



Mobile Game-Based Learning to Enhance the Reading Performance of Dyslexic Children

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ABSTRACT

Children with dyslexia are one of the learners in special education that need an intervention tool such as a game-based learning system to enhance learning. This type of learner has different learner characteristics that need to consider in designing and developing an effective game-based learning system for them. This study aimed to identify the specific game elements that shall be integrated into the mobile game-based learning system developed in the previous study of the researchers and identify if there is a significant difference in the reading performance of the dyslexic children in using the LaroLexia. The game elements identified in this study that need to be integrated into the LaroLexia application are based on the learning needs of the children with dyslexia to have an effective game-based learning system. The pre-test and post-test results on the reading of letters and syllables administered before and after the implementation of the mobile-game-based learning system were compared using the paired t-test. The t statistics results shown that there is a significant difference in the reading performance of dyslexic children. Therefore, it shall be considered as one of the learning materials or tools in the basic reading of the Filipino language for dyslexic children. This application shall be also considered as one of the interventions for dyslexic children to manage their reading disability.

Key words: dyslexic children, game-based learning, game elements, learning approach, mobile game-based.

1. INTRODUCTION

Dyslexia is a specific learning disability that affects the ability to read and process language-based skills [1]. Because of their disability support from the families and teachers is needed in the learning process. Developing and designing additional materials or learning tools for dyslexic children is one of the ways to help them to manage their learning disabilities. Nowadays, a game-based learning system is one of the tools used to enhance the learning performance of dyslexic children. But this type of learner has different learner characteristics that need to consider in designing and

developing an effective game-based learning system to avoid psychological stress to the learners.

A game-based learning (GBL) approach is one of the popular techniques used to enhance the learning of learners through educational computer games. Games can increase the motivation of children to learn [2]. GBL used to enable students to engage and increase interest in the learning process while playing [3] and engagement in the game has an affirmative learning outcome [4].

GBL systems using technology are one of the methods in the education system today to enhance knowledge of the various types of learners. Different factors need to consider to design and developed usable and effective game-based learning for children with dyslexia. There are different design game elements and features that are integrated into the game-based learning approach to enhance the motivation and engagement of the users to the game-based learning system but not of them applies to the children with dyslexia due to their learning disability. Selection and identifying of game elements and features are some of the factors to consider to design and developed an application for them. It is important to consider appropriate game mechanics for user types, as some research has shown that certain elements of the game can produce a contrary result against a particular type of user and use an adaptive approach to match the individual motivational preferences with the correct game elements [5]. Moreover, game-based learning must identify how each game element selected promotes the learning process of the learners [6].

In this context, the researchers conducted this study to identify the game elements that must be integrated on the mobile game-based learning system for dyslexia called LaroLexia to have an effective game-based learning system and to identify if there is a significant difference in the reading performance of the dyslexic children in using the LaroLexia.

2. METHODOLOGY

Descriptive research was used to define and describe the game elements needed along with the evaluation of the dyslexic children's reading performance using the application developed in this study. In selecting the respondents of this study, the researchers used purposive sampling. The study

was conducted in the Special Education Department of Daet, Elementary School. The respondents of this study are the twelve (12) dyslexic children whose age range is eight (8) years old to twelve (12) years old and enrolled in the school year 2019-2020, the parents of the dyslexic children selected in this study and the five (5) teachers handling children with dyslexia.

Interviewed respondents to gain first-hand knowledge on the game elements that inspire or enable the dyslexic user to play a certain game program, the experience of dyslexic children with the use of mobile games, and common dyslexic children's reading issues. The experts validated the questions to ensure the data required was collected and the questions are answerable by the respondents. Along with these queries, the researchers collected efficiently the required data on the characteristics of the learner, the game elements to be incorporated into the LaroLexia. Through an interview with the dyslexic children's teachers and parents, the researchers were able to collect qualitative data to come up with a personal description to address research problems in defining the game elements needed for dyslexic children in the game-based learning application.

The researchers asked permission to the parents of the children subject and explain to them the purpose of the study. The researchers would not harm or offend respondents not put them in a position of discomfort. Respondents were given enough time for them to answer the instruments and ensure that their answers to information would be treated with the utmost confidentiality.

Respondents in this study did not force to use the game-based learning system daily during implementation to avoid the problems in their case. Before the application was used, the researchers conducted first the pre-test evaluation through the questionnaire to the 12 dyslexic children selected in the study as respondents, to be able to know the status of reading performance of the respondents in the reading letter and syllables in the Filipino language. The score of individual pre-tests was recorded for comparison to post-test results. The developed application was used by the dyslexic children for 10 consecutive days. After using the application, the researchers administered a post-test to the 12 dyslexic children. The paired t-test statistics were utilized to identify the significant difference in the reading performance of the dyslexic children in using the application. The pre-test and post-test have the same content of questions.

3. RESULTS AND DISCUSSIONS

The researcher considered the learner characteristic of the target user of this application, analyzed the response of the respondents from the interviewed as well as reviewed the different literature about game elements to identify the game elements and how these game elements shall be integrated into LaroLexia application. For this research, the identified

user's learner characteristics have difficulty with phonic sounds in the Filipino language and difficulty with reading the Filipino alphabet because of their disability.

3.1 Game Elements

Game elements are one of the aspects of game design that should be taken into consideration when designing game-based learning applications for dyslexic children. This is one of the factors in increasing the user's motivation to use the game-based learning application. Game elements that were integrated into the application were identified in this study from the response of the respondents of this study on the question "what do you think your child likes in the game application he or she played?". Story, points and rewards, clear game goals and objectives, level, feedback, and achievement system are the game elements integrated into the LaroLexia application that are suitable to the children with dyslexia.

3.1.1 Story. Stories get the attention and stir the imagination of the children. In this study, more respondents stated that "*children love story*", "*story of the games is mostly attracted to their children*", "*excited to know what happens to the story*", and "*stories in the game application is never forgotten by the children*". If a game-based learning application possesses a story, dyslexic children would most likely recognize with it and would evoke higher interest to play it. Proper selection of stories integrated into the game makes the entire game better [7]. Based on the response and analysis of the researchers to enhance the motivation and engagement of the dyslexic children to continue to use the application, the story is one of the game elements integrated into the LaroLexia application.

3.1.2 Points and Rewards. Dyslexic children like other children think receiving rewards from different activities they did or completed is significant. Children are still looking forward to receiving rewards and recognition from parents. Like playing in the games, the more rewards they get, the more they play and even become addicted to playing games. Most of the respondents of this study stated that "*score or stars that the child gets at every level makes their child happy and encourage to continue to play in the game*" and "*their child is excited to know what are they prize or rewards after completing the games or levels*". Giving rewards or awards is one of the ways to motivate learners to continue to play and passed at each level of the games [8]. Points are one of the ways to reward the user in the games, adding to the user's desire to overcome some goal or obstacle in the game. Rewards are given to users when they attained the goals and objectives [9]. Points and rewards are the game elements that are integrated into LaroLexia to enhance the motivation of the dyslexic user to continue using the application as a tool to learn basic reading.

3.1.3 Clear Game Goals and Objectives. Clear game goals and objectives are one of the elements of games that shall be

integrated into the LaroLexia to motivate the dyslexic learner. In LaroLexia application as well in other game-based approaches it is important to set goals and objectives so that users know what to expect and how to achieve the goals. Game goals are the user's target in each game of the application, which is matched with learning objectives that the dyslexic user of the game-based learning application will accomplish. More of the respondents of this study said that *"the goal is clear and achievable for their child their child to continue to play the games"*, and *"the game is easy to play which means the instruction is easily understood by the children"*. Learning objectives will be attained if the goals and objectives are clear and understandable by the user. The goal is commonly known as motivational and may be used by different types of users. [10].

3.1.4 Level. The level is incorporated into the LaroLexia application to track the dyslexic user's progress towards the learning goals. The level of the games in LaroLexia is to define the difficulties of each lesson in the application which the dyslexic user will achieve. It can also improve dyslexic user interaction with the LaroLexia. The level of the games the user reached showed how their learning ability improved.

3.1.5 Feedback. Feedback is also included in the LaroLexia, as the immediate feedback will serve as a reference for the dyslexic user to know if their response is correct. The purpose of the feedback is to remind the user of the progress of their activities towards the objectives [11]. It may also serve as another way for the dyslexic user to give the reward for any corrective action or response.

3.1.6 Achievement System. The achievement system is the game elements that are to be incorporated into the LaroLexia applications as such elements will indicate the development or success of the dyslexic user as well as what is already done in the learning goals. Points, badges, achievements, leader boards, and levels are the gamified elements that have positive effects on learner motivation among exceptional learners [12]. These game elements could be used by the educators of the dyslexic user to monitor the learning achievement of the dyslexic user. The achievement system in the game-based learning application would enhance the engagement of the user to play the games.

3.2 Implementation of Game Elements in LaroLexia

LaroLexia is a mobile game-based learning system for Filipino children with dyslexia on the Android platform which helps them read. The LaroLexia learning material is written in Filipino. The approach to reading used in LaroLexia is the marungko or conventional approach of reading. The native games of the Filipino system such as luksong tinik or basag palayok have been used in the game theme of each mini-games at LaroLexia.

The LaroLexia has two major categories. The first category is the Titik, which goals to help the dyslexic children by incorporating consonants and vowels in the familiarization and reading of the Filipino alphabet and reading syllables. The Titik category starts from the easiest level of basic reading which is the familiarization and sounds of an individual letter. In this category, the researchers mostly use sight word technique in teaching basic reading to dyslexic users. The second category is namely Salita, which aimed to teach word through reading syllables.

Figure 1 shows an example of a screenshot of LaroLexia. This learning media integrated different game elements such as story, clear goals and objectives, and points. At the start of the game, the researchers incorporated a simple short story in the application to catch the attention and increase the motivation of the dyslexic children. The story in this application shall narrate using the audio before the level start and there is a short lecture on how to read and sounds the letters and syllables for the dyslexic user. The researchers chose this theme because most of the children are familiar with the fiesta event and in this case, most of the children's games at the barangay fiesta are Filipino's native games. The story in this application is *"There is a child name Juan who invited by his friend to come in their house for the celebration of the barangay fiesta, unfortunately, he forgot the direction to go in the house of his friend, to be able to see his friend house he needs to participate to the games, can you help Juan to win the games by identifying the correct image that starts the name with the letter or syllables displayed on the screen or correct letter or syllables missing in the word displayed on the screen"*



Figure 1: Example screenshot of LaroLexia that integrates game elements such as story, clear goals and objectives, and points.

The example clear learning goal in Figure 1 is to choose the correct image that sound starts on the letter M so that the character can climb up to the tree which is the game goal. The simple objectives of this application are written to make the dyslexic user easy to understand. The learning objective of this learning multimedia is to familiarize the dyslexic learner with the different letters by using sight words techniques. In the mini-games, one (1) point is given to the dyslexic user score for each correct answer picked or found. The points the

dyslexic user receives shall accumulate for every user's correct answer. The highest score the dyslexic user obtains in each mini-games is five (5) points.

Rewards and achievements are mechanisms for motivating dyslexic users to use the LaroLexia as learning aids. In this application, the reward is in the form of the stars. For each mini-game the dyslexic user has finished it has a corresponding number of stars which will contribute to the user's previous number of stars. The maximum number of stars the dyslexic user will get in each mini-game is three (3). Stars are used as rewards since it is the common practice of educators in giving rewards to children with dyslexia. Figure 2 shows the example screenshot of the rewards.

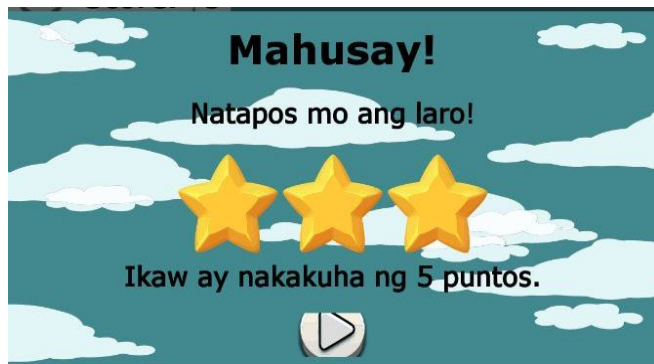


Figure 2: Example Rewards in LaroLexia

The LaroLexia achievements system displays the user's mastery in every level of the category. When the user perfects the points for each level, the level is marked as a gold star, the user will earn a silver star if the number of levels with a perfect score is only 3 to 4 levels, then the bronze star will be displayed. Figure 3 is an example screenshot of the achievements system in this application. In the achievement system, the number of tries, category, score, and level is shown.



Figure 3: Achievement System in LaroLexia

Feedback mechanism in every answer of the dyslexic user in the questions is important to let the learner know if their answer is correct or not. In the LaroLexia application, the

immediate feedback messages will pop up every dyslexic user's response. The feedback is in the form of a positive if the user gets the right answer and encouragement feedback is provided for any user's wrong response to prevent the dyslexic user's negative impact. Figure 4a shows the example of positive feedback given to the dyslexic user for every correct answer and the Figure 4b example of encouragement feedback to the user.



Figure 4a: Positive

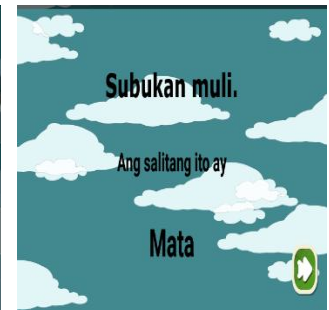


Figure 4b: Encouragement

The game level in LaroLexia is integrated into each category of the application. It begins with a simple lesson heading into the most challenging part of the lesson. The level 1 is more on finding the picture starts on the letter or syllables provided, level 2 is finding the start letter or syllable of the pictures shown in the screen and level 3 is the spelling category where the user needs to type the correct letter or syllable missing in the word.

3.3 Reading performance of Dyslexics Children using a Game-based learning approach

The pre-test and post-test results on the basic reading test administered before and after the implementation of the game-based learning approach were compared. This comparison can provide insights into the reading performance of dyslexic children. The pre-test and post-test composed of a total number of 60 items. Table 1 shows the results of the performance of the dyslexic children in Reading Letter (Titik) Category and Word (Salita) Category.

Table 1: Results of the Performance of the Dyslexics Children

Student	Letter Category		Word Category	
	Pre-test (Score)	Post-test (Score)	Pre-test (Score)	Post-test (Score)
1	23	43	36	57
2	22	44	28	52
3	22	39	36	44
4	28	45	32	40
5	31	44	37	46
6	37	42	32	40
7	30	50	25	45
8	25	43	24	48
9	36	54	20	54
10	35	57	27	58
11	35	46	31	55
12	25	49	30	54

The performance of students in the pre-test and post-test was compared and calculated by using a t-test. The t-test is applied on the pre-test and post-test results of the dyslexic children in reading letters and words. The results of the t-Test were shown in Table 2.

Table 2: Results of t-Test: Paired Two Sample for Means

Category	Letter	Syllables
Pre-test Mean	29.083	29.833
Post-test Mean	46.333	49.417
Mean Difference	17.250	19.583
t-stat	-10.193	-6.688
t-Critical Value (two tail)	2.228	2.228
df	11	11

Based on the results of the mean difference of the post-test and pre-test in the letter and words category conducted by the researchers, it is shown that it has a significant mean score difference in the reading performance of dyslexic children using the mobile game-based learning system called Larolexia. Likewise, the t-test is applied on the pre-test and post-test results in letter category with the following value of t statistics are 10.193 which is higher to the t-critical value of 2.228 means that the result has shown that there is a significant difference in the reading performance of dyslexic children using Larolexia mobile application in Letter Category. Moreover, the word category, the t-statistic is 6.688 which is higher to the t-critical value of 2.228, which means there is a significant difference in the reading performance of the dyslexics' children in the syllable's category using Larolexia mobile application. Based on the results of the reading performance of the dyslexic children using the Larolexia mobile application it shows that the developed application enhances the reading performance of the dyslexic children.

4. CONCLUSION

Children with dyslexia need an effective game-based learning system for dyslexia to help and manage their reading disabilities. Game elements were integrated into each component of the proposed mobile game-based e-learning system. Specific game elements such as story, goals, points, rewards, achievements, feedback, and levels shall be integrated into the mobile game-based learning system for the dyslexic user to enhance their reading performance. These game-elements that were integrated into the system would contribute to the dyslexic user to continuous use of the application and enhance the learning process, especially in basic reading while enjoying.

Based on the results, using the game-based learning system called Larolexia in this study shows that there is a significant difference in the reading performance of dyslexic children. Therefore, it shall be considered as one of the learning materials or tools in the basic reading of the Filipino language for dyslexic children. This application shall be also considered as one of the interventions for dyslexic children to manage their reading disability. For further study, evaluation of dyslexic users in the system in terms of usability, playability,

and learnability must be conducted to be able to enhance more the application features and much effective as an intervention tool for reading disability of the dyslexic users.

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