Kinect-Based Learning Games for Dyslexic Children

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ABSTRACT

Dyslexia is a developmental disorder of reading and writing that generally found in children from 7 to 8 years old. Learning difficulty in reading fluency and difficulty in understanding normally or above average are the characteristics of children with developmental disorders. This study aims to build a game that can be easily utilized to introduce letter types and several techniques of reading with the correct spelling attached to pictures of each spelling. This educational game is Kinect-based so it is interesting and interactive for users and can help children with dyslexia in the process of learning reading. The research method used is the SDLC (System Development Life Cycle). The study also studies students' ability to recognize numbers. Based on interviews with teachers, students did not recognize all forms of numbers. The result of this study is the design of an educational game that is expected to help to improve the fluency of reading in dyslexic children.

Key words : Eeducational game, Dyslexia, Kinect, Children.

1. INTRODUCTION

Children with dyslexia are children which are characterized by disorders in reading and writing development and generally occur in children aged 7 to 8 years. Dyslexia is more likely viewed as a difference in reading difficulties due to other causes, such as non-neurological disorder in vision or hearing and or weak understanding in reading instructions. There are 3 cognitive aspects of dyslexics: hearing, vision, and attention.

Games are advancement in the current technology [1]. Games are widely played as entertainment media. Through age, games are not only used as a medium of entertainment but also to improve one's thinking ability [2].

Based on the results, researchers will develop an educational game entitled 'Kinect-Based Learning Game for Dyslexia Children. This research as proposed by several researchers, in which the material is related to educational games [3]. In designing the game, several users are used as in previous studies such as dyslexic children [4] and some regular students [5].

The tools used in this study have been applied in other linear studies, namely construct [6], *CorelDraw* [7], *google chrome* [8] and Kinect-Based Educational Games for Children with Special Needs (Autistic) with the Finite State Machine Method [1].

The research method used is the SDLC (System Development Life Cycle) of the Waterfall model conducted through observing children with dyslexia in teaching and learning activities in a particular classroom and identifying children's obstacles related to their interests and development in reading.

The purpose of this study is to facilitate the process of learning reading to dyslexic children with Kinect-based. Kinect is a new technology for game devices that scans human movements and are processed in animation or game function [9]. This game can increase children's interest in learning reading as it is interactive and can be understood easily.

2. RESEARCH METHOD

The researchers utilized SDLC (System Development Life Cycle) method of the Waterfall model [10] by observing dyslexic children in teaching and learning activities in the classroom and identifying children's obstacles related to their interests and development in reading.

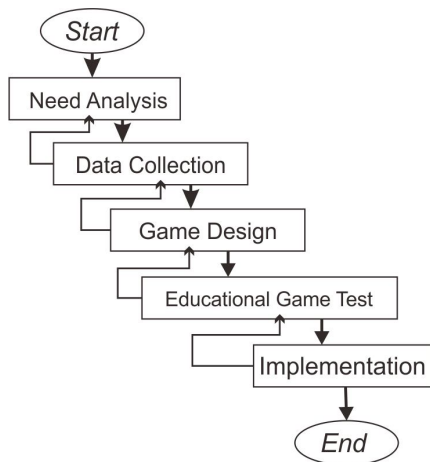The SDLC (System Development Life Cycle) method of the Waterfall model is shown in Figure 1.

Figure 1: Research Method Flowchart

2.1 Need Analysis

Researchers conducted an interview with a teacher of first grade in MIM PK Kartasura. Researchers observed several learning curricula to obtain data. The results of the interview with a teacher are as follows :

   a. Rewriting what has been written on the blackboard by teachers is one of the methods in children's learning, with the expectation that this learning method can improve children's memory in arranging sequential letters to be applied and spelled into a reading.

   b. Commonly, children easily get bored and cannot rewrite the letters that have been written by teachers, so the presence of media is important to eliminate dullness in the learning process.

   c. Students need guidance and assistance to accept and apply learning in the classroom, especially during interaction with learning media that are still unfamiliar and novel to them.

   d. The curriculum in MIM PK Kartasura is theoretical and thematic, so teachers must carefully and patiently teach a number of themes and students potentially find it difficult to accept the material in class.

There are several needs analysis to create learning games for dyslexic children :

2.1.1 Tools and Materials

The tools and materials used to create the edugame are explained in Table 1.

2.2 Data Collection

Based on the results of the analysis, researchers collected some required data, such as preparing the Construct 2 game engine and other supporting software. Data to be used and prepared objects are according to the children's needs that later to be displayed.

Table 1: Hardware and Software Needs

Hardware	Software
Laptop Asus Intel *Inside* ram 2 GB RAM, *Hardisk* 500MB	a. *Construct 2* b. *CorelDraw X7* c. *Adobe Ilustrator* d. *Mozila Firefox* and *Google Chrome*

2.3 Educational Game Design

The stages that researchers did in making educational games include :

2.3.1 Arising of Game Ideas

The main idea of this game is triggered by the learning interest of children with special needs, especially children with dyslexia that is changing every time. When the learning process that initially uses the rewriting method has become plain for students, so children show undesired motivations to learn. Based on that background, researchers are eager to develop a learning method using Kinect with a motion sensor.

2.3.2 Making a Storyline

Researchers created a storyline from educational games as follows :

a. There is a playground containing various fruits and types of plants.

b. On the next page, the users must first complete the challenge to go to the next field.

c. The first field that the users must complete is to pair the fruit object with the fruit name at the bottom continuously up to the next level.

d. At every level, users must solve the same challenges but with different objects.

e. The level of difficulty in every level is almost the same.

f. At the end of the game, refound in the form of score and sprinkling stars will be given to the users as a gift.

2.3.3 Storyboard Making

Based on the storyline that has been written, the researchers created a storyboard to facilitate the process of making educational games[11]. In Figure 2, there are pictures of the

characters in this game. The characters consist of several objects of plants, fruits, school equipment, animals, home appliances and other characters that are often found in everyday life.

Figure 3 is the illustration of the main page. On the main page, the researchers gave the title of the game "fill the world", which explains about objects in the world ranging from fruits, plants, to home appliances.
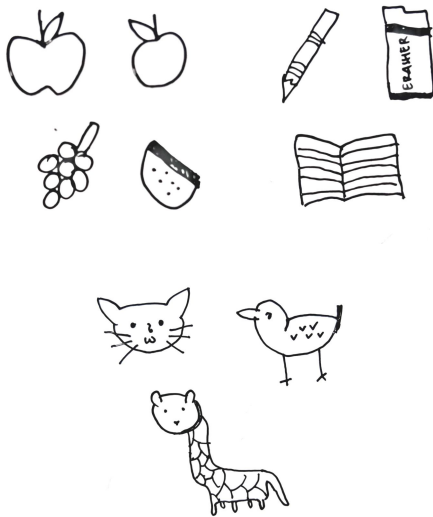

Figure 2: Main character objects

Figure 3: Main page

In Figure 4 the second page is to start the challenge. There are several levels available on this page, start from level 1 to level 5. However, 4 levels are still locked, which means the users must complete the challenge at level 1. After passing the first level, the next level will be automatically unlocked.
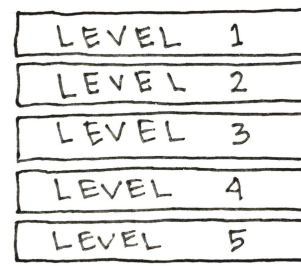

Figure 4: Start page

The next step is when one level is chosen, then the first arena will appear at level 1. From the illustration, the game will automatically lead the users to start on the first point, the users must choose one of the words available under the picture based on the commanded image. After completing level 1, level 2 will automatically open and directly leads to the level 2 page and so on to the next level. The storyboard used to create the edugame are explained in Table 2.

Table 2: Storyboard

No	Figure	Information
1		Figure Level 1
2		Figure Level 2
3		Figur Level 3
4		Figur Level 4
5		Figur Level 5

2.3.4 Creating Educational Game Objects

The objects of this educational game are some of the images needed to build an educational game visualization as explained in previous researchers [12] , visualization of the game fill the world will be adjusted to the storyboard that has been written. Images creation was completed using CorelDraw and Adobe Illustrator software.

2.3.5 Music and Sound Preparation

Based on the aforementioned storyline, this educational game raises the topic of puzzles. Therefore, the author uses adventure background music for the materials and shocking background music when the users have successfully overcome obstacles [13]. Moreover, there are several sound effects to liven up the atmosphere of the game. To ease users to read the material, researchers downloaded the sound through the internet and recorded sound using Asus Zenfone 2 camera and edited it to be inserted into Construct 2 using Format Factory and Audacity software.

2.3.6 Build Educational Game

After the preparation complete, researchers began to created edugame using Construct 2.

2.4 Testing Educational Game

After the educational game had been made, researchers conducted a Blackbox test of the buttons used in the edugame whether it was functioning properly or not as formulated in a study by [14-15]. For multi-platform needs, the researchers developed this educational game to be opened using one type of platform, which is desktop.

2.5 Implementasi *User Testing*

Implementation of User Testing was carried out at schools in MIM PK Kartasura to find out the usefulness of this educational game. The respondents who participated from the five schools were 4-5 students.

3. RESULTS AND DISCUSSION

This research produced an educational game about one's journey in completing a mission to discover some of the contents of the earth while simultaneously learning to practice concentration and accuracy, also can help the process of learning to read and memorize letters that are commonly used in everyday life to children with dyslexia. The following is a discussion of the results of the research :

3.1 Educational Game Display Results

The structure of this educational game can be seen in the flowchart shown in Figure 5.

3.1.1 Main page

This educational game begins with the Main page shown in Figure 6. On this page, 2 main menus are available, the Play Button to start the game and the Sound icon Button in the upper right corner to turn on and off the background music. In addition, there is an exit button in the top left corner to exit the game.
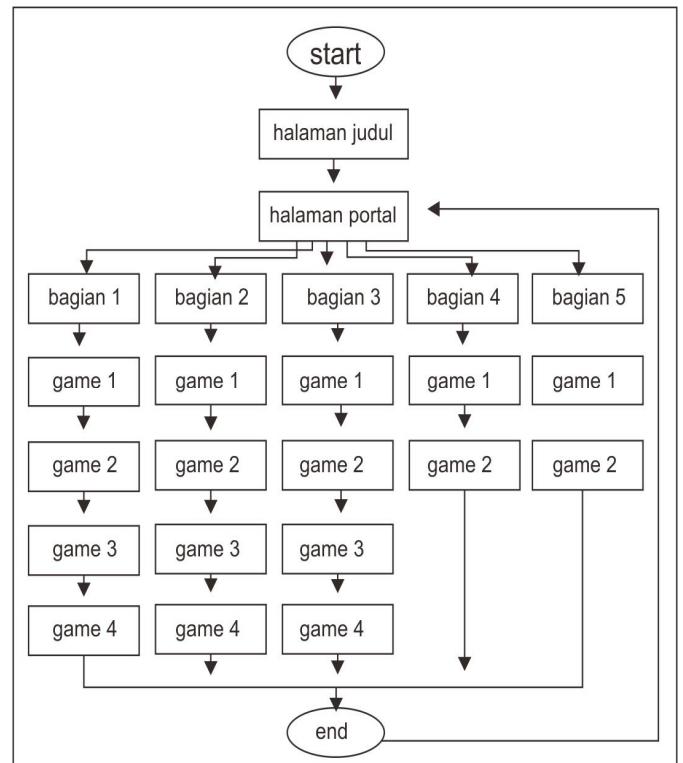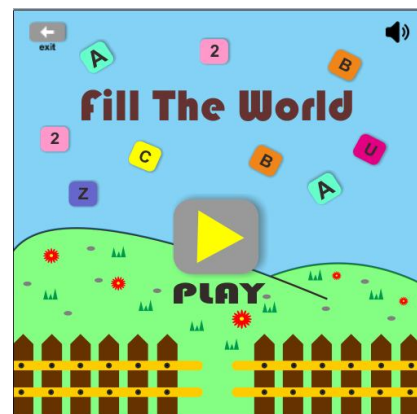

Figure 5: Educational Game Flowchart

Figure 6: Screenshot of Main page

3.1.2 Portal page

When the play button is clicked, Portal Page will appear as in Figure 7. On this Portal Page, there are 6 main menus in illustrations and also divides this educational game into 5 parts: level 1, level 2, level 3, level 4, and level 5. Also, there is a back button to return to the main page.
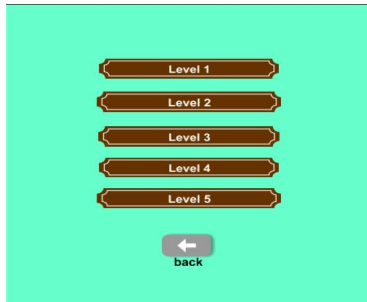

Figure 7: Screenshot of Portal Page

3.1.3 Level 1

The part one shown in Figure 8 is a players' adventures to match the names to the random objects. At level 1, several objects must be matched with names, such as fruits, stationery, animals, and daily necessities. After the players successfully match the picture with its names, the players will earn 5 scores, and so on.
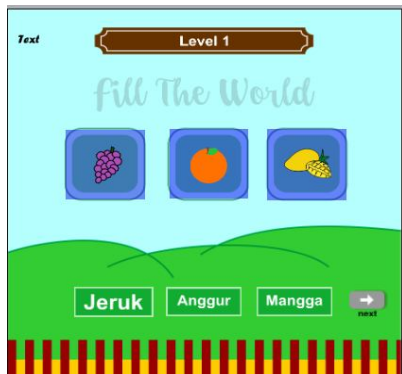

Figure 8: Screenshot of Level 1

3.1.4 Level 2

Part two shown in Figure 9 is to complete the missing letters of words placed next to the objects. Missing letters are available under words and objects where players drag and drop to the place where letters are missing. At this level, players will also earn 5 scores when they have placed the missing letters correctly

Figure 9: Screenshot of Level 2

3.1.5 Level 3

Part three shown in Figure 10, which is matching objects with names. This level shares similarities with the level one that uses drag and drop, but in level 3 the players only click on available words and connecting lines will appear between the objects and objects' names. At level 3, players will earn 5 scores if they succeed in matching objects with their names.
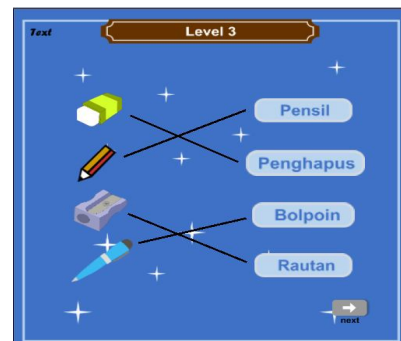

Figure 10: Screenshot of Level 3

3.1.6 Level 4

Part four shown in Figure 11 is matching objects with their names. Level 4 is almost similar to level 1, but it only uses 1 object with some names provided under the object. The players only drag and drop the text under the object. The players must choose one of the correct names to match the object. Players will obtain 5 if they successfully match the object with its name.

Figure 11: Screenshot of Level 4

3.1.7 Level 5

Finally, part five shown in Figure 12 is to catch the ball that falls after touching the letterbox. It consists of 1 ball and several letterboxes where each box consists of 3 colors. If the ball successfully touches 1 box to 3 colors then the players will get 5 scores.

3.1.8 Scoring

This scoring explains that each point in the completed game will earn 5 points. At each level, the total score is different because each game has a different number of challenges. There is no score reduction if an error occurs. If the players make a mistake, then the object being played will be silent (some returning to its place) and wait for the players to do the challenge correctly. This applies to the next level.

3.1.9 Blackbox Testing

This Blackbox Test is to show the function of the software on how to operate a game, whether the input data output has been going well or poor [16-17]. Table 2 shows that the Edugame Blackbox test can run properly on a desktop device.

Figure 12: Schreenshoot Level 5

Table 3: Blackbox Testing

no	Test Class	Test Scenario		Expected Results	Results
1	Main page	Play button	Click the button to enter the portal page	Back to the portal page	valid
		Icon sound button	Click sound button	Turn on and off the sound	valid
		Exit button	Click exit button	Exit from application	valid
2	Portal Page	Back button	Click back button	Move to the main page	valid
		Level 1 button	Click the start button to play level 1	Move to the page to start level 1	valid
		Level 2 button	Click the start button to play level 2	Move to the page to start level 2	valid
		Level 3 button	Click the start button to play level 3	Move to the page to start level 3	valid
		Level 4 button	Click the start button to play level 4	Move to the page to start level 4	valid
		Level 5 button	Click the start button to play level 5	Move to the page to start level 5	valid
3	Page Level 1	Drag and drop mouse pointer	Click the name and drag to the object	Earn 5 scores if the names are dragged to correct object if failed the names will return	valid
		Next button	Click next button	Display layout of the next game	valid
4	Page level 2	Drag and drop mouse pointer	Click the letter and drag to empty space	Earn 5 scores if letters are dragged to correct place if failed the letters will return	valid
5	Page level 3	Drag and drop mouse pointer	Click object name	Earn 5 scores if object names match the objects	valid
		Next button	Click next button	Display layout of the next game	valid
6	Page level 4	Drag and drop mouse pointer	Click object name and drag to the object	Earn 5 scores if the object names are dragged to correct object if failed the names will return	valid
7	Page level 5	Black ball	Ball falls vertically	Display ball falling and is blocked by line under according to the right and left button on the keyboard Earn 5 scores if boxes change color twice and disappear.	valid
		3 color box	Touched by ball	Display box color changing twice due to bouncing ball and disappear	valid

5. CONCLUSION

Educational games for children by using Kinect have been tested by BlackBox with the results showing that this educational game can run well on desktop devices. Henceforth, this educational game can improve dyslexic children in reading, writing, and recognizing letters. Suggestions for the application and the development is to improve the appearance to be more attractive and enhance the features of the game display.

ACKNOWLEDGEMENT

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