PAPER

# User Interface Design for Dyslexia Children Learning Application Using Design Thinking Approach

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**ABSTRACT**

The ability to read and count is essential to be mastered by every student to foster future academic and professional success. However, students with dyslexia have limited ability to read and count. Using learning apps can help children with dyslexia develop reading and counting skills. User interface design is an essential aspect of application development. The research aims to develop a user interface design for learning applications for dyslexic children. User interface design development methods use design thinking approaches that have levels of empathy, define, ideate, prototype, and test. The development of user interface design of learning applications also involves gamification and multi-sensory to help improve students' understanding of dyslexia when using applications. Evaluation of user interface design using the System Usability Scale (SUS) method yields a total average value of 82. This shows that the user interface design of learning applications for students with dyslexia is acceptable and suitable for users.

**KEYWORDS**
user interface design, dyslexia children, learning application, design thinking approach

## 1    INTRODUCTION

Reading and counting skills are essential to each student to support future academic and professional success [1]. However, students with dyslexia have limited ability to read and count [2]. These limitations can cause difficulties in understanding the subject matter effectively, leading to inequalities in education between students with dyslexia and other students who do not experience similar difficulties [3]. Dyslexic students can develop reading and counting skills through specially designed-learning strategies and methods [4]. The use of learning applications can help children with dyslexia build reading and counting skills.

Developing learning applications for children with dyslexia involves visual aspects of design that play an essential role in the success of mobile learning applications,

namely user interface design [5]. A good user interface design ensures a positive user experience so that the dyslexic child feels comfortable using the application [6]. A good user interface design also minimizes user errors that can hinder a child with dyslexia from learning [7]. User interface design in the dyslexia learning application will make it easier for the user to use the application and meet the user's needs in learning reading and counting.

User interface design can use several methods, such as Design Thinking Approach [8], User-Centered Design (UCD) [9], iterative design [10], agile design [11], and prototyping [12]. User-Centered Design (UCD) places the user at the center of attention throughout the design process [13]. In contrast, iterative design involves recurring cycles where each iteration produces improvements based on previously received feedback [14]. Furthermore, agile design advances team collaboration that works in short iterations and focuses on a specific feature or interface component in each one [15]. Prototyping involves building interactive prototypes that visually depict how the interface will work [16]. Of some of these methods, the Design Thinking Approach has advantages over other methods. Design Thinking provides a holistic approach that involves a deep understanding of the user, creativity in designing solutions, and continuous iteration [17]. Such an approach results in a better user interface regarding functionality, relevance, and user satisfaction. Therefore, the study developed user interface design using design thinking approaches for learning applications for dyslexic children.

This research aims to develop a user interface design for learning applications for dyslexic children. A learning application was developed based on gamification and multi-sensory. Gamification is the application of the elements of the game in the context of learning to increase learners' motivation and encourage them to be more active and engaged in the learning process [18] [19]. Meanwhile, a multi-sensory approach combining several types of sensory stimuli, such as visual, auditory, and tactile, can help strengthen understanding and better remember information [20] [21]. This research has a novelty in combining gamification and multi-sensory strategies to apply to user interface design applications for learning dyslexia. This learning application is expected to help improve the reading and counting skills of people with dyslexia so that they can understand the material effectively.

## 2 LITERATURE REVIEW

Research related to the development of user interface design in applications has been developed previously. The study [22] discusses the user interface design process of forming touchscreen-assistive learning numeracy apps (TaLNA) to teach basic calculations to children with autism. Furthermore, the user interface design was also developed by Yasmine et al [23] for tourism village websites using the User-Centered Design (UCD) method. Research [24] develops user interface design for college academic information systems using a design thinking approach. Other research [25] developed a mobile application design for disaster mitigation management using a design thinking approach. Previous research has only developed user interface design applications using specific methods, such as UCD or design thinking approaches.

This research has been a novelty in developing user interface design for gamification-based and multi-sensory learning applications. Research [26] [27] explores the effects of gamification on student motivation and involvement

in learning. Gamification is also used to motivate student learning in colleges [28] [29] [30]. The use of gamification also occurs in language learning [31]. Multi-sensory approaches are used for learning mathematics [32] and English [33]. In addition, a multi-sensory approach is used to improve the writing skills of students who learn English as second language [34]. The research above still has a limitation of using only one strategy, such as gamification or multi-sensory only to be applied in learning applications. Combining gamification and multi-sensory learning strategies in learning applications is expected to help learning more effectively [35]. Therefore, this research has the novelty of combining gamification and multi-sensory learning strategies to apply to dyslexic learning applications. This learning application is expected to help improve reading and math skills for people with dyslexia to understand the subject matter effectively.

## 3    METHOD

The method for developing user interface design in learning applications for dyslexic children uses the design thinking approach. The design thinking approach has five stages. The stages in the design thinking approach are Empathy, Define, Ideate, Prototype, and Test. Figure 1 shows the stages in the design thinking approach.
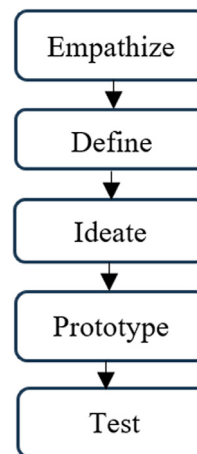


**Fig. 1.** Research methodology

### 3.1    Empathize

The first step is to understand users in depth. The technique is used to understand the user by conducting in-depth interviews. Interviews are conducted with students, teachers, and parents to dig up students' reading and counting difficulties data, as well as the availability of tools/applications that can be used to make students read and calculate easier, at home and school.

### 3.2    Define

After gaining user understanding in the first stage, the next step is to define the problem to be solved. The problem is that students with dyslexia have difficulty

reading and writing, making it difficult to understand the subject matter. Based on the issue, tools/applications are needed to help dyslexic students read and write. This definition stage focuses on the needs of the identified user and sets a clear goal for the development of the interface. The results at this stage will direct a design that matches the user's wishes.

### 3.3    Ideate

A possible solution for the problem that users experience is to create an application for dyslexic children. The basic idea is to design a user interface that meets the user's needs for learning applications for children with dyslexia. This application's user interface design combines gamification and multi-sensory strategies. The integration of several learning styles is expected to enhance the interactivity and enjoyment of the learning process, consequently enhancing the reading and counting proficiency of individuals with dyslexia.

### 3.4    Prototype

The next step is to create prototypes based on the generated ideas. The prototype was designed to realize an idea that demonstrates the features of the solution to improve the reading and counting abilities of students with dyslexia. The resulting prototypes can be mockups, wireframes, or more complete interactive prototyping. This prototype step generates a wireframe and then gives a touch of colors and images to give a clear overview of the application to be made for students with dyslexia. This prototype helps illustrate the proposed concepts and allows for initial testing with users to get further feedback.

### 3.5    Test

The last stage is the test phase, where the prototype is tested on the actual user, the student with dyslexia. These tests help gather valuable feedback about how users interact with the interface, what works, and what needs to be improved. Testing can reveal problems that may not have been seen before. At this stage, testing is also carried out using the System Usability Scale (SUS) [36] to measure user satisfaction with the application interface experience.

## 4    RESULT AND DISCUSSION

The following sections present the findings and discussion of the study.

### 4.1  Empathize

At the empathize stage, the researcher interviewed students, teachers, and parents of one of the elementary schools where there were students with dyslexia. Researchers explored the experiences of students, teachers, and parents regarding

learning to read and count by students with dyslexia, the obstacles experienced by students, teachers, and parents, and the desired needs in the application of learning to read and count. The results of this stage are as follows.

- The application contains instructions for parents or teachers to support their children in learning.
- The learning application has gradual content and is tailored to the needs and abilities of each student so that students can work on the training according to the learning development of each student.
- The application should have an intuitive interface that is easy to understand for teachers and parents.
- The app has features that praise and appreciate students for their achievements and provide give motivation in learning.

## 4.2   Define

The define stage identifies the user's needs in the application for learning to read and count dyslexic students. The list of application requirements is as follows.

- The application has a parent or teacher guide menu to accompany students in learning.
- The application has an attractive appearance and a clear font size to make it easier for users.
- The application integrates text with audio and there is an audio repetition feature to help learning.
- The application has a learning to read menu starting with reading letters, reading one syllable, reading two syllables, and reading three syllables.
- The application integrates visual, audio, and kinesthetic images in each lesson.
- The application has a menu for learning to count, starting to recognize numbers, counting objects, adding and subtracting.
- The application has reading exercises such as guessing letters, guessing words, reading words, guessing numbers, and counting numbers. Each exercise is provided with visual and audio images to facilitate the user.
- The application has a gamification feature that provides rewards in the form of scores and rankings to motivate participants.
- The application has gradual content, where the user must complete one easy stage first and then proceed to the next stage.

## 4.3   Ideate

After defining the problems and needs, the next stage is the idea stage to make a potential solution to develop the application. Figure 2 shows the menu flowchart in the learning application for dyslexic children.
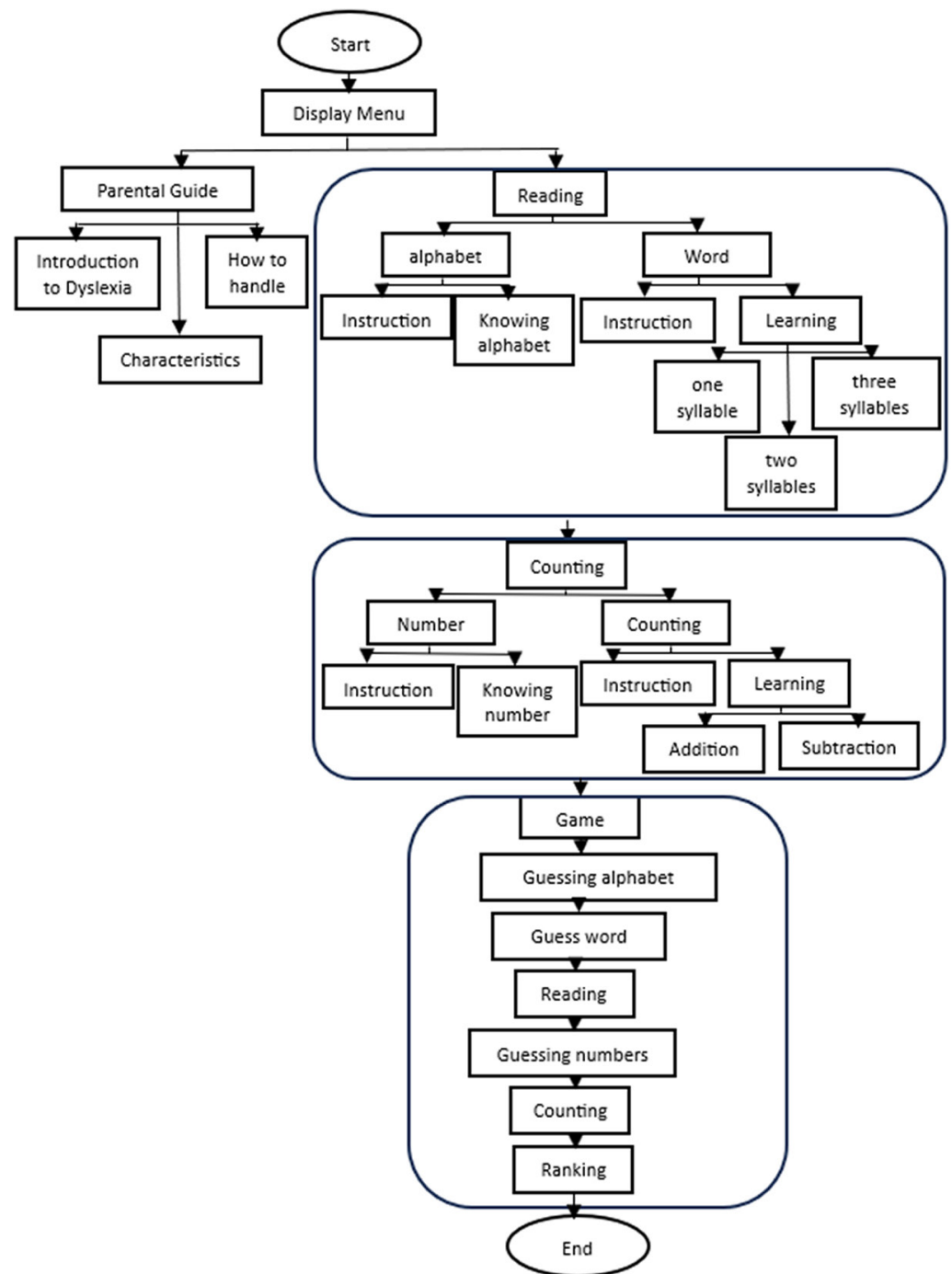
**Fig. 2.** Flowchart menu in user interface design application

The reading and counting learning application for children with dyslexia has a menu display that contains the parent guide, reading, counting, and game menus. The counting menu is only accessible if the user has already studied the reading menu and the game menu is accessible only if the users have already learned the counting menu. The parent guide menu is a guide for parents and teachers in accompanying learning dyslexia students using this application.

Then, the reading menu is gradually designed according to the students' abilities. The reading menu contains the reading alphabet and reading word menus.

The instruction menus for parents or teachers and the alphabet menu are on the reading Alphabet menu. Next, there is the reading word menu with instructions for parents and teachers, and the learning reading menu. The learning reading menus consist of three menus: reading one syllable, reading two syllables, and reading three syllables.

The counting menu is a menu for learning to count, starting with the number menu, which consists of the instructions and knowing numbers menus. Furthermore, the counting menu consists of an instruction menu and a learning menu. The learning counting menu consists of addition and subtraction.

Finally, the game menu consists of several games designed in stages, namely guessing alphabet, guessing words, reading, and counting. The user can play by answering five questions per game with the time available and a score if the answer is correct. There is also a ranking menu on the game menu that sorts users according to their ability to work on the game. This is used to motivate users to learn to use this application.

## 4.4 Prototype

This stage makes a prototype by designing the user interface according to user needs. The application prototype uses Indonesian to make it easier for users. Creating a user interface for this application uses Figma application. The following is a user view and explanation for the learning application for dyslexic students.

The user enters the application and the menu appears. Menus that can be accessed are the parent guide and reading menus. The counting menu and game menu can only be accessed after the user has passed the reading menu. The menu display and parent guide can be seen in Figure 3.
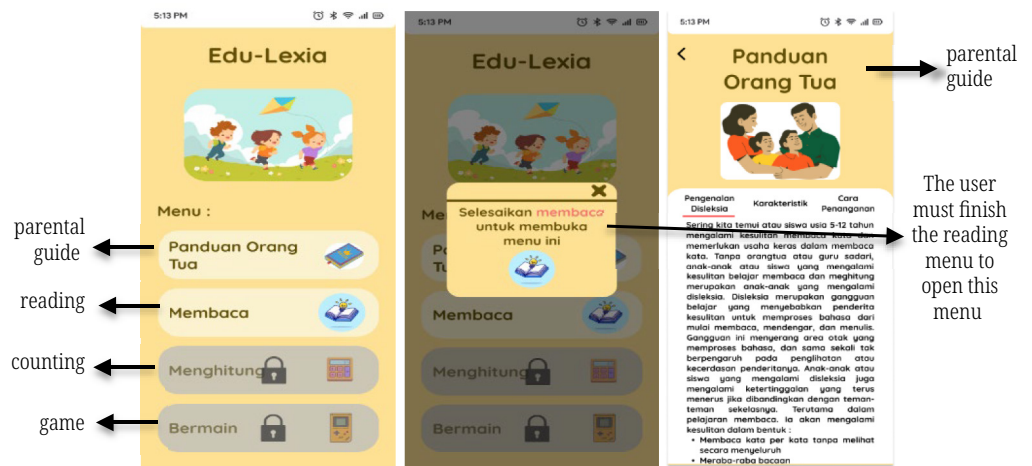


**Fig. 3.** The display of the main menu and parental guide

Furthermore, the reading menu consists of reading the alphabet and reading words. Before accessing the reading menu, the application has an instruction menu to guide parents or teachers in assisting dyslexic students. Figure 4 shows a picture of the menu for learning to reading, instructions, and know the alphabet.

**Fig. 4.** The display of the learning to reading, instructions, and knowing alphabet menu

The alphabet reading menu consists of reading one syllable, reading two syllables and reading three syllables. Figure 5 shows the menu display for reading alphabet.



**Fig. 5.** The display of the reading alphabet menu

After accessing the reading menu, the user can access the counting menu. On the calculating menu, there is a numbers menu and a counting menu. The numbers menu contains instructions for parents and teachers and recognizes the numbers 1 to 10. Figure 6 shows the menu for counting, instructions, and know the number.



**Fig. 6.** The display of counting, instruction, and knowing numbers menu

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Furthermore, the calculating menu consists of adding and subtraction operations. Users can learn to add and subtract numbers through examples in the application. Figure 7 shows the display of calculating, addition, and subtracting operation menu.
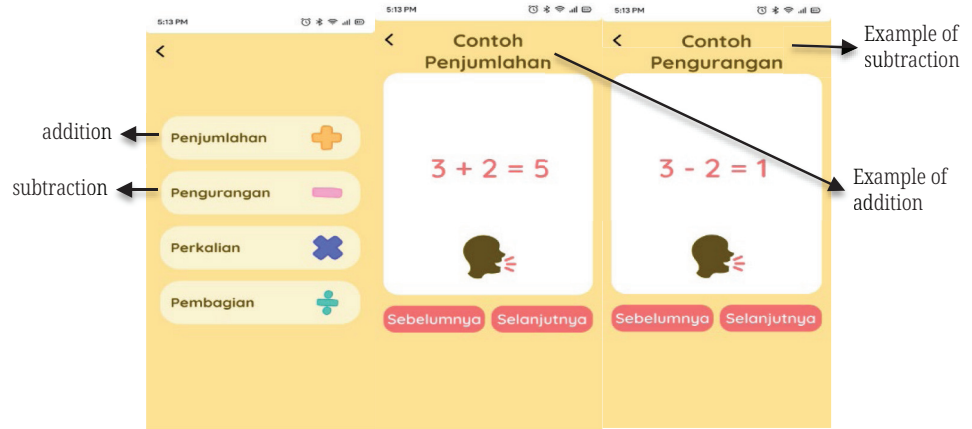


**Fig. 7.** The display of the counting, addition, and subtraction operation menu

The game menu is designed to practice learning to read and count. The application will ask the user to enter a name, then the user will enter the game menu display. The game menu consists of guessing letters, guessing words, reading, guessing numbers, and counting. Finally, the ranking menu displays the ratings of users who play games so that they can motivate students. Figure 8 shows the display of the game menu.



**Fig. 8.** The display of the game menu

## 4.5 Test

This stage tests the prototype user interface design for real users. Testing was carried out using the System Usability Scale (SUS), where users were asked to try using the system's user interface and evaluate it by filling out a questionnaire. There were 10 dyslexic students who participated in the user interface test. The questionnaire consists of 10 questions on a Likert scale of 1–5 (Strongly Disagree – Strongly Agree).

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very awkward to use.
9. I felt very confident using the system.
10. I needed to learn many things before I could get going with this system.

Then, the questionnaire was processed based on the System Usability Scale (SUS) method. The results show that the total average value of SUS is 82. The score results are included in the excellent category with a grade scale of B. This indicates that the user interface design of learning applications for dyslexic students in terms of usability gets an assessment that is acceptable or suitable for use by users.

## 5    CONCLUSION

This research successfully developed a user interface design for learning applications for dyslexic students using a design thinking approach. The stages in the design thinking approach are Empathy, Define, Ideate, Prototype, and Test. The user interface design development produces several features, namely the parent guide menu, learning to read, learning to count, and games to practice reading and counting. The application's user interface design also pays attention to gamification and multi-sensory aspects to help improve the reading and counting skills of people with dyslexia so they can understand the subject matter effectively. Evaluation of the user interface design using the System Usability Scale (SUS) method produces the total average SUS of 82. It shows that the user interface design of learning applications for dyslexic students in terms of usability gets an assessment that is acceptable or suitable for use by users.

Future research can implement the user interface into a mobile application that can be used directly by dyslexic students. Future research can also compare user interface design development methods other than the design thinking approach, such as User-Centered Design (UCD), Iterative design, or Agile design. Future research can also apply artificial intelligence technology that can be used to analyze user behavior and produce more personalized designs.

## 6    ACKNOWLEDGMENT

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