

Enhancing Quality of Experience in Malay Language Dyslexia Screening Test

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Received: November 29, 2020. Revised: April 17, 2021. Accepted: May 4, 2021. Published: May 13, 2021.

Abstract— Identifying dyslexia among Malaysian citizens, especially children nowadays is a prominent issue. The usual practice of dyslexia screening tests in the Malaysian school system is by teacher's observation and intervention. However, this is usually time-consuming, less accurate and lacking additional supporting tools. Moreover, dyslexic children enrolling in a normal education system will encounter many problems for the teacher and the children themselves. A Malay language mobile-based application for a dyslexia screening test named **Kiddo Disleksia** has been developed to solve this issue. However, it has not been tested in terms of Quality of Experience (QoE) as well as usability. Therefore, this research aims to test the QoE level of **Kiddo Disleksia** and also to compare the traditional dyslexia screening test with **Kiddo Disleksia** in terms of usability. To test the QoE, several special education teachers are required to rate **Kiddo Disleksia** using Mean Opinion Score (MOS). Ten children were tested using **Kiddo Disleksia** and 80% of them recognized as dyslexic. This result also similar with the traditional paper-based screening test. Therefore, the **Kiddo Disleksia** application is considered reliable for dyslexia screening tests for children. For QoE, the results show that the mean values of MOS are 3.9 and above. Therefore, the quality of experience during dyslexia screening tests can be enhanced using **Kiddo Disleksia**.

Keywords—Dyslexia Screening Test, Mean Opinion Score, Quality of Experience, Usability.

I. INTRODUCTION

Dyslexia is not a disease, but it is an internal disorder in children that prevents language development during the learning process [1]. Children with dyslexia are usually smart and hardworking. However, they have difficulties in recognizing words, letters, and other symbols, thus, having problems in reading, writing, as well as speaking. In Malaysia, there are around 5 to 10% of its population is born with dyslexia symptoms [2]. Dyslexia has been acknowledged by the Ministry of Education Malaysia as one of the Specific Learning Disability and establishes a Special Education Program for children with dyslexia [3].

The normal practice of dyslexia preliminary screening test in the Malaysian school is fully conducted by the school teacher. Identifying dyslexia among students manually is a difficult task. Students must be identified earlier whether or not are dyslexic. However, it is usually impossible to identify dyslexic children in the early stages of primary school. One of the most dyslexic symptoms among children is having difficulties learning letter names and their sounds [4]. They also always spell with unpredictable and inconsistent letters. Dyslexic children are prone to writing letters and numbers backward, such as '6' instead of '9' or 'b' instead of 'd.' Due to these difficulties, dyslexic children could not understand what has been taught by their teacher [5]. These difficulties are worsening if dyslexic children are not identified earlier. Therefore, teachers' knowledge in identifying dyslexic children is crucial.

A. Kiddo Disleksia



Figure 1. Kiddo Disleksia Interface

This study was conducted using the developed Kiddo Disleksia mobile application [6]. Figure 1 shows the main interface of the Kiddo Disleksia application. This application was developed as a screening tool to detect dyslexia. In this application, preschool or lower secondary students aged between 5 to 10 years are the target test subjects because they are in the early stage of learning letters and words. The main language of this application is Malay which is the official language of Malaysia. The first objective of this application is to aid in the identification of letters as well as phonetics. The second objective is to encourage dyslexic children to learn and read. The third objective is to identify dyslexic symptoms in children in a stress-free and entertaining way.



Figure 2. Kiddo Disleksia letter identification gamification interface

Figure 2 shows the in-app Kiddo Disleksia test. The first step in this application is to recognize the letters. This is an important step before children may start reading and writing. The activity in this module is recognizing and memorizing. Then, the process is repeated several times to improve the learning process [6]. The letter and phonetic identification

module used a blended and multisensory approach that uses media elements such as text, graphics, audio, and animation.

Another approach used in this application is Gamification Based Learning [5]. This approach will ensure children have fun, thus enhancing the quality of experience during screening tests. Children can also focus more and reduce stress during screening tests. The results of the activity are saved after the game for further analysis and evaluation.

In general, the use of multimedia elements to convey or display information to the targeted users can enhance the quality of experience [3][6]. The use of multimedia elements in applications such as Kiddo Disleksia is broadly implemented in numerous areas, especially education because it may increase children's motivation, consequently, improve learning performance [4][5]. From recent research, the use of multimedia may also increase the ability of dyslexic children in learning and assessment [1]. Multimedia elements such as interactivity in applications for dyslexic children can be considered as an important factor of success in teaching and learning [1][7]. However, creators, inventors, or developers need to be aware of the cognitive weights of interactive multimedia for dyslexic users [7][8]. This element must be strictly adhered to obtain the best results for evaluation.

B. Screening test

Screening tests can be defined as the presumptive detection of a defect disease that is difficult to recognize. Usually, screening tests can be done by tests, examinations, and other procedures to assess the symptom of the disease. However, this process is not considered a diagnosis. If the findings are positive or suspicious, further diagnosis and treatment should be done by a psychologist.

Several methods can be used to distinguish dyslexic children. One of the methods is to screen them with a special traditional test that can be carried out in school. Screening tests like these are important as initial dyslexia tests. If there are any dyslexic symptoms discovered, further examination will be done by a psychologist for confirmation.

Traditional paper-based tests are usually time-intensive and less interesting. Also, it may cause discomfort during testing. Children often feel bored during long-term screening tasks and prefer not to complete activities [3]. Therefore, the primary goal of this study is to compare the traditional dyslexia screening test with Kiddo Disleksia in terms of user experience and usability. The quality of experience (QoE) metrics will be used to measure the user experience level.

System or application has been proven to be suitable for the dyslexia screening test [7][9][10][11][12]. In this research, screening testing is designed to be used on each test subject. The characteristic symptoms of dyslexia that will be screened are the difficulty of understanding the word, reading with words, and the difficulty associating letters and sounds. Dyslexia screening tests are intended to provide reliable results to measure the likelihood of symptoms of dyslexia in children. It is expected that from the test result, children with possible dyslexic symptoms will be identified. However, this process is not proposed to be used as a diagnostic tool to some extent.

Further examination and treatment by a psychologist are still needed. Nevertheless, the symptom can be identified in advance using this system or application. Therefore, teachers or tutors can get an early notification and be prepared to deal with children's disabilities. Thus, appropriate teaching methods can be planned and prepared earlier.

II. METHODOLOGY

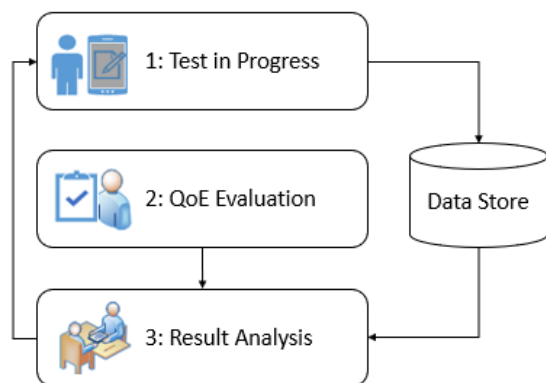


Figure 3. Research Phase

Figure 3 shows the phases of this research: Test in Progress, QoE Evaluation, and Result Analysis.

A. Test in Progress

In the Test in Progress phase, the Kiddo Disleksia application is given to selected respondents. The selected respondents are special education teachers and dyslexic children. Samsung Galaxy Tab A tablet with standard specifications has been used in this phase. In the tablet, a library that can distinguish results on each test has been created. Randomized gamification questions were also given to the test subjects.

The respondents will use the Kiddo Disleksia application and at the same time, screening test data will be collected and uploaded into a dedicated server for further analysis. Also, a traditional paper-based dyslexia screening test will be performed. The questions given in the questionnaire are basically to interpret the relationship between the QoE of the teacher or tutor with the screen test that has been conducted. A total of 10 questions were given to 10 selected children to get the final result. The test results will give the final assumption about whether the child has learning difficulties due to dyslexia or not. The categorization is shown in Table 1 to determine the user experience of the application and the accuracy of the screen test.

Table 1. Screening Test Cases Categorization

Dyslexic?		Yes	No
Identify as a dyslexic during screening test?	Yes	True +	False +
	No	False -	True -

Table 1 shows the categorization of cases to determine the accuracy of the screening test. There are four categories of

screening test accuracy determination.

- True positive – children who have dyslexia and were recognized as dyslexic by the screening test.
- True negative – children who do not have dyslexia but were recognized as dyslexic by the screening test.
- False positive – children who do not have dyslexia but were recognized as dyslexic by the screening test.
- False negative – children who have dyslexia but were not recognized as dyslexic by the screening test.

B. QoE Evaluation

Quality of Experience (QoE) is the level of quality as perceived by the user. In this phase, the perception of teachers or tutors is important to find relevant acceptance value between the targeted users and the efficiency of the application [13]. Besides, it also determines the suitable features according to the application point of view that can satisfy the user experience. We used a direct matrix that considers factors that influence users' perceptions of the multimedia experience.

Empirical evaluation is considered as one of the methods to obtain feedback from respondents on the usability of the applications. Seven respondents who are special education teachers were involved in this study. Six important criteria have been identified for this test which are interface design, navigation design, sound implementation, content usability, gamification approach, and user friendly.

In this study, it is difficult to access the entire information and measure the level of QoE accurately. Besides, complex processes are involved in the process of accurately determining the symptoms of dyslexia. Therefore, the Mean Opinion Score (MOS) is used to determine users' QoE in terms of user opinion on application usage. Table 2 shows the direct matrix of MOS. MOS scale from 1 (Bad) to 5 (Excellent) can be used to evaluate user perception in terms of content, approaches, multimedia elements, and also general items such as user-friendliness, attractiveness, value, support, and appeal.

In this evaluation, respondents will provide comments and feedback on each of the criteria of the application based on the MOS scale. Several aspects such as the user interface are related to usability issues in certain application elements [9].

Table 2. Mean Opinion Score (MOS)

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very Annoying

C. Result Analysis

Finally, results from all test phases are analyzed in this phase. Screening test data from both traditional paper-based and Kiddo Disleksia is compared.

III. RESULT AND DISCUSSION

A. Usability test result

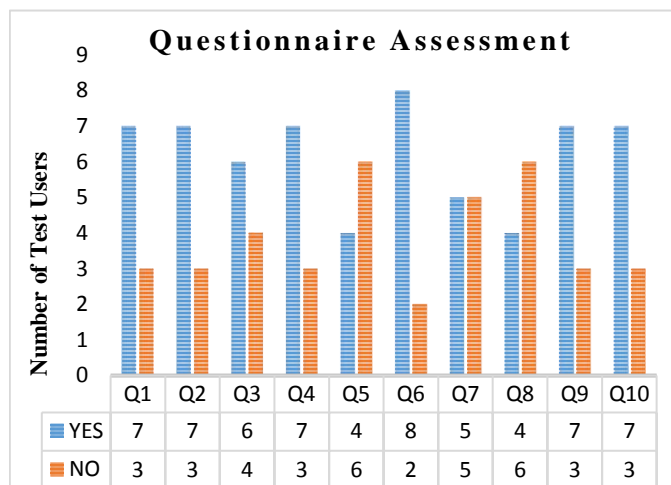


Figure 4. Questionnaire Assessment Result

Figure 4 shows the result of questionnaire assessment from the traditional paper-based screening test. From the test, 80% of children were having symptoms of dyslexia. These results are consistent with the Kiddo Disleksia which the same children 80% also recognized as having dyslexia symptoms. Therefore, the Kiddo Disleksia application is considered reliable for dyslexia screening tests for children.

B. QoE Evaluation result

QoE results are important to determine whether the underlying results are reliable or not from the human perspective [13].

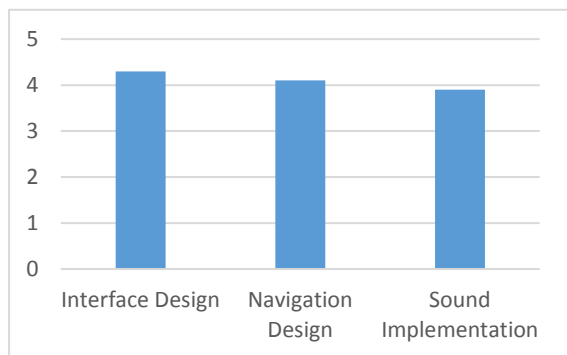


Figure 5. MOS Evaluation based on Multimedia Elements

The MOS rating based on the results of the multimedia elements of the application is shown in Figure 5. In terms of design, all respondents agreed that the application was designed with the proper multimedia concepts (Interface design = 4.3), Navigation design (mean = 4.1), and sound implementation (mean = 3.9).

Figure 6 shows the result of the MOS rating based on the content and methods. The MOS results showed that all respondents agreed that this application is designed with

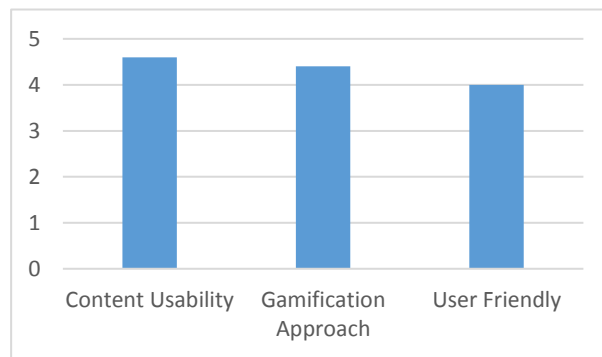


Figure 6. MOS Evaluation based on content and method

sufficient content and method (Content usability = 4.6), Gamification approaches (mean = 4.4) and user-friendly (mean = 4.0).

From the results of the MOS rating, as shown in Figure 5 and Figure 6, it is clear that the Kiddo Disleksia application gets a rating above average. Therefore, the QoE level of the dyslexia screening test can be enhanced using the Kiddo Disleksia application.

IV. CONCLUSION

Dyslexia in general is not a disease that cannot be cured. However, delays in the identification of dyslexic symptoms among children will cause difficulties, especially in learning. Interventions that require every member of the community to work together to overcome these difficulties are essential. Even though if the number of these disabled individuals is relatively small, the future of the children involved may be affected if there is no awareness to solve this problem. Early dyslexia identification is needed to ensure proper teaching and learning method are given.

Kiddo Disleksia application results have similarities with the results of the traditional paper-based screening test. Therefore, the Kiddo Disleksia application can be considered reliable for the dyslexia screening test. Kiddo Disleksia application with multimedia elements and gamification method has proven to enhance the quality of experience of the dyslexia screening tests. The results show that the mean values of MOS are 3.9 and above. Therefore, the quality of experience during dyslexia screening test can be enhance using Kiddo Disleksia. Moreover, the dyslexia screening tests can be done in a more fun and enjoyable way. Also, there is a much lesser intervention of teachers or tutors by using the application compared to the traditional screening tests. Hence, teachers or tutors will have more time to focus on the teaching and learning process.

ACKNOWLEDGMENT

The authors would like to thank Universiti Tun Hussein Onn Malaysia (UTHM) and the Malaysian Ministry of Education for funding this research through the Tier 1 Grant, Vot No. H093.

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