: A whole school approach* (Resource materials for teachers). Great Britain: David Fulton Publishers
- [2] Shiratuddin, N. & Zaibon, S. B. (2011). Designing user experience for mobile game- based learning. In: *User Science and Engineering (i-USER)*, 2011 International Conference, Shah Alam, Selangor. Nov. 29 - Dec 1 2011(pp.89 - 94). IEEE.
- [3] Fawcus, M. (Ed.). (2000). *Children with learning difficulties: A collaborative approach to their education and management*. London: Whurr Publishers Ltd.
- [4] McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2013). Sight word and phonics training in children with dyslexia. *Journal of learning disabilities*, 0022219413504996.
- [5] Logsdon, A. (2014). Sight word reading strategies. Retrieved July 11, 2014, from <http://learningdisabilities.about.com/od/readingstrategies/a/Sight-Word-Reading-Strategies.htm>
- [6] Ortlieb, E., Cheek Jr, E. H., Bowers, E., & Grandstaff-Beckers, G. (2012). Selecting appropriate individual and group-based assessments. *Literacy research, practice, and evaluation*, 1, 137-178.
- [7] Bouquett, K. E., & Lindsey, S. (2008). *Systematic sight word instruction for reading success: A 35-week program*. Scholastic Inc. Retrieved November 16, 2014, from <http://store.scholastic.com/content/stores/media/products/samples/87/9780545036887.pdf>