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DyslexiaMap: Distribution of Dyslexia Students using Data Visualization and Mapping

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Abstract: The purpose of this project was to create a web application that can visualize the distribution of dyslexic students in the Kedah region. There is a lack of preparedness by schools, tutors and education for catering to students with dyslexia and one of those causes is due to the limited awareness of dyslexic students in their area. The main objective of the web application is to provide a web map that illustrates the distribution of dyslexic students in different Kedah regions. The web application was evaluated by targeted users and on average they rated it a 4/5. However, the web application has improvements to be implemented such as making it more mobile-friendly. In the future, the web application can have added features to distinguish student numbers by district and possibly expand to other states in Malaysia.

Keywords: Digital Solutions, Dyslexia, Knowledge Visualization, Web Map

1. Introduction

The number of students diagnosed with Dyslexia has shown an increment year by year, in contrast to the rapid development in the healthcare and education sectors in Malaysia. This scenario has posed a new challenge for Malaysian educators, especially when a recent study has evidenced that many of them are still not fully ready for catering to students with this kind of learning disability [1]. Dyslexia is a neurological condition [2] that negatively impacts students' lives especially early in their education journey as they struggle with phonological awareness [3]. It is categorized as a learning disability because it challenges their chances to succeed academically in a typical learning environment. Although there are many types of dyslexia such as rapid naming, double deficit, surface, visual, primary, secondary and acquired [4], they share similar common symptoms, which are difficulty in reading, spelling, writing, identifying speech, and processing language in general [5].

Although efforts have been made to be inclusive to all students including those affected with dyslexia it is still difficult for schools to map dyslexic students because the data and details that are available about special needs people are limited [6] and do not provide the distribution of specific

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special needs such as dyslexia. To help dyslexic students to be less negatively impacted DyslexiaMap was developed as means for teachers, and educational facilities to detect regions that have students with dyslexia and acquire awareness to make proper arrangements to cater to dyslexic students when needed. The web application was developed to provide accessible [7] and visual-based data by mapping the geographical distribution of dyslexic students. This will assist education institutions in making efficient preparations for students that have dyslexia such as by employing a suitable estimated number of trained teachers, preparing programs, and making the classrooms more Dyslexia-friendly according to their areas. The objective of the project was to create a dyslexic students distribution visualization map application that is easy to interact with and have it evaluated by my targeted users.

2. Materials and Methods

2.1 Materials

In the early stages, Figma web application was used to design the user interface of the system. The development of the DylexiaMap web application was done using a combination of PHP, HTML, JavaScript, CSS, and SQL on Cpanel. API (Application Programming Interface) such as Google map reverse geocoding API was incorporated to convert addresses into longitude and latitude. To create an interactive map Leaflet JavaScript API was integrated due to its large library, open source and highly customizable.

2.2 Methods

A development methodology was utilized to structure and assist in managing the development process of the web application. As shown in **Figure 1** methodology practiced consisted of five phases which are Planning, Requirement Specification, Design, Development and testing, and Evaluation and Demonstration. All the phases were executed in a time frame of 6 months.

Figure 1: Development methodology phases

Planning

The planning phase is where the project is designed and determined how it was going to be managed and conducted. Initially, discussions were conducted to get a clear picture of the project title followed by research and exploration relating to the project title. The data collection process and resource estimation were also initiated to ensure that the project's requirements would be fulfilled. The product of this phase was the proposal of the project approved by the supervisor.

Requirement specification

In this phase, the user and system requirements and functions were defined to guide what needed to be developed. The general requirements were gathered from targeted users which are teachers and tutors who would use the system when it was built. 5 participants were approached and they proposed the requirements they would need. UML diagrams such as sequence diagrams, use case diagrams and collaboration diagrams were also made to illustrate the behavior of the system and the workflow of how the components would interact with each other and users. The outcome of this phase was the requirement specification document that detailed all the functional and non-functional requirements and UML diagrams.

Design

In this phase, the requirements were translated into technical details. As shown in **Figure 2**, Figma software was used to design features for the low-fidelity prototype to display a visual interpretation of the system's functions, behavior, and interface. The goal of the interface was to keep it minimalistic and functional for all types of users and devices.

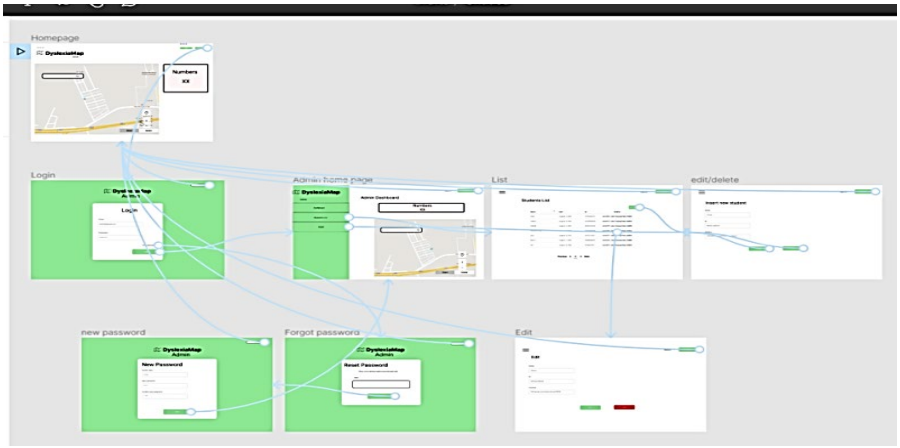

Figure 2: Low fidelity prototype on Figma

Development and testing

In this phase, the system was built. HTML, JavaScript, CSS, PHP, and SQL were used to develop the whole web application. Frequent ongoing testing was conducted during development to ensure the system worked as intended.

Evaluation and Demonstration

The last phase was to evaluate the usability of the web application with real users. A field test involving teachers, tutors and school administrators from schools around the Kedah region was conducted virtually over a period of two weeks. The questionnaire was sent out to respondents using WhatsApp. Modifications to the web application were then made according to the feedback given by respondents.

3. Results and Discussion

A field test was conducted online using a Google form questionnaire as the instrument. The questionnaire consisted of 21 questions divided into 6 categories and was distributed to 30 respondents of which 25 were teachers and tutors and 5 were administrators.

3.1 Results

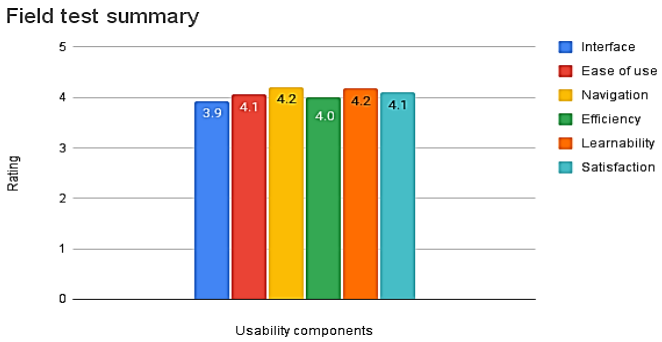

Figure 3: Field test summary results

Figure 3 reveals the average score out of 5 for each category tested. Most components have an average score of 4/5 which means that users were satisfied with the usability of the Dyslexia web application. An exception is shown with the interface component which scored an average of 3.9/5 this served as an indication that the interface had to be improved.

3.2 Discussions

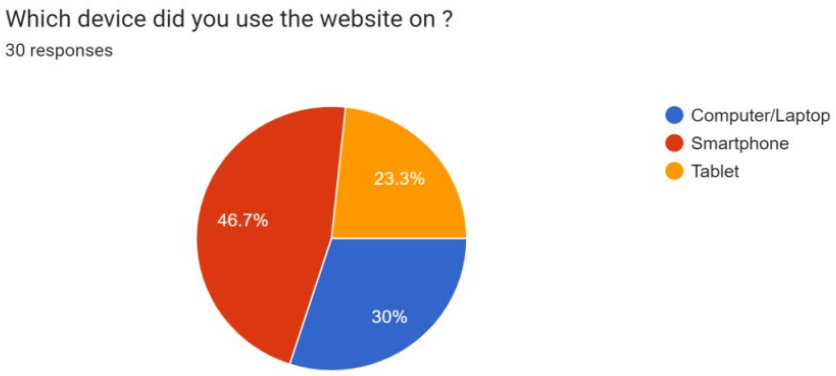

Figure 4: Device usage results

The results from the field test were found to be very useful as they indicated that the web application would be useful for educators. The results also showed that the interface had to be improved and made more dynamic for mobile screens as it was observed in **Figure 4** that 70% of the respondents had been using their mobile phone or tablet to use the web application. Results from the field test implied that the respondents were less satisfied with the interface on their phones or tablet as the majority used their mobile devices and the interface ranked the lowest among the other components tested with a 3.9/5 score. The web application was then updated to cater to different screen sizes as shown in **Figure 5**.

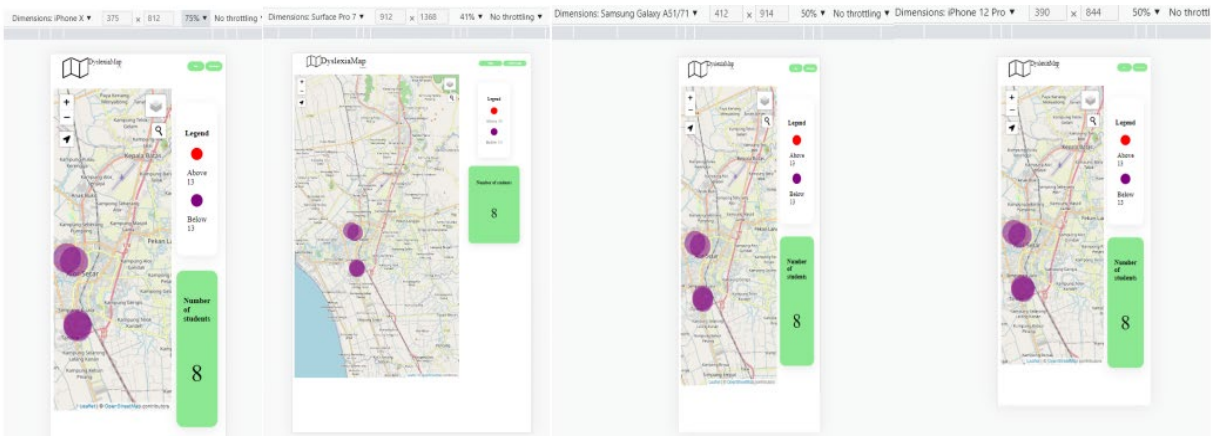

Figure 5: Web application interface on different screen sizes

Some of the users also proposed a new feature to be added that was to categorize the number of students by their district this would increase the relevancy for teachers, tutors and education facilities in their districts.

4. Conclusion

To conclude, the web application was developed to deal with the little knowledge and inaccessibility of information regarding dyslexic students' distribution in different regions, this leads to

unpreparedness by schools and tutors' to properly cater to them After inspecting the results of the field test, it can be determined that the project serves its purpose and can be helpful for tutors, teachers and educational facilities. However, there are still more improvements that can be made in terms of adding new features such as categorizing students by districts, the interface, and expanding to other states around Malaysia.

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