Software Development of Word Search Game on iPhone for Learning English: A Case Study

Anon Sukstrienwong

***Abstract*—** The growth in use of iPhone on campus is rapidly increasing. They are becoming as a part of daily life with new software games, which are considered as entertainment. As we all know, a word search game has been implemented on mobile devices for decades. It facilitates English vocabulary acquisition of students. The word search game on mobile devices allows education to be delivered in a more convent way, anytime and anywhere at the students' own place. To this paper, a survey is conducted to target students at Bangkok University, Thailand. As a result, the word search game on iPhone embedded with the English dictionary, which helps Thai students to memorize the words is developed. Moreover, the process in developing the game on iPhone has been presented. It is expected that our research findings in English learning on mobile devices for Thai students will be further shared for educators and researchers in the future.

Keywords—English vocabulary, mobile game, mobile application, word search game.

I. Introduction

STUDENT'S English learning involves memorization of a large number of vocabulary words and grammatical structures. New technology devices such as personal digital assistants (PDAs), tablet computers, iPhones, and other mobile devices are invented to help in English learning. These devices are used for business or personal use with a variety of purposes, including conducting business, keeping in touch with friends, and playing games. Nevertheless, they are often disguised as a game device because they are highly capable of playing a variety of games. Nevertheless, there exist evidences that games improve student's understanding and the learning outcomes [1], [2]. An increasing number of universities in US are adopting mobile wireless technologies as teaching tools [3]. Mobile devices, therefore, impact educational outcomes and facilitate new learning which is learner-center, situated, collaborative, ubiquitous, and lifelong [4].

To date, games have proven to be beneficial for Science and Engineering Education because they can mainly be integrated within a classroom to improve student learning and participation [2], [5], [6], [7]. Several games involve the basic language skills such as listening, speaking, reading, and writing [8]. Game-based learning on mobile has being proposed for undergraduate research [9], [10], [11]. Some traditional teachings in classes can be replaced by games. Teachers can use the games' metaphors and illustrations of reading and Math exercises [12], [13]. Therefore, utilization of mobile phones as a medium of learning in school has increased [14], [15]. In the work of Saran and friends [16], this work focuses on phones in language learning. The results indicate that students' abilities to learn Irish autonomously in the pilot project were enhanced by the use of mobile phones. Students are remarked on progress made in grammar and vocabulary. They are delighted to use the instructional materials in their mobile phones for language learning. SMS may be one of the most common wireless applications used with mobile wireless phones to support teaching [3]. The interesting work published by Thornton and Houser shows that graduate students in Japan often use their mobile devices such as smart phones and PDAs for daily sending and receiving e-mails [17]. The paper emphasizes on providing English vocabulary by three mini-lessons to students each day. Even the biggest group of students (57 percent of students) read messages once a day. However, the researchers demonstrate that SMS helps improve student scores in classes. In addition, several mobile games have been designed for students to learn English. Word search game is one of the excellent games that are good for players to spend free time memorizing vocabulary and to enhance problem-solving skills. This type of game is an example of activity that takes a great deal of time to prepare by hand, but very little to do on the computer [18].

Unlike other word search games, in this paper we aim to develop the word search game on iPhone for Thai students in English vocabulary learning. Also, we want to understand the needs of Thai students on this kind of games. The major design is based on our user-needs survey. There are four sections to our paper including this introduction. The brief overview of word search game is shown in Section 2. Section 3 presents the design of our word search game in details. A user- needs survey is described to support our system design and development. The usability of evaluation in developing the word search game and the evaluation of satisfaction are provided in this section. Conclusion and discussion are prepared in the last section.

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II. Introduction of the Word Search Game

Word search game is known as a word find game, which is well known for helping students to recognize words. It is a game that letters of a word lay in a grid and usually has a square shape. To play this game, players search and mark all hidden words inside the grid. In the most word search games, a list of hidden words is provided. Frequently, many words are related which are easy for players to search for. Listed words may be arranged in horizontal, vertical or diagonal directions in the grid. Sooner you complete every level, higher scores you will get.

Some teachers apply this kind of games as educational tools for students. In searching for words, students read and memorize the words while they are playing the game that helps them learn the words and spelling, letter by letter, in the puzzle.

III. The Design of Word Search Game

IPhone has immense public utility, improving education and communication on campus; therefore our word search game is designed to play on iPhone to help students recognize English vocabulary words. Adapted from user interaction model called star life cycle of Hartson and Hix [19]. This is a software development process which only four areas of interest are identified as follows; application design, task design, physical design of interface and usability evaluation as shown in Fig. 1.This life cycle presents an evaluation-center approach; we can start developing the program at any point of the cycle while these activities are interconnected through evaluation in the center [20]. In the following part, we detail briefly on an "informal description" of the design phases.

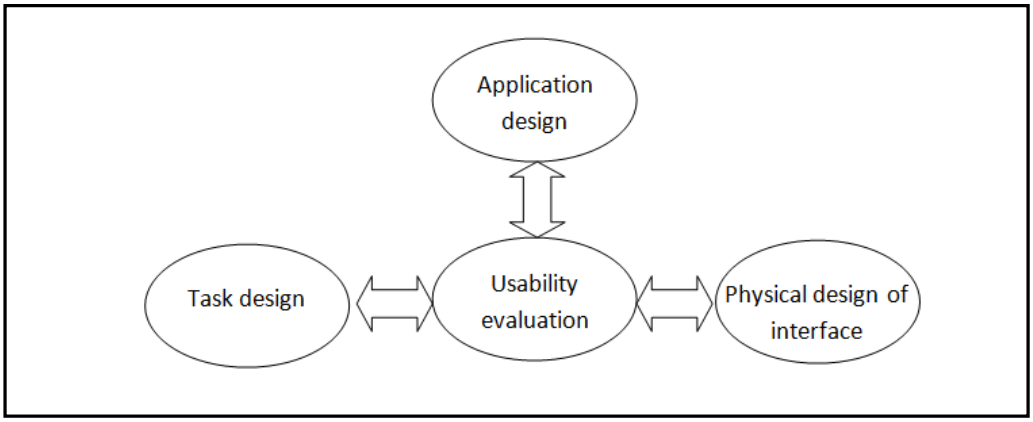

Fig. 1: Our area of interest

Table 1: Survey results of user's needs

No.	Questions	Scores and results
1	Have you ever played the word search game?	Yes (100%) No (0%)
2	Is it good to enhance your English by playing the word search?	Avg. score 4.13 out of 5
3	Is there any application out there that allows you to play word search?	No (71%) Yes (29%)
4	Have you ever wished that you could create your own word in word search?	Yes (100%) No (0%)
5	If you do not have internet provided, which media or device would be good for you to play word search?	iPhone (54.7%) Newspaper (29.3%) Others (15.9%)
6	What feature or program should be within the word search game to enhance your English?	Dictionary (94.1%) WordPad (2.3%) Others (3.5%)
7	Is there any reason that will make you not to play the word search game?	Too difficult (57.8%) Word list not related to player (31.6%) User interface (8.1%) Other reasons (2.4%)

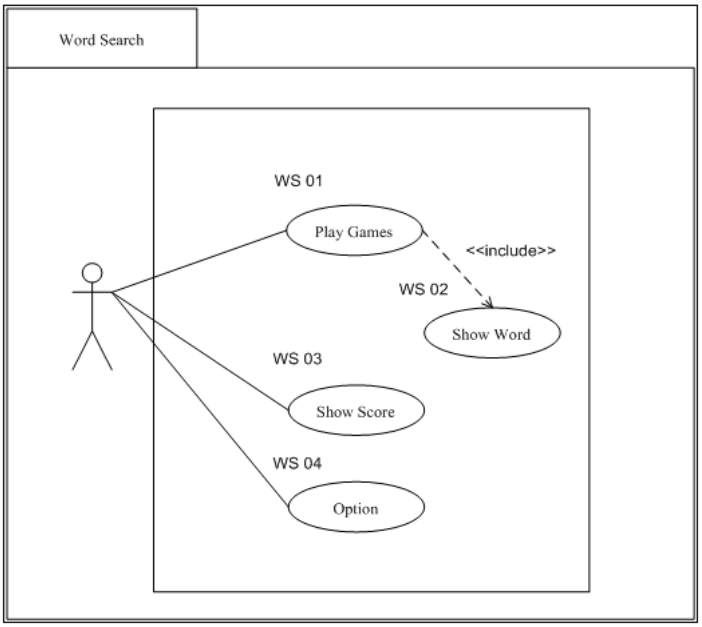

Fig. 2: use case diagram

A. *Application Design*

Students are considered as the recipients, which affect both the teachers' instructional approaches and learning strategies [21], therefore we have to get to know the needs of our students. It covers the user analysis as a better understanding of concerned users which will lead to design the best to meet the users' needs. In common, the first phase in our application development process is the application analysis. The requirements in the word search game on iPhone are modeled by a use case diagram as it is a simplest to represent a user's interaction with the system detailed in Fig 2. It gives short description and basic informal functionality of a system. It also presents three actors that interact with the system. The word search game comprises of three main parts; play game, show score, and option. We are concerned that the users have control over the functioning of the system. The quickest way of finding out the user's needs is to question some representative members of the desired group. We conduct a survey to explore the needs of the students about the word search game in learning English. The survey results give important information and several facts as shown in Table 1. Students prefer the program with a special feature allowing them to create their word search lists associated to their topics, while some players concern for the quality of the graphical interface of the program. Additionally, the mobile devices such as iPhones are the device that students are likely to choose to play the word search game (54.7%), which is higher than newspaper (29.3%). Moreover, a feature that most players prefer to have within the word search is dictionary (94.1%). Nevertheless, if the word search game is too difficult, they will immediately stop playing the word search game (57.7%).

B. *Task Design*

Task analysis is a fundamental methodology to define our module in developing word search game. Procedures are determined sequentially so that each step is unambiguous and simple as shown in Fig. 3.

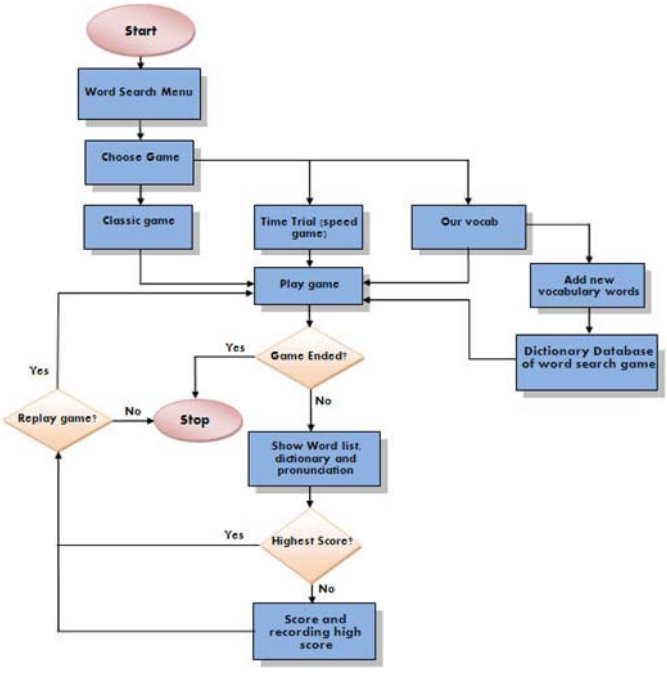

Fig. 3: Task design

C. Physical Design of Interface

Our word search game is designed for Thai students in Bangkok University in English vocabulary learning. The chosen development environment is Java 2 Micro Edition (J2ME) on iPhone OS. Xcode is integrated for creating our game on iPhone as well. It includes the Xcode IDE, Instruments, iOS Simulator.

The icon of word search game is presented in Fig. 4. The players have three options to select; classic mode, time trial, and our vocab or self-adjusting mode as represented in Fig. 5.

Fig. 4: The icon of word search game

Fig. 5: Main menu of word search game

Classic mode: This mode is a common word search game. The players can select the level of difficulty of the game; easy, normal and hard as shown in Fig. 6(a). The screen will automatically display English characters in the 9x9 characters table for players to search for hidden words. The list of random vocabulary words is shown at the end of the table; see Fig. 6(b). If the players have found any words in the grid, the players mark a box covering that word. When all existing words are discovered, the game shows the meanings of each word including pronunciation for the players to listen. However, the players can click on a hint button for help when they cannot search the words. Finally, the scores of each game are calculated based on how many words are found.

Time trial mode: This mode is designed to stimulate the users to play with timing presented in Fig. 7. The countdown timer starts from 180 to zero seconds. If the time becomes zero, the current game automatically stops. This challenges most of students to play with fun. At the end of each game, vocabulary words will be summarized with their meaning and proper pronunciation. In addition, this part provides the hint button in the cases that uses cannot search the word hidden in the table. To click this hint button, the players will lose the points. The highest scores can be recorded in the system if the users want.

(a) Game level

(b) Playing game

Fig. 6: Word search game (Classic mode)

Our vocab mode: This mode is customizable and more flexible than other modes because new vocabulary of any topics can be added into the game. The system allows players to add new topics related to the players which are easy for them to search for. As it can be seen in Fig. 8, "Emotion" is a new topic that is arbitrarily set by a user. This mode facilitates the students to enter new words into their own database to help them practice later.

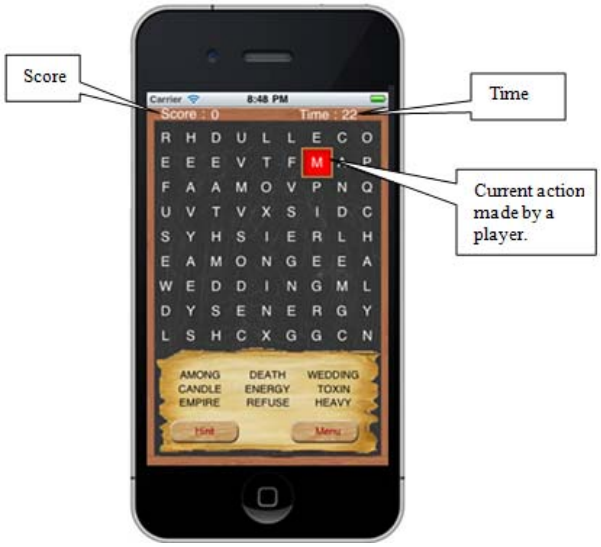

Fig. 7: Game interface (Time trial mode)

Fig. 8: Adding new vocabulary words into the system

At the end of each game, the system automatically shows total score and bonus reworded during the play. In addition, a list of random words of the game is shown sequentially with their meaning and pronunciation, see Fig. 9.

A. Usability Evaluation Phase

In order to study the efficiency of our word search game, a set of 46 students was chosen without any specific criteria. They are divided into three small groups according to the test number shown in Table 2. The first group is equipped with iPhone and presented with some rules prior to the word search game on iPhone.

Fig. 9: The summarized score received at the end of each game including words and their pronunciation

For the second group, the students are not equipped with iPhone. But, they are introduced to use the web-based e-mail to obtain the English vocabulary. As it is similar to the work of Thornton and Houser (Thornton and Houser, 2005),we sent the short messages to students by e-mail with five English vocabulary words a day. It would be repeated when the twenty-five words had been sent. The students in the last group are not equipped with iPhone either. On the other hand, they receive small pieces of papers to play crossword game daily. However, there are some essential aspects that we should take into consideration at the time of sending vocabularies, for example, load of works that students have on hand to do during the certain period of times [22].

The students involved in our software evaluation process were introduced the word search game except the second group. Each group receives the same set of twenty-five words for one week. Though, English pretest of participants is made before separating students into three groups. The details of each group; group size and type of technology used; are briefly illustrated in Table 2. All groups have improved after two weeks of practicing. The percentage of improvement is calculated. From the experimental results, it turns out that students in the first group who have been equipped the word search game on iPhone has the highest improvement at 21.4%. But, students of the other groups (2nd and 3rd group) have lower improvement at 13.6% and 11.1%, respectively. We can see that the word search on iPhone has improved the student scores twice as much as they received their vocabulary with crossword game on the papers. It is because the word search game on the papers has less attraction to students.

The last evaluation is the user satisfaction evaluation. This evaluation is made by participants of the first group. The result is shown in Table 3. It indicates that respondents require an English dictionary in the game with the average score of 4.26. Additionally, the students prefer to manage their own word list with the average score of 4.25. The overall interface and system design are satisfactory; the average score of 4.04.

Table 2: The summarized score of Pre-test and Post-test (46 students)

Group No.	iPhone	Type of Technology		No. of students	Test (25 words)		% of improvement
		Word Search game	e-mail		Pretest	Posttest	
1	Yes	Yes	No	16	15.4	18.7	21.4
2	No	No	Yes	15	16.2	18.4	13.6
3	No	Yes (paper)	No	15	14.9	16.9	11.1

Table 3: Results of Evaluation of the effectiveness of the system (Group No. 2 with 15 students)

No	Question	Avg. Score	SD
Graphical interface design			
1.	Are screen layouts helpful?	4.15	1.52
2.	Arrange of information on screen	4.05	1.32
3.	Presentation of game and contents	3.80	1.12
4.	Comprehension of menus	3.37	1.34
5.	Character on screen	3.51	1.27
6.	Image of buttons and icons	3.90	1.19
7.	Sequence of screens	3.90	1.34
8.	The size of the buttons and icons is appropriate.	3.95	1.23
	Average	**3.83**	**1.29**

System design			
9.	Does this game suit the iPhone?	4.05	0.87
10.	Is the word search game on iPhone facilitating you to recognize the English vocabulary words?	4.08	1.31
11.	Do you feel the system under control?	4.05	0.67
12.	Variety of vocabulary words provided in the game	4.05	1.28
13.	How easy of making own vocabulary lists?	3.91	1.33
14.	How good is to create your word list in this word search game?	4.25*	1.48
15.	Is dictionary provided useful to play the word search game?	4.26*	0.97
16.	Is pronunciation provided in the game suitable?	4.04	1.12
17.	Is pronunciation provided in the game facilitating you to learn English?	4.01	1.09
18.	Game speed	3.98	1.13
19.	The overall design of the game is appropriate.	3.82	1.14
	Average	**4.04**	**1.12**

IV. Conclusion and Discussions

To the development of the word search game on iPhone, we conduct a survey to explore the needs of users. The study collects the data from 46 students as a case study. An evaluation was carried out to students to get feedback on the effectiveness and system design. We found that Thai students positively preferred to play the word search game on iPhone if they can manage their own vocabulary words. Students participating in our research believe that the word search game on iPhone can improve their scores because it facilitated them to recognize English vocabulary words. In this paper, we tried different techniques to compare with our word search game. The findings indicate that either word search on paper or e-mail attached with crossword vocabulary had less attraction to Thai students because they were not possible to keep students motivated. In addition, two special features that students preferred to have within the word search game on iPhone, while they are playing, are an English dictionary and its English pronunciation. However, some areas that were suggested by students to improve the word search game on iPhone are characters on screen, comprehension of the menus, presentation of the game and content, sequence of screens and game speed. In the future, the feedbacks should be also applied to improve the final game.

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