Design and Development of a Mobile Game - Based Learning Application in Synonyms, Antonyms, and Homonyms

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Abstract - The goal of this study is to design and develop an interactive mobile game-based learning application in synonyms, antonyms, and homonyms for elementary school students using an android operating system. The mobile game-based application incorporated graphical design, background music and animation, and key structural elements in the development of a game to interests the elementary school students. It is expected that this game-based learning application named “Word Infection” for mobile devices can act as a supplementary tool for the improvement of students’ vocabulary through word game familiarization in synonyms, antonyms, and homonyms.

Keywords - Mobile Game-Based Learning, Interactive Game, Supplementary Tool, Language Learners, Android Operating System and Word Games

I. INTRODUCTION

Today’s generation when growing up deeply experienced, a radically new form of play - computer and video games - and that this new form of entertainment has shaped their preferences and abilities and offers an enormous potential for their learning, both as children and as adults [1].

Gaming has evolved to being more than a medium of entertainment. Various platforms are being released and improved to be made available for the people. These can be used as a source of learning, fun, and entertainment. Games evolve first from arcade to console to pc and now with mobile phones [2].

The goal of this study is to design and develop an interactive mobile game-based application in learning new vocabulary that could serve as a supplementary tool for students learning synonyms, antonyms, and homonyms that would cater to the style preferences of today’s generation with the
premise that they learned differently and cannot be just told what to learn but instead through interaction and fun. Rapid Application Development was used in the implementation of the study with the help of elementary school teachers and their students for the content and improvement of game play.

II. THEORETICAL BACKGROUND

In considering the design of the mobile game-based application, the following design principles are carefully noted and considered in the implementation:

First, is the study conducted by Chua and Balkunje (2012), they used the three design principles derived from the literature, namely, motivation, gaming and learning to design the Mobile Application for Project Management Learning (MAPLE). MAPLE is a game which explores the use of game-based M-learning (Mobile-learning) for Software Project Management (SPM). Based on the preliminary evaluation, three major observations could be culled. These are:

1) Game-based M-learning is a useful and an entertaining augmentation to traditional learning;
2) Design principles namely motivation, gaming and learning and their appropriate blending are necessary to develop an effective M-learning game; 3) Appealing features in the mobile application are risk alerts, avatar creation and feedback [3].

Second is Prensky’s (2001) six key structural elements of games:

1) Rules impose limits and forces players to take specific paths to reach goals and ensure that all players take the same paths;
2) Goals and objectives are important because people are goal-oriented as a species and push players to win;
3) Outcomes and Feedback is used to measure the progress against the goal and feedback comes when something in the game changes in response to what a person does and lets the user know if they are moving closer to the goal or further away;
4) Conflict, competition, challenge, opposition are the problems in a game you are trying to solve;
5) Interaction and Representation or Story what gets the user’s adrenaline and creative juices flowing, and makes them excited about playing the game [1].

III. METHODOLOGY

The implementation of the study used Rapid Application Development (RAD). The structure of the RAD lifecycle ensures that the software needed by the users is constructed. These stages were introduced by James Martin in 1991 [4], the phases are the requirements planning, user design, construction and cutover as shown in fig. 1.

A. Requirements Planning Phase

Requirements planning phase combines software planning and software analysis. In software planning all stakeholders agree on the project needs, scope, constraints and software requirements. The elementary teachers are interviewed on what are the difficulties encountered by their students in learning new vocabulary and they are also observed on how they handle their class to gather sufficient data to support the development of the mobile game-based learning application. Lastly, the words used in the game was checked and approved by the elementary teachers to ensure validity of the words being used is applicable to the knowledge level of elementary school students.

B. User Design Phase

In user design phase, the learning path selected for the mobile application is linear sequencing strategy. In this strategy, the student will only be able to progress through the game sequentially, from one level to another. Consequently, the learner can only go forward one way. The student can go back to the previous levels but is not allowed to skip
around [5].

Figure 2 shows the functional decomposition diagram of the mobile application which includes play button, how to play and exit button while figure 3 shows the implementation of the main menu.

![Functional Decomposition Diagram](image)

**Fig 2. Functional Decomposition Diagram**

Below are the functionalities of the mobile application:

1) The user can choose from the selected options in the main interface;
2) There are three options; play, instruction and exit;
3) In the play menu, user can select a boy or girl character;
4) The next module contains the three topics that the user can choose from: synonyms, antonyms, and homonyms.

![Welcome Screen of Word Infection App](image)

**Fig 3. Welcome Screen of Word Infection App**

5) There are two game modes: beginner and advance modes. The beginner mode contains easy set of words while advance mode contains average to difficult set of words.

6) In the game play, a word is given and the player needs to look for its synonym/antonym/homonym from the words given by the four viruses as shown in fig. 4.

7) Every mode has three stages wherein the target score varies. A reward of hundred points is given for every correct answer and a deduction of hundred points for every wrong answer from the player’s score.

![Screen Shot of the Main Module of Word Infection App](image)

**Fig 4. Screen Shot of the Main Module of Word Infection App**

![Screen Shot Showing the Meaning of a Word](image)

**Fig 5. Screen Shot Showing the Meaning of a Word**

8) The player can click on the question mark symbol to know the meaning of the word as shown in fig. 5 and a sample sentence using the word as shown in fig. 6.

![Screen Shot Showing a Sample Sentence of a Word](image)

**Fig 6. Screen Shot Showing a Sample Sentence of a Word**
9) Every time the player commits a mistake the virus would go near the character of the player and eventually infect it with virus thus the name “Word Infection” (see fig. 7.)

10) The main control of the game is by tapping the right word among the choices that corresponds to the word given. This is a typical multiple choice type of a question with a twist. The idea is to match the given word with the correct word depending on the topic selected.

<table>
<thead>
<tr>
<th>Fig 7. Screen Shot Showing the End of Game</th>
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</table>

To make word infection game more fun and exciting the following features have been added:

1) User can personalize the game by selecting a character.
2) Graphics are used for the choices instead of the usual letter choices. In particular, virus was selected to represent the choices since the theme for the game is about infection.

| Fig 8a. Screen Shot Showing a New Background and Change of Expression in the Character’s Face |

3) Game background changes when then user advances to the next level and facial expressions of the character selected changes for every committed mistake as shown in figures 8a and 8b.

4) Audio has been included but can be turned off or on.
5) The mobile game has beginner and advance modes and there are three level for each modes and a goal was set for every level.

| Fig 8b. Screen Shot Showing a New Background and Change of Expression in the Character’s Face |

C. Construction Phase

In the construction phase, it was decided that the mobile application will run on Android operating system since it ranked as the first mobile operating system usage in the Philippines in 2012 [7]. Eclipse was the software development platform used together with SQLite a relational database management system and Adobe Photoshop for photo editing. In this phase, there is continuous communication with the elementary teachers to get feedback for the improvement of the mobile application.

D. Cutover Phase

In Cutover phase, functional testing, peer testing and user acceptance testing are performed to make sure of the quality of the mobile game application. In the user acceptance testing, selected students from grades three to five are asked to use the mobile game application. A total of twenty eight students joined in the user acceptance testing.

A five-point likert scale survey was developed and it contains the following criteria: design functionality, learning content and ease of use. Listed below are the questions asked from the respondents:
1. Design Functionality
   Q1. The design of the interface is attractive and the audio added excitement in the game.
   Q2. The game rules, goals, feedback, challenge, and interaction provided enthusiasm in playing the game.

2. Learning Content
   Q3. The topics on synonyms, antonyms and homonyms are presented clearly.
   Q4. The game is helpful in learning word or vocabulary.
   Q5. The game is useful in familiarization of new word or vocabulary.

3. Ease of Use
   Q6. The navigation controls of the game are easy to use.
   Q7. The game provided instruction that helped in playing it.

   For ease of interpretation, table 1 was developed showing the verbal equivalent of the computed mean.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>LIKERT SCALE INTERPRETATION</th>
</tr>
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<tbody>
<tr>
<td>Mean</td>
<td>Verbal Interpretation</td>
</tr>
<tr>
<td>1.00 - 1.79</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>1.80 - 2.59</td>
<td>Disagree</td>
</tr>
<tr>
<td>2.60 - 3.39</td>
<td>Neither Disagree or Agree</td>
</tr>
<tr>
<td>3.40 - 4.19</td>
<td>Agree</td>
</tr>
<tr>
<td>4.20 - 5.00</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

IV. RESULTS AND ANALYSIS
A total of twenty eight students joined in the user acceptance testing and with the help of their teachers, a seven-item questionnaire was administered but prior to that these students are asked to use the game and it was made available for download in Google’s Playstore.

Two tables are prepared: table II shows the percentages per scale and table III shows the computed mean of the user acceptance results. This was made so that the results can be described fully and issues can be identified for the improvement of the game.

In Table II, under the first category of design functionality almost half of the respondents strongly agreed with the attractiveness of the game and one percentage of the users had a strong disagreement while half of the respondents agreed on the enthusiasm brought by the game and less than ten percent disagreed.

In the second category which focuses on the learning content of the game when asked of the clarity of presentation less than half agreed but almost half of the respondents strongly agreed that the game can be useful and helpful in learning synonyms, antonyms and homonyms.

In terms of ease of use, although almost half of the respondents strongly agree there are still thirty percent of the respondents only agreed on the navigation controls while exactly half of the respondents strongly agreed that the game provided instruction that helped them play the game.

<table>
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<tr>
<th>TABLE II</th>
<th>PERCENTAGES PER SCALE OF THE USER ACCEPTANCE RESULTS</th>
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<tbody>
<tr>
<td>Criteria</td>
<td>1</td>
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<tr>
<td>Design Functionality</td>
<td>Q1</td>
</tr>
<tr>
<td>Learning Content</td>
<td>Q2</td>
</tr>
<tr>
<td>Ease of Use</td>
<td>Q3</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
</tr>
<tr>
<td></td>
<td>Q5</td>
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<td></td>
<td>Q6</td>
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<td></td>
<td>Q7</td>
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</tbody>
</table>

Table III shows the result of the user acceptance testing conducted at South Learners Creative School. The first category focuses with the design functionality used in the mobile application which includes graphical user interface, music or sound effects of the game which receives a mean of 4.62 with verbal interpretation of strongly agree and the game rules, goals, feedback, challenge, and interaction provided in playing the game got a mean of 4.00 which can be interpreted as agree.

The second category is concerned with the learning content of the mobile application which includes the objective of presenting the topics clearly with a mean of 3.86 and a verbal interpretation of agree and how the audiences
rate their learning as helpful with 4.43 and useful with 4.48 both of which can be verbally interpreted as strongly agree.

Lastly, the third category covers the usability of the application which includes questions on the ease of use of the navigation controls with a computed mean of 3.78 and verbal interpretation of agree and the instruction of the mobile application with 4.32 and verbal interpretation of strongly agree.

<table>
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<tr>
<th>TABLE III</th>
<th>COMPUTED MEAN OF THE USER ACCEPTANCE RESULTS</th>
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<tbody>
<tr>
<td><strong>Criteria</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>Design Functionality</td>
<td>Q1</td>
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<tr>
<td></td>
<td>Q2</td>
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<td>Q3</td>
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<td>Q4</td>
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<td></td>
<td>Q5</td>
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<tr>
<td>Learning Content</td>
<td>Q6</td>
</tr>
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<td></td>
<td>Q7</td>
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</table>

**V. CONCLUSION AND RECOMMENDATIONS**

This study attempted to design and develop an interactive and fun way of learning new vocabulary that could serve as a supplementary tool for students learning synonyms, antonyms, and homonyms for target users, specifically for students age eight to eleven.

The traditional way of teaching the students of these topics is by providing books and classroom activities and these ways have somehow made the students uninterested. For this reason, a mobile game-based learning application was conceptualized following the design principles presented in the literature - a game that can help the students learn while having fun.

Based on the results and analysis of the data collected from the users of the mobile game-based learning application the following can be concluded:

- In the design functionality, the aesthetics of word infection game was successfully implemented as well as the game rules, goals, feedback, challenge, and interaction, however, the small percentage of users rating it as average must still be looked into for the improvement of the game play;

- In the learning content, the presentation of the content was rated average and should be reviewed while the goal of making the mobile game application helpful and useful was successfully achieved;

- In terms of ease of use, the design of the navigation of mobile game should be rechecked such as sizes of buttons and ways of moving backward and forward while the instruction provided has been successfully implemented; and,

- Overall, the mobile game-based learning application has been successfully implemented for the elementary school students following the design principles provided by Prensky (2001) and Chua and Balkunje (2012). Based on the results and the feedback from the users of the mobile game-based learning application the following are recommended:

  - The demographics of students in the user acceptance should be included such as: the level of technology use and the type of device they used for the game because navigation on the game can be affected by the size of the screen of the mobile phone they used;

  - Include functionalities that can add more challenge and competition such as: a module that records high scores, achievements to earn, a new mode that is time-based; and,

  - Lastly, incorporate a story as suggested by Prensky (2001) that would make the game more relevant to students in elementary schools and integrating other subjects in the
story such as character education which is also taught in the elementary level.

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