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Research paper

Dysgraphi Coach: Mobile Application for Dysgraphia Children in Malaysia

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Abstract

Learning Disability (LD) or Learning Disorders refers to the difficulties of obtaining, processing and storing information in their memory. There are several categories of LD including Dyslexia, Autism and Dysgrahia. The term Dysgrahia refers to learning difficulties which associates to writing skills. Commonly, Dysgrahia occurs to schoolchildren. Researchers proposed that Dysgraphia children could be assisted by using supportive learning tools, however the study on learning tools particularly in mobile application for Dysgrahia is still scarce. Thus, the objective of this paper is to report on the development of a mobile application called DysgraphiCoach as well as its usability testing results. The DysgraphiCoach was constructed by using Evolutionary prototyping approach. In future, DysgraphiCoach will be evaluated in terms of its effectiveness in improving writing skills among the Dysgrahia children.

Keywords: *Learning disability, Dysgraphia, mobile applications, learning disorders, writing skills*

1. Introduction

Agatha Christie and Albert Einstein were some of the prominent people that once been diagnosed with LD. Although they were diagnosed as LD, however they were very successful in their life. This is may be due to proper treatments and strategies given to them in their early childhood. In essence, early intervention is vital to lessen the difficulties. There are many types of difficulties such as listening, counting, listening, spelling and writing [2].

There are verities of LD such as Autism, Dyslexia, Dyscalculia and Dysgraphia. Dyslexia refers to difficulties in reading due to weakness in left-right orientation and visual memory. Meanwhile, Dyscalculia refers to difficulties in Mathematics. Basically, Dyscalculia children have issues in calculation, classifying and evaluating the similarity

or dissimilarity numbers [3]. Additionally, Dysgraphia is related to
difficulties in conveying ideas into writing [4]. Normally, Dysgraphia children have troubles in writing and also reading. This is also supported from the result obtained from preliminary interview conducted with pediatricians.

Research in LD particularly related to Dysgraphia is still new in Malaysia. As to date, there is no statistical data specifically for Dysgraphia since in Malaysia, Dysgraphia is considered as Dyslexia although both are facing dissimilar learning issues [5]. As a consequent, Dysgraphia children did not received appropriate strategies, treatments and interventions , which could impede the learning process of these children.

Fortunately, studies have found that LD children interact and performed well with technology such as mobile applications [6]–[8]. '1000 English Words Color Coded' and 'ROY G BIV math system' are two examples of mobile applications which are designed and created for LD children. Nonetheless, mobile application specifically to address Dysgraphia learning difficulties is still scarce. Hence, this study aims to develop a mobile application called DysgraphCoach for Dysgraphia children. DysgraphiCoach is equipped with a stylus pen to mimic the writing activity.

As mentioned earlier, research on Dysgraphia in Malaysia is still limited [3], [7]. From the preliminary conducted prior to the development of DysgraphiCoach found that most of the mobile applications in the market are built for Dyslexia and Dyscalculia children (refer to Table 1). This indicates that there is lack of awareness on Dysgraphia and limited tools were developed for Dysgraphia children.

Table 1. Number of mobile application for LD children

Type of Learning Disability	Total number of mobile application
Dyslexia	250
Dyscalculia	49
Dysgraphia	14

As mentioned earlier, mobile application has potential to assist the learning process of Dysgraphia children. This is due to its aesthetics aspects, sounds and interactivity. The objectives of this paper are to (1) investigate existing mobile apps specifically for Dysgraphia children (2) develop a mobile application with stylus pen for Dysgraphia children and evaluate the effectiveness of DysgrahiCoach in terms of its usability and knowledge change. The DysgraphiCoach is developed in the Android operating system. The target audience of DysgraphiCoach is Dysgraphia children aged between 7 to 10 years old. DysgraphiCoach will focus on writing skills on alphabets and numbers.

2. Literature Review

2.1. Learning Disability

LD is defined as people who have neurologically-based processing issues [2]. Basically, LD people have issues in learning fundamental expertise such as counting, reading and writing. Additionally, LD people could have difficulties to organize, managing time, thinking dynamically, short-term memory span and lack of focus [10]. There are many categories of LD and one of it is Dysgraphia.

2.2. Dysgraphia

In general, Dysgraphia refers to the learning disability related to reading and writing [10]. Dysgraphia children has low writing speed, inconsistent and unclear handwriting and also has tendency to duplicating letters and words as compared to children with the same age, IQ and educational level[10-12]. As a result, commonly Dysgraphia children will be considered as underperformers. The symptoms of Dysgraphia could be categorized into six types: visual spatial, fine motor, language processing, spelling/handwriting, grammar and organization of language as shown in Table 2.

Table 2. Symptoms of Dysgraphia [2]

Types	Symptoms	Description
I	Visual Spatial Difficulties	Has difficulty with shape and letter spacing
II	Fine Motor Difficulties	Has difficulty holding a pencil effectively
III	Language Processing Issue	Has difficulty getting thoughts down on paper rapidly
IV	Spelling Issues/Handwriting Issues	Has difficulty to understand spelling rules
V	Grammar and Usage Problems	Does not know how to utilize punctuation
VI	Organization of Written Language	Has difficulty telling a story

2.3. Mobile Application for Learning Disabilities

The evolution of ICT offered better support for LD children. [3], [6], [7]. This is due to the aesthetic environment supported by graphics, sound and also rewarding experience when LD children interact with it. Furthermore, this claim was also supported by one of the interviewees. The interviewee suggested that using ICT particularly mobile application with stylus pen could ease the writing process for Dysgraphia children. Using stylus pen could provide better control, better grip and have natural feel as though they were using the ordinary pencil.

2.4. Existing Mobile Application

Currently, there are only 14 mobile applications found in the market for Dysgraphia children, however only 7 were downloadable (refer to table 3). From those 7 applications, 2 applications are about awareness ('Legasthenie Coaching' and 'A Day in Our Shoes'), while the remaining 5 applications are about teaching and learning writing skill. Due to the similarity to the research context, only 3 mobile applications are considered in this research work (i.e Fono3, Learn to Read, Write & Spell).

Table 4 illustrates the detail description of the 3 selected mobile applications. The limitations and strengths of each mobile application were identified based on the feedbacks obtained from the Dysgraphia teacher. Initially, the teachers identified set of preferences related to Dysgraphia children such as choices of images and colors. Later, these mobile applications were tested and assessed bh the respective Dysgraphia teacher. From the assessment, it was found that Learn to Read, Write & Spell is the most appropriate application for Dysgraphia children although it has several limitations. Thus, the DysgraphiCoach attempts to address those identified limitations.

Table 3. Mobile application for Dysgraphia children

No	Name	Focus
1	Legasthenie Coaching	Awareness
2	A Day in Our Shoes	Awareness
3	1000 English Words Color Coded	Education
4	ROY G BIV math system	Education
5	Fono3	Education
6	Learn to Read, Write and Spell	Education
7	HexaDyslexia	Education

Table 4. Description of the existing mobile applications

Application	Target Audience	Limitation	Strength
Fono3	For Dyslexia, Dysgraphia, Dyscalculia	• User interface design is not suitable for Dysgraphia children • Used bright colors • Used too many colors • Crowded and complexed background • Medium of instruction: English • Require Internet connection	Has various exercises such as reading, speech, thinking and memorising
Learn to Read, Write & Spell	Children with LD: Dyslexia, Dysgraphia, ADHD and Dyscalculia	• Need to purchase full version • User interface design is not suitable for Dysgraphia • Medium of instruction: English	Has various lessons such as alphabet, reading, writing, spelling, and language.
HexaDyslexia	Dyslexia	• User interface is not suitable for Dysgraphia • Guidance (tutorial) is not provided	• White background • Used multiple font colors to help readability • More suitable for Dyslexia children

3. Methodology

Evolutionary prototyping is used as the research methodology in this project. The evolutionary prototyping is a suitable method to deliver the suggested project to meet the user requirements and needs

3.1. Planning & Requirement Gathering

Planning stage is to determine the content that the author intends to accomplish. Additionally, in requirement gathering phase, the author gathered the requirement through interviews and survey. First interview session was conducted at Persatuan Dyslexia Malaysia in Ipoh, Perak with one of the LD teachers. The second interview was conducted with a pediatrician cum LD specialist.

3.2. Analysis & Design

Based on the literature search and interviews, the features of the mobile application were recognized. The preferences of Dysgraphia children are different as compared to normal children. For example, unlike the normal children, Dysgraphia children prefer to have soft color background. Additionally, Dysgraphia children also prefer to see real life images instead of cartoon-like images in their learning environment. Thus, these preferences will be considered and addressed in the development of DysgrahiCoach. Additionally, based on the feedbacks and literature search, the medium of instruction in DysgrahiCoach will be in Malay.

3.3. Develop Prototype

In this stage, the prototype is developed based on the design phase. As mentioned earlier, the development of the DysgrahiCoach is based on the characteristics of Dysgraphia children. Later, the prototype was evaluated in terms of its usability and functionality. There were 8 participants (3 LD teachers and 5 Dysgraphia children) from Persatuan Dyslexia Malaysia (PDM) involved in the usability testing. The usability testing evaluates the color, font and ease of use of DysgrahiCoach.

4. Result and Discussion

4.1 DysgrahiCoach prototype

As mentioned earlier, existing mobile application evaluation found that *Learn to Read, Write & Spell* is the most suitable for Dysgraphia children although it has several limitations. Hence, DysgraphiCoach attempts to address the limitations of *Read, Write & Spell*. Table 5 shows the comparison between *Learn to Read, Write & Spell* and DysgraphiCoach.

Table 5. Comparison between *Learn to Read, Write & Spell* and DysgraphiCoach

Features	Learn to Read, Write & Spell	DysgraphiCoach
Language	English	Malay
Image	No image	Similar images from Dysgraphia book
Color	Bright color	Pastel color
Instruction	Complex instructions	Simple and repeated instructions
Font	Serif	San serif
Strength	Can be used by other types of LD	Focus specifically for Dysgraphia children.
Content	Enhancing reading, writing and language skills	Enhancing writing skills
Weakness	The interface design is complicated for Dysgraphia children	•Local use only. •Available in Android operating system only.

The DysgrahiCoach was designed to have 3 parts: 'Huruf', 'Nombor' and 'Latihan'. Table 6 describes each of the DysgrahiCoach part and its aims.

Table 6. Description of each section in DysgrahiCoach

Section	Description
"Huruf" 	Aim: to teach alphabets writing.
"Nombor" 	Aim: to teach number writing.
"Latihan 1" 	Aim: improve short-term memory and speed recognition skills

4.2 Usability testing

Table 7 shows the usability results obtained from the LD teachers and Dysgraphia children. From Table 7, it shows that all Dysgraphia children found that DysgrahiCoach is attractive and they were excited to use and learn using DysgrahiCoach in the classroom. Additionally, the children were also found that DysgrahiCoach is easy to use due to the simplicity of the buttons and functions. However, only 80% of them prefer the colors used in DysgrahiCoach. Interestingly, one of these children prefer to have bright colors in DysgrahiCoach. Additionally, only 80% of these children found that the font is readable. This is may be due to his incapability to read yet. Based on this result, it shows that DysgrahiCoach successfully meets the usability requirement.

Table 7. Usability result from Dysgraphia children

Question	Agree (%)	Disagree (%)
DysgraphiCoach is attractive	100	0
DysgraphiCoach is easy to use	100	0
The colour is pleasant	80	1
The font is understandable	80	1
I can easily write using stylus pen.	100	0
I know how to use DysgraphiCoach without guidance	100	0

Table 8 shows the usability result from the LD teachers. From the table, it was found that all teachers agreed on the benefits of DysgrahiCoach in terms of its educational value to the Dysgraphia children. The teachers also agreed that DysgrahiCoach is easy to use. Additionally, all of the teachers agreed that the design interface is appropriate for Dysgraphia children and looking forward to use DysgrahiCoach in the classroom. Only 2 teachers agreed that the usage of stylus could help these children. Only 1 teacher disagreed by claiming that the usage of stylus could take longer time to write. Based on the usability results from the children and teachers, it could be concluded that DysgrahiCoach

had successfully meets the usability criteria and could be used in the classroom.

Table 8. Usability result from LD teachers

Question	Agree (%)	Disagree (%)
Do you think DysgraphiCoach is beneficial to the Dysgraphia children?	100	0
Do you think DysgraphiCoach is easy to use?	100	0
Will you use DysgraphiCoach to teach the Dysgraphia children?	100	0
Is the user interface design is suitable for Dysgraphia children?	100	0
Is DysgraphiCoach with stylus pen is suitable for Dysgraphia children?	67	1
I am satisfied with DysgraphiCoach	100	0
I believe all Dysgraphia children should use DysgraphiCoach	100	0

5. Future works

In future, DysgrahiCoach will be tested in terms of its effectiveness in improving the writing skills of the Dysgraphia children. Once the testing is completed, DysgrahiCoach will be released in Google Play Store.

6. Conclusion

This study attempts to provide a mean for Dysgraphia children to write. A mobile app called DysgrahiCoach was developed and evaluated by Dysgraphia children and teachers. It is hope that this effort could address the difficulties faced by the Dysgraphia children since Dysgraphia children have normal intelligence level as compared to normal children.

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References

[1] P. Manghirmalani, P. Zenobia, and K. Jain, "Learning Disability Diagnosis and Classification – A Soft Computing Approach," in *In 2011 World Congress on Information and Communication Technologies (WICT),IEEE*, 2011, pp. 479–484.

[2] "Understanding Dysgrahia," 2012.

[3] M. M. Ariffin, F. Azureen, A. Halim, and N. Abd, "Mobile Application for Dyscalculia Children in Malaysia," in *Proceedings of the 6th International Conference on Computing & Informatics (pp*, 2017, no. 099, pp. 467–472.

[4] Munir, Rasim, C. Cahyadi, and L. S. Riza, "A System to Diagnose Learning Disability in Children of Special Need," in *2nd International Conference on Science in Information Technology (ICSITech) A*, 2016, pp. 47–51.

[5] "Laporan Statistik Jabatan Kebajikan Masyarakat 2015," 2015.

[6] N. Che Pee, A. S. Sibgatullah, and S. Mohtaram, "Mobile Dyslexia Screening Test : A New Approach through (Multiple-Deficit) Model Mobile Game to Screen Developmental Dyslexia Children," in *In Malaysia University Conference Engineering Technology*, 2014, no. November, pp. 10–11.

[7] N. Zuhaidah, M. Zain, M. Mahmud, and A. Hassan, "Utilization of Mobile Apps among Student with Learning Disability from Islamic Perspective," in *5th International Conference on Information and Communication Technology for the Muslim World*, 2013.

[8] R. Skiada, E. Soroniati, A. Gardeli, and D. Zissis, "EasyLexia : A Mobile Application for Children with Learning Difficulties," in *Procedia - Procedia Computer Science*, 2014, vol. 27, no. 2013, pp. 218–228.

[9] M. ; Ariffin, W. Fatimah, and S. Sulaiman, "TOWARDS A CULTURALLY-ENHANCED SERIOUS GAME," *J. Theor. Appl. Inf. Technol.*, vol. 90, no. 2, pp. 95–105, 2016.

[10] J. Fischer and M. A. Rettig, "Dysgraphia : When Writing Hurts," *Princ. Math-Web Exclus.*, vol. 84, no. 2, pp. 1999–2001, 2004.

[11] R. Guerrini, F. Melani, C. Brancati, A. R. Ferrari, P. Brovedani, A. Biggeri, L. Grisotto, and S. Pellacani, "Dysgraphia as a Mild Expression of Dystonia in Children with Absence Epilepsy," *PLoS One*, vol. 10, no. 7, pp. 1–13, 2015.

[12] M. Regina, I. Martins, J. Alexandre, and A. Traldi, "Screening for motor dysgraphia in public schools," *J. Pediatr.*, vol. 89, no. 1, pp. 70–74, 2013.