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RESEARCH ON THE USABILITY OF GAMES FOR THE INTERVENTION OF KOREAN DYSLEXIA - FOCUSING ON COUNTING GAMES –

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Abstract

It is estimated that around 5% of the Korean population, or about 2,500,000 people, have dyslexia. For the purpose of developing a functional dyslexia intervention, online phonological awareness games that focus on counting syllables and phonemes have been developed. In this research, a usability test was conducted to evaluate two such games. A checklist was developed based on the test results of the User Interface experts. The checklist consisted of 10 questions to be answered by students and 18 questions for clinicians. The subjects for the usability test comprised 21 students and 22 clinicians. A test platform was developed to provide a test environment that was conducive to playing online games. The analysis of the usability test results has been grouped into two parts: a quantitative analysis and a qualitative analysis. Based on the quantitative analysis results, the dyslexic students averaged 8.5 points (±1.53) on a Likert Scale of 10; while the dyslexia clinicians averaged 8.7 points (±0.87) on the same Likert Scale. Based on the results of the qualitative analysis, an enhancement of the rewards function, a better

user interface for the button used to check for the correct answer, and a button to enlarge the screen were identified as areas for improvement. In the future, the requirements of the test subjects and the stakeholders will be taken into consideration, and the games will be improved accordingly.

Keywords

Usability Test, Phonological Awareness, Online Education Game, Dyslexia, Intervention

1. Introduction

Phonological dyslexia is a condition caused by a problem in the phonological information processing system, namely the phonological pathway, which is composed of the units of speech sound in a language (Kim yong wook et al., 2015). In this type of dyslexia, a person has difficulty in recognizing the speech sounds. The problem occurs before the letter recognition phase of development. Therefore, a phonological education which can help a child to recognize and process speech sounds in the units of words, syllables, and phonemes is required. Phonemic recognition, in particular, plays an important role in the ability to read and write letters (Ehri, 2000), so it is crucial to teach children with a disability in terms of speech sound recognition to develop the fundamental skills and capabilities of phonemic recognition. This research paper will mainly discuss the usability of the educational programs (online games) that have been developed to teach syllable counting and phoneme counting skills to children.

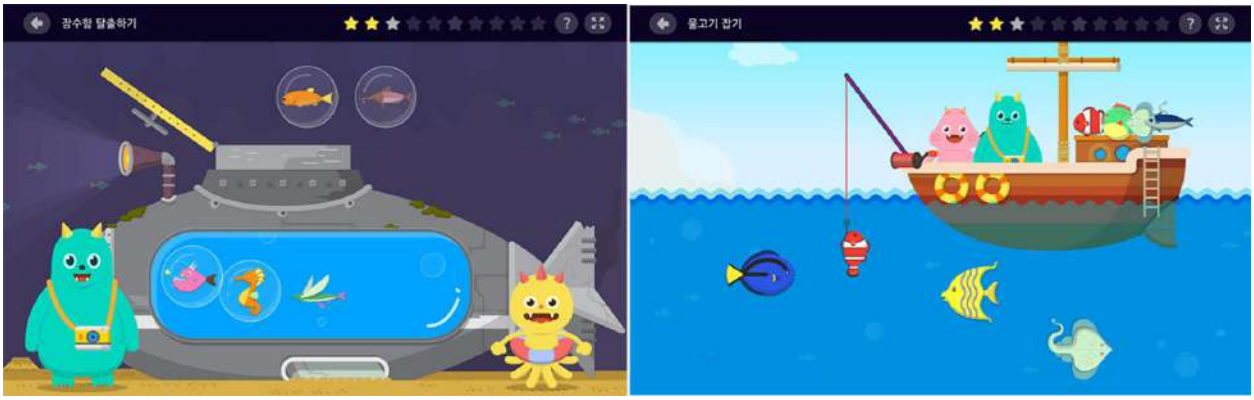

Figure 1: *Syllable-counting Game (left), Phoneme-counting Game (right)*

2. Method

A checklist was developed to conduct usability tests for the syllable-counting game and phoneme-counting game. This section describes the checklist the was developed for the two groups of test subjects – composed of dyslexic students and clinicians – as well as the test environment in which the usability evaluation was performed.

2.1 Usability Test Checklist

For the usability tests of the syllable-counting game and the phoneme-counting game, two separate checklists (using a Likert Scale of 10) were created for the dyslexic students and the clinicians, respectively. The checklists consisted of four categories: the game manual, tutorial, playing the game, and learning management (Table 1). For the students, the checklist had a total of 10 questions that consisted of: 1 tutorial category question, 7 questions from the playing the game category, and 2 questions from the learning management category. For the clinicians, there were a total of 18 questions consisting of: 2 questions from the manual category, 2 tutorial category questions, 9 questions from the playing the game category, and 5 questions from the learning management category.

Table 1: *Usability Test Checklist*

Category	For the Students	For the Clinicians
Game Manual	-	1. The game icon images have been selected appropriately according to the theme.
		2. The titles of the game menu and the buttons are intuitive, so the users can easily recognize what functions the menu or button will provide.
Tutorial	1. It's easy to play the game.	3. By using the tutorial, the students can easily learn to play the game.
		4. The rules of the game are sufficiently explained.
Playing the Game	2. The game is fun.	5. The background images in the game (such as the underwater sea scenes, and the scenes above the water, and the islands) are interesting for the students.
	3. I think I can do better if I play this game again.	6. The images of the objects in the game such as the fish, submarine, fishing boat, seagull, and the coconut tree, are interesting for the students.
	4. I like the characters in the game.	7. The background sound effects make the game more realistic.
	5. I like the fish in the game.	8. The images of the characters in the game are interesting for the students.
	6. I feel good when I receive a yellow star.	9. The voices of the characters in the game are interesting for the students.
	7. I don't feel good when I receive a gray star.	10. The game flows naturally from one stage to another.
	8. I feel good when I receive a badge.	11. It is necessary to show the progress of the game in a visual manner, both how much has been played and how much is remaining, by using the stars whenever the user ends the game.
	-	12. I think the yellow stars will motivate the students and the students will consider the yellow stars as rewards.
	-	13. Gaining badges will provide psychological rewards for the students.
Learning Manage	9. I'm curious about the next phase of the game.	14. The stages of the game shown in the game map can provide the students with both a purpose and motivation for playing this

ment		game.
	10. I'd like to gain more badges.	15. The game-based learning is helpful for the purposes of dyslexia intervention.
	-	16. There is a tendency for the score to go up as the user plays the game repeatedly.
	-	17. Providing different content based on the level can increase the sense of accomplishment for the students.
	-	18. The number of accumulated badges shown in My Page can be a factor in satisfying the students.

2.2 Usability Test

The usability test was performed with 21 dyslexic students from an Uijeongbu Education District elementary school, ranging from those in Grade 2 through to Grade 4, and 22 clinicians. For the evaluation, an online game test platform was developed. The students and the clinicians first played the online games, and then they evaluated the games based on the usability test checklist.

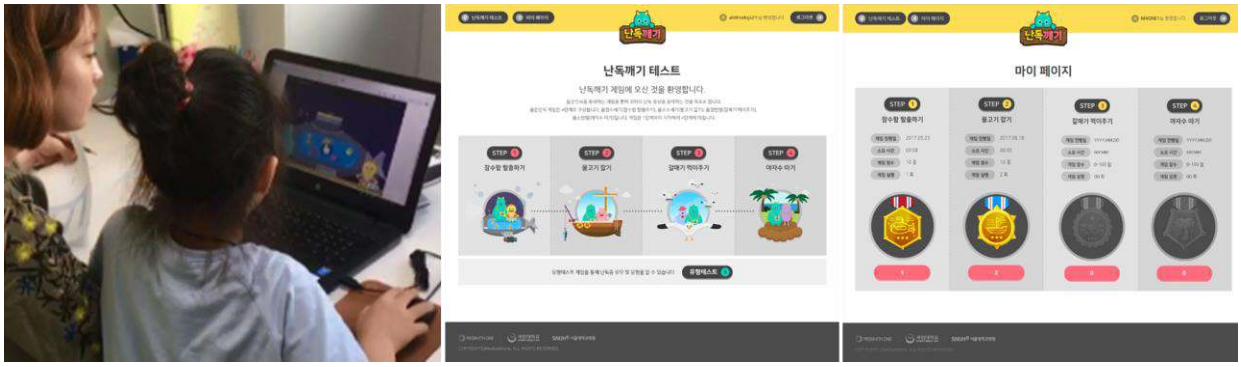

Figure 2: *Usability Test Scene (left), Test Platform (right)*

3. Analysis

3.1 Quantitative Analysis

In order to evaluate the usability of the counting games, the test results from 19 dyslexic students and 22 clinicians were analyzed. Two of the 21 students were deemed to be biased so their test data was discarded. Also, question Number 7 had negative connotations, and it was deemed inappropriate to assess the Likert Scale score for this question along with all the other questions which had positive connotations. Therefore, the data from question Number 7 was excluded from the analysis. To analyze the usability test results quantitatively, the scores and the average score of each checklist question were gathered. Based on the resulting computation, the

average score for the dyslexic students was 8.5 points (±1.53) (Table 2), and the average score for the clinicians was 8.7 points (±0.87) (Table 3).

Table 2: *Usability Test Results for the Dyslexic Students*

Type	Subjects	No.1	No.2	No.3	No.4	No.5	No.6	No.8	No.9	No.10	Average	Total
Student	**1**	10	10	10	10	9	9	10	10	10	9.8	**8.5**
	2	10	10	10	10	9	10	10	10	10	9.9	
	3	5	6	10	5	7	7	9	2	8	6.3	
	4	10	10	10	10	10	10	10	10	10	10.0	
	5	5	1	2	5	10	8	10	5	10	5.8	
	6	10	9	0	0	7	5	9	10	3	5.5	
	7	9	10	10	10	10	10	0	0	0	7.4	
	8	10	8	8	5	5	7	7	10	6	7.4	
	9	10	10	10	10	10	10	10	10	10	10.0	
	10	5	5	10	10	10	10	10	10	10	8.8	
	11	10	5	10	1	9	10	10	0	10	6.9	
	12	10	10	10	10	10	10	10	10	10	10.0	
	13	10	10	10	8	1	10	6	10	6	8.1	
	14	10	10	10	10	10	10	10	10	10	10.0	
	15	10	10	10	8	9	10	10	10	10	9.6	
	16	10	10	5	7	9	10	10	10	10	8.9	
	17	10	10	8	10	9	10	10	10	10	9.6	
	18	5	10	10	10	0	10	10	10	10	8.1	
	19	8	10	9	8	9	10	10	9	10	9.1	

Table 3: *Usability Test Results for the Clinicians*

Type	Subject	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16	#17	#18	Average	Total
Clinician	**1**	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	9.9	**8.7**
	2	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	9.9	
	3	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10	9.9	
	4	8	9	8	9	7	8	9	8	9	8	7	7	9	8	9	9	7	9	8.2	
	5	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10	9.9	
	6	10	10	6	10	9	8	9	10	8	9	10	4	1	1	7	3	5	4	6.9	
	7	10	10	10	10	10	6	7	9	6	5	10	10	10	5	7	10	10	10	8.6	
	8	7	6	9	9	8	8	8	7	7	7	9	9	9	8	6	9	9	9	8.0	
	9	8	8	8	8	8	8	8	8	8	8	7	8	7	7	8	7	7	7	7.7	
	10	9	10	10	10	8	8	9	9	9	10	10	10	7	9	8	9	7	8	8.9	

11	10	8	10	10	10	10	8	10	5	8	10	8	10	10	5	8	10	10	8.9	
12	9	8	10	10	9	9	8	8	8	8	9	9	9	9	8	8	9	9	8.7	
13	8	6	8	9	9	8	8	7	7	8	8	7	9	7	8	8	7	9	7.8	
14	10	8	10	10	10	10	8	10	10	10	8	10	10	8	10	10	10	8	9.4	
15	8	7	9	9	9	9	8	8	7	8	7	8	8	7	7	7	7	9	7.9	
16	10	8	10	10	10	10	10	10	10	8	10	6	8	8	8	10	8	9	9.1	
17	8	7	9	9	9	9	8	8	7	8	7	8	8	7	7	7	7	9	7.9	
18	8	6	8	10	9	10	8	10	8	8	10	10	10	7	7	7	8	7	8.4	
19	10	10	10	10	7	8	10	10	10	7	10	10	10	10	10	8	10	10	9.4	
20	8	8	9	9	10	10	7	7	8	8	9	6	8	8	6	6	5	5	7.6	
21	10	8	10	10	10	10	10	10	10	8	10	9	10	10	9	10	10	10	9.7	
22	9	9	8	9	10	7	8	9	5	7	8	7	8	8	7	9	7	9	8.0	

3.2 Qualitative Analysis

In order to qualitatively analyze the usability of the games, a number of issues that had been raised were gathered from the test subjects – the dyslexic students and the clinicians – as well as from the experts of the Korean Dyslexia Association and UI experts, and solutions to these issues were presented.

Table 4: *Qualitative Test Results and Solutions*

Stake-holders	Game	Issues	Solutions
Students	Counting Syllables (Escape the Submarine)	UX Design: the subject feels good after receiving the gray star. The gray star is supposed to be a penalty, so its negative connotation is not being conveyed clearly.	While making the game interesting for the students, create visual and audio effects that will accurately convey the meaning (e.g. the star might explode, a gray star could turn into a stone, or a sound effect could be added)
	Counting Phonemes (Catching Fish)		
Clinicians	Counting Syllables (Escape the Submarine)	The rewards function should be enhanced: The badge rewards are weak in comparison to the efforts that are put in by the students to receive them	Make the animation effects fancier and more active - Make the size of the reward badges bigger -Have the game characters jump up and down or stamp their feet (indicating a happy mood) - Keep the cheering sound effect for longer
	Counting Phonemes (Catching Fish)		
Korea Dyslexia Association	Counting Syllables (Escape the Submarine)	Users aren't induced to click the enlargement button	Induce users to click the enlargement button (e.g.: make the button flash in different colors)
	Counting Phonemes		

	(Catching Fish)		
UI Experts	Counting Syllables (Escape the Submarine)	Users aren't induced to click the button to check for the correct answer Users aren't induced to click the button to listen to the correct answer again	Make the button blink when no action has been taken within 3 seconds
	Counting Phonemes (Catching Fish)	Users aren't induced to click the button to check for the correct answer Users aren't induced to click the button to listen to the correct answer again The questions need to be read out more loudly	Make the button blink when no action has been taken within 3 seconds Increase the volume of the questions being read out by about 30%

4. Conclusion and Discussion

The subjects in this research – the dyslexic students and the clinicians– performed a usability test of the syllable-counting game and the phoneme-counting game based on a checklist.

As a research limitation, the usability test was performed with 21 dyslexic students from a Uijeongbu Education District elementary school, ranging from those in Grade 2 through to Grade 4. The analysis of the usability test showed an average score of 8.6 points out of 10 points, indicating that the score was fairly high overall. However, there were requests from the subjects to enhance the reward function and improve the game user interface. In the future, the requirements of the test subjects and the stakeholders will be taken into consideration, and the games will be improved accordingly.

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