# Design of Mobile Game-Based Learning Application for Children with Dyslexia

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## ABSTRACT

A game-based learning system is a common approach to improve the learning process of the different types of learners such as dyslexic learners. The researchers investigate first the factors or components of a game-based approach that affect the learning of the learner from a variety of related literature and identify which factors and principles that shall apply and significant in the development of a game-based learning system to improved the learning of the dyslexic user. The proposed framework consists of the different components that meet the dyslexic users learning needs and provide a guide for designing a game-based learning system for children with dyslexia. The proposed framework was implemented in this study by developing an application for dyslexic users. The respondents of this study moderately agreed with the usability, efficiency, and portability of the application developed in this study. Therefore, the application is applicable, useful, meets and satisfied the needs of the dyslexic children in terms of the learning process of the basic reading in Filipino language and shall be used as learning tools and materials for reading.

**Key words:** Dyslexia, factors of a game-based approach, framework,game-based learning.

## 1. INTRODUCTION

Today an e-learning system is integrated with the game-based approach to be more effective in enhancing the learning of the learnersE-learning system, with a game-oriented approach also known as an e-learning method focused on sports. It is one of the teaching strategies used for the learning process of learners by educators using a game as part of the learning process.It also serves as a teaching resource for attracting attention and enhancing learner performance through the game approach. The game as a learning intervention got the higher interest of students compared to conventional learning medium [1]. Game-based learning tools (GBL) can be used as an advanced teaching technique that promotes knowledge among teachers and learners. Building an effective mobile game-based learning system is not easy, it depends on what type of learner the GBL system would use.

Various methods, processes, and mechanisms used in the development of an efficient game-based learning program for a different learner type. Dyslexic learners are one of the learners who used the GBL system.Dyslexia is a life-long condition but it does include an intervention to support them overcome their learning disabilities. This is a particular learning disorder due to the neurological-processing problem in reading. Children with dyslexia have difficulties with word comprehension, word reading, spelling[2], phonological awareness, verbal memory and speed of speech processing[3], and are known as language learning disabilities [4].

A lot of research conducted to have an effective intervention to teach students with learning disabilities. Today, most of the dyslexic learner intervention tool uses technology particularly the game-based learning system. Developing a GBL system for the dyslexic user is important because this type of learner has a learning difficulty and needs to address the learning needs of these learners. Developing an effective and efficient GBL system for children with dyslexia needs several factors to consider.

In this context, the purpose of this study was to establish a framework for the design of a mobile game-based learning system (MGBL) and developed the MGBL system for children with dyslexia based on the established framework. The researchers claimed that this study would help the MGBL program developer who will direct them to build a dyslexic learner-friendly MGBL program.

## 2. METHODOLOGY

The descriptive and developmental method was used in this study. Descriptive research applied in describing the components of the proposed framework and the usability results of the application while the developmental method was used in developing the application using the proposed framework as a guide in designing the application.

Different search engines were used using the phrase "model for game-based learning application", "framework for educational game, "game-based learning model" and

"game-based learning application for dyslexia". The researchers investigate the factors or components of a game-based approach that affect the learning of the learner from a variety of related literature and identify which factors and principles that shall apply and significant in the development of a game-based learning system to improved the learning of the dyslexic user.

## 2.1Factors or components of game-based learning approach

Many researchers are conducting the study on developing a structure and implementing a game-based learning system that combines various game-based approach factors or components to provide an efficient learning system for the learners.Table 1 summarizes the various game-based learning method frameworks and the components or factors of each framework examined in this report.

**Table 1:**Summary of the component in each framework

| Framework | Components |
|---|---|
| Four-dimensional framework | context, representation, learner and pedagogy[5] |
| HEXA-GBL, a methodology for GBL design and evaluation | learning objectives, learning-centered  need analysis, game modalities, game mechanics and rules, learning assessment and feedback, and gaming and learning experience[6] |
| Educational games (EG) design framework | game design, pedagogy and learning content modeling [7] |
| Educational Computer Game Design Model | game elements, game environment, and the game design factors to consider [8] |
| Pre-MEga Framework | screen design, navigation and control, ease of use, responsiveness, game design, and learning potential, instruction, feedback, level of difficulty, content delivery and presentation, pedagogical agent, customization, security, accessibility, and value [9] |
| LexiPal: Design, Implementation, and Evaluation of Gamification on Learning Application for Dyslexia | type of game, game elements, mechanic [10] |
| Game Factors and Game Base Learning Design Model | freedom, mystery, and game value [11] |

Most of the existing game-based learning frameworks are composed of the game design elements, content design, screen layout, game environment, learner needs, learning objectives and the pedagogical approach. It also discussed the game mechanics and game elements that enhance the enjoyment and learning of the target user of the application.For the screen layout, it is about the graphics, the game environment is about the application settings, the learner needs are about the specific learning objectives of the application and the pedagogical approach.

After identification of the factors of the game-based approach, the researchers conducted focus group discussions (FGD) with the Special Education (SpEd) teacher to capture all requirements needed in the learning process of the children with dyslexia using the mobile game-based learning system.The SpEd teachers emphasized during the FGD the importance of understanding the learning process, learning style and particular characteristics of the learner with dyslexia to be able to provide an efficient game-based learning system.The information gained in the FGD were deliberated and incorporated in the proposed framework.

The framework was applied to test the proposed framework in the creation of a prototype game-based learning application, and the ISO 9126 characteristics and sub-characteristics-ISO 1991[12] were used to assess the application. The respondents of this study are the five (5) teachers of dyslexic children of Daet Elementary Schools in Daet, Camarines Norte.

## 3. RESULTS AND DISCUSSIONS

Based on researchers review, the corecomponents or factors of the game-based learning approaches such as goals and objectives, interface design, feedback, challenges, conflict, learning content design, game design elements, mechanics, learning outcomes, learning activities,navigation and control, game achievement, and game type are the important components of the game-based learning system.

### 3.1 Dyslexia Game-Based Learning SystemFramework

The proposed structure of the Dyslexia Game-Based Learning Method in this study was focused on the game-based method variables which affect the learners mentioned in this study and the dyslexic children's learning process needs. The four components of the framework that are connected in the respective component as shown in Figure 1,are the Learner Characteristics, Curriculum, Factors of Game-based Approach, Feedback and Assessment.

3.1.1*Learner Characteristics*. The developer will first determine the specific learner characteristics of the users of the application such as identifying the specific learning difficulties and the knowledge of the dyslexic children. Identifying the learner characteristics is needed to identify the best elements of game design and make the game-based learning system suitable for learners.
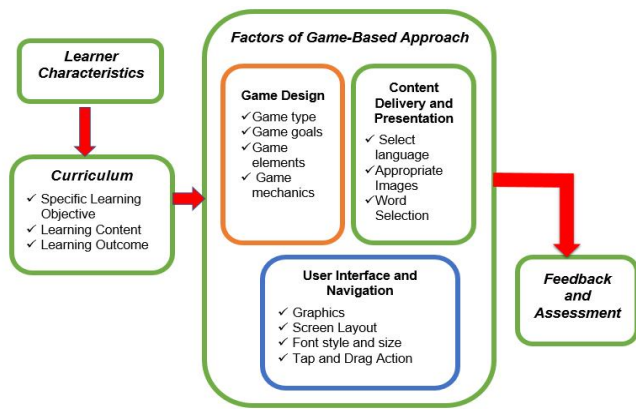
**Figure 1:** Dyslexia Game-Based Learning System Framework

3.1.2 *Curriculum.* The curriculum component will serve as the game content guide and consists of the system's learning objectives, learning content, and learning outcome. Learning objectives are to define the basic learning that must be accomplished by dyslexic learners, and should be written in the application shortly and clearly. It is the guidance for what the learning material must contain in the program. Learning content is a collection of lessons embedded in a game-based learning system to achieve the learning goals set out in the application. Learner outcomes are the predicted learners' performance based on the learning material and learning objectives.

3.1.3 *Factors of Game-Based Approach.* Game design, user interface and usability are the three key factors of game-based learning, and content delivery and presentation need to be addressed in designing a game-based learning framework to improve the learner experience and achieve the learning outcomes of the game application. Those factors enhance the motivation, commitment and learning process of the dyslexic user..

For the game design category, the components are game type, game goals, game design elements, and game mechanics [11, 13, 14, 15]. User interface and navigation are all about the user interface layout, graphics, navigation control or the different commands are used in the gameplay [16, 17]. User interfaces have become the most important aspect of an end-user program, and key to program success[18]. The content delivery and presentation include the language that would be used in the game, the learning objectives and the choice of graphics for the content of the game.

4.1.4 *Feedback and Assessment.* The game-based learning system should include the feedback and assessment in the development for further enhancement of the application. The feedback and assessment will help the developer to make the game-based application suitable to the target user.

## 3.2 Development of Dyslexia Game-Based Learning System

To verify the proposed framework, the researchers developed the system architecture design as a guide in developing the proposed game-based mobile application for dyslexia,as shown in Figure 2. The application is composed of the user profile, where the user needs to register to the application first on the first use, the user information will be saved to the user database. After registration or log-in, the next component is the category of the lesson where the user needs to select the lessons suitable for their needs. The application has three levels of the lesson, level 1 is more on finding the pictures, level 2 is naming the pictures and the last level is the spelling word category. Before the interactive lesson starts the game story and the game goal is introduced to the user. The interactive lessons will be retrieved from the learning content database of the application. For every lesson in the application, there was audio recorded on how to read the letter as well as the sounds to teach the dyslexic user to read. The selection of the words and images as well as the questions in the exercises were based on the existing learning materials used by the teachers of the dyslexic students and was validated by the Department of Special Education in the Daet Elementary School in Daet Camarines NorteThe user may take an assessment after interactive lessons in the application in the form of a summative test. The user may take an assessment after interactive lessons in the application in the form of a summative test.
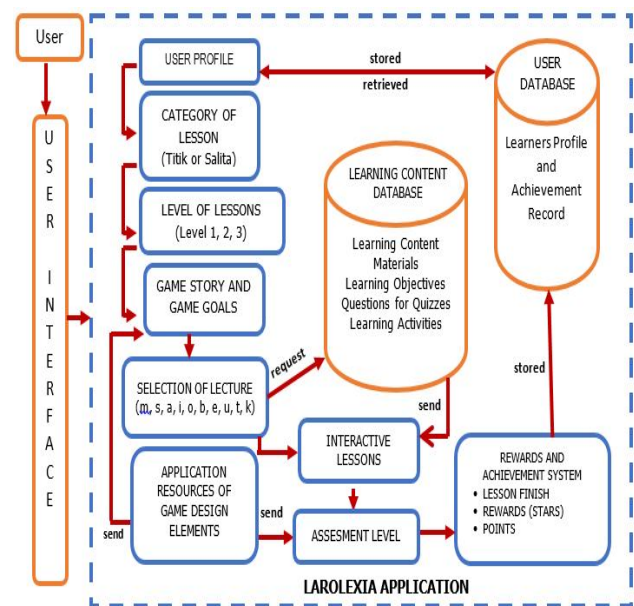


**Figure 2:** System Design Architecture

To have randomized questions and answers in the assessment level, the researchers used the shuffling algorithm and the quicksort algorithm. The quicksort algorithm was applied to arrange questions retrieved from the database, then the system applied the shuffling algorithm. The shuffling algorithm minimized the duplication of the questions in the summative test. For every correct answer of the user, an additional one (1) point is given to the total score in the summative test, if the user got a wrong answer the previous score remains. After the

summative test, rewards earned and points earned by the user will be store to the database and update the user's profile.

The developed application was built in the Android Studio. The learner characteristics of the target users are the disability is reading only and has knowledge using mobile phones. The learning objective of the application is to help the user to familiarize in the sounds and name of the Filipino alphabet through sight word. The dyslexic learner can read the Filipino alphabet independently as one of the learning outcomes of the application. Figure 3 shown the example interface of the application that incorporated the story, and game goals.
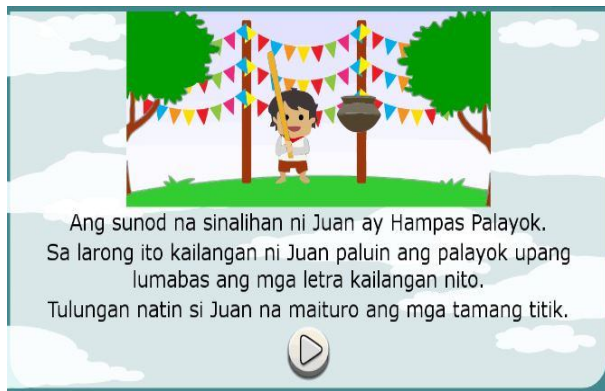


**Figure 3:** Screenshot with game goals and story

Figure 4 shown the example user interface of the application that incorporated the game mechanics, simple graphics, interactive lessons, with the font style Verdana and font size 18 to make the content readable to the user. All action in the game was done through tapping of the letter or buttons to make it easy to navigate.
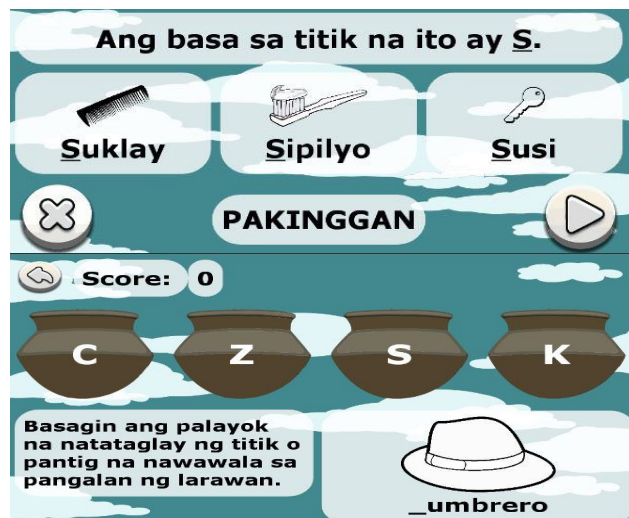


**Figure 4:** Screenshot of User Interface

The researchers presented the application to the Special Education Department for feedback and assessment of the application and were modified and redesigned for usability purposes.

## 3.3 Evaluation of the Game-Based Learning System for Dyslexic Children

The evaluation of the developed application in this study was done to verify if the proposed framework could be as a guide of the game-based developer in designing a mobile game-based learning system for children with dyslexia. Shown in Table 2 is the evaluation of theapplication evaluated by the five (5) respondentteachers of the dyslexic children using the ISO 9126 characteristics and sub characteristics in terms of usability, efficiency, and portabilityThe 5-point Likert rating scale used to include the proposed study's descriptive rating was 5 (4.50-5.00), Strongly Agree; 4 (3.50-4.49), Moderately Agree; 3 (2.50-3.49), Agree; 2 (1.50-2.49), Moderately Disagree; and 1 (1.00-1.49), Strongly Disagree.

**Table 2.**ISO 9126 Characteristicsand Sub-Characteristics

| Characteristics | Sub-Characteristics | Weighted Mean | Descriptive Rating |
|---|---|---|---|
| Usability | Understandability | 4.40 | Moderately Agree |
| | Learnability | 4.60 | Strongly Agree |
| | Operability | 4.40 | Moderately Agree |
| | Attractiveness | 4.40 | Moderately Agree |
| | *Weighted Mean* | *4.45* | Moderately Agree |
| Efficiency | Time Behaviour | 4.20 | Moderately Agree |
| | Resource Utilization | 4.20 | Moderately Agree |
| | *Weighted Mean* | *4.20* | Moderately Agree |
| Portability | Adaptability | 4.20 | Moderately Agree |
| | Installability | 4.40 | Moderately Agree |
| | *Weighted Mean* | *4.30* | Moderately Agree |
| Total Weighted Mean | | **4.32** | **Moderately Agree** |

Based on the assessment outcome of the test, respondents fairly agree on the usability of the application with a weighted average of 4.45, which means that the programs are easy to use , easy to understand and the interface is good. For efficiency characteristics of the application, the respondents moderately agree with 4.20 weighted mean, which means the application is quickly responded to the action of the user and utilizes the resources efficiently. For portability characteristics, the respondents rated a weighted mean of 4.30 or moderately agree that the application is easy to install and adaptable to other android devices.The total weighted mean of all characteristics is 4.32 or moderately agree, which means that the application is efficient, portable and useful that can

be used by the dyslexic children as an intervention tool to enhance their reading performance.

## 4. CONCLUSIONS

The variables found in a game-based learning methodology influence the learner when using this study's proposed application. Therefore, in designing the game-based learning system for dyslexic children, it is implemented to increase the users' encouragement and determination to continue using the game-based learning system as one of the resources in the dyslexic learning process for children.

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