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A Development of Augmented Reality-supported Mobile Game Application based on Jolly Phonics Approach to Enhancing English Phonics Learning Performance of ESL Learners

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Abstract: Phonics is an essential foundation for English learning, particularly in reading and writing. However, most students who learned English as a second language have not learned phonics appropriately when they were young, resulting in failed pronunciation in reading and writing English words. With Jolly Phonics approach, students could develop their phonics learning performance effectively regardless of memorization. In addition, game has been considered to be an engaging platform, while augmented reality can provide students more interactive learning environment. Therefore, in this study, an augmented reality supported mobile game application was developed based on Jolly Phonics approach in order to improve students' phonics learning performance. In addition, an experiment has been conducted with primary school students to examine the effectiveness of the proposed mobile game application. Consequently, it was found that students who learned with this application could improve their phonics learning performance, also revealed positive attitudes towards the application. The findings of this study could provide an effective learning approach to improve phonics efficiency for English as a second language learners.

Keywords: Phonics learning, Jolly Phonics, Augmented Reality, Mobile game application, English learning, L2, ESL

1. Introduction

As a beginner in learning English as a Second Language (ESL), learning how to read might be too difficult. They have to use multiple perceptions, e.g. seeing, recognizing and understanding of the words to read well. In reading, learners need to have a number of vocabulary, know how they are pronounced (Fry, 2005), which requires understanding on Phonics learning (Ehri, Nunes, Stahl, & Willows, 2001). Phonics focuses on how to connect sounds with letters and decoding them; while its learning can be either Analytic phonics or Synthetic phonics.

Compared to the phonics learners, the non-phonics learners usually have much faster reading ability to get familiar with words but they scored less in phoneme segmentation and non-word reading tasks (Connelly, Johnston, & Thompson, 2001). Besides, Analytic phonics learners learn to analyze letter sounds after seeing the word in which this approach cannot sustain over time. Students will be memorizing and can't spell the word. Both types of learners face problems in reading comprehension performance.

Conversely, there have been several studies showing that students who learned phonics; especially those who learned Synthetic phonics, namely Jolly Phonics approach outperformed in reading (Ekpo, Udosen, Afangideh, Ekukinam, & Ikorok, 2007). Jolly Phonics approach enables students to learn the letter sounds before seeing the word, regardless of memorization of words because

they learn each letter sounds and blend them to make a word before reading the whole passage (Johnston, & Watson, 2005).

In the past decade, there have been a number of applications that use augmented reality (AR) technology in various subjects in education (Barreira, Bessa, Pereira, Adão, Peres, & Magalhães, 2012; Liu, & Tsai, 2013). It was found that AR could increase language learning performance since it enables students to pay more attention, increase their enthusiasm, and engage students in manipulating virtual materials from a variety of students' perspective Significantly, AR helps bridge the gap between learning in formal and informal settings and enhancing students' understanding of abstract and invisible concepts or phenomena (Wu, Lee, Chang, & Liang, 2013).

Therefore, a mobile game application was developed based on Synthetic phonics (Jolly Phonics approach) in order to enhance students' phonics learning performance, hereinafter called P-Whale. AR was integrated into the application to make their learning more engaging by enabling students to interact on the mobile, and bridging the virtual games and interactive medias with phonics learning. Moreover, the experiment has been conducted to examine the effectiveness of the proposed application with following research questions:

- Do students have better phonics learning performance after experiencing P-Whale?
- How are the students' attitudes towards P-Whale?

2. Related Studies

2.1 Jolly Phonics Learning

Jolly Phonics approach was proposed by Sue Lloyd in 1998 to help students understand how letter sounds can be blended together to pronounce unfamiliar words, which produce sustainable reading skill for learners (Johnston, & Watson, 2003). This approach contains 5 main steps of learning. First step is learning the letter sounds in which students learn 42 main letter sounds (divided into 7 groups); while letters are not in alphabetical order. Second, learning letter formation, students learn how to connect the sound with its letters. This step helps students to recognize the letter and know how to write it when they hear the sound. Third, blending, students listen to the sounds and blend it to a word. Forth, identifying sounds in words, this step helps student to spell better by listening to the sounds in word. Finally, spelling the tricky words, this step contains different words that not go along with all the above items.

Jolly Phonics approach can help students' phonics learning without memorization. For example, Bednarz's study found that students who learned with Jolly Phonics had better skill to decode words in which other approaches teach students to memorize words which does not develop skill to decode unknown words; while Ginsberg's study (2000) showed that Jolly Phonics aims at teaching students to decode any words not like the look-and-say method that students learn through memorization.

By considering the benefits and successful applications of Jolly Phonics approach, it could not only help students to improve their phonics learning skills, but also help them to learn without memorization.

2.2 Language Learning with AR

Augmented Reality (AR) can support language learning incredibly by offering new learning opportunities and also creates new challenges for students (Wu, Lee, Chang, & Liang, 2013). AR combines the real world with the virtual world by overlay each other.

Nowadays, technology has been used to support education in many fields since it can encourage students more effectively by using interaction with multimedia via mobile or tablet devices. It also helps enhance cognitive learning outcomes (Schmitz, Klemke, & Specht, 2012). Dunleavy and Dede (2013) reported that AR technology is effective in changing students' perspective because this technology can be used with multimedia interaction. Besides, Hsieh and Lin (2010) found that AR technology encouraged students to pay more attention than learning in the regular class.

Therefore, it would be interesting to integrate the language learning, especially Jolly Phonics approach with AR technology in order to increase reading and spelling skills. AR technology could enhance the traditional learning to be more engaging by using multiple virtual interactions and multimedia which are suitable for students (Liarokapis & Anderson, 2010).

2.3 Mobile Game-assisted Language Learning

Learning language in mobile game application can motivate students to have better language learning skill (Kukulska-Hulme & Shield, 2008). Recently, mobile-assisted language learning (MALL) is known as an innovation that motivate students' language learning anywhere anytime on mobile devices. Nowadays game has become an effective tool to enhance learning, help students to learn certain contents, and increase skills when they play the game. Recent studies showed that mobile games can improve language learning (Wongwatkit, Tekeaw, Kanjana, & Khrutthaka, 2015); while games could motivate students to learn with happiness and enjoyment during the learning process (Cornillie, Clarebout, & Desmet, 2012).

Therefore, mobile game could be considered as an interesting platform to promote language learning performance.

3. The Development of P-Whale

3.1 Word Analysis

Prior to develop P-Whale, we conducted an analysis to find the proper words to be used in the application in following steps: 1) Gathering all the words from 9 English text books used in first grade students' English subject in Thai schools and the original Phonics handbook written by Sue Lloyd. There are more than 500 words in total, 2) Reordering the words by the frequency of appearance, 3) Selecting words based on 1) frequency and 2) number of letters used in each group, and 4) Dividing qualified words into 7 groups according to Jolly Phonics approach (Lloyd, 1998).

After the analysis, we had 70 words in total to be used in the application. Each group contains 20 words (excepting the first group with only 10 words). These words were then divided for 'Blending' and 'Identifying' stages.

3.2 Mobile Game Application Development

P-Whale, a mobile game application, was developed with Unity3D and Vuforia SDK. P-Whale comes in a package with 42 AR marker cards. There are four mini games in the mobile application running in sequence of Jolly Phonics approach for first four stages. While learning and applying their existing knowledge, the games are challenging and fun for students with limited score, and number of letters and words, and they require students multiple perceptions interacting with AR. Sound feedback is provided to help remind the students. Note that students are suggested to learn under teachers' or parents' facilitation in sequence of letters groups. The four mini games are run as follows:

1. Learning the letter sounds: students need to understand how each letter sound. This stage was designed to work with AR, as shown in Figure 1(a). At this point, students begin the phonics learning foundation by recognizing the difference between phonemes and letter sounds of letter.

2. Letter formation: students use the back of the marker card to begin the session. Once detected, students form a letter by tilting the device and reminds students how each letter sounds when forming a letter, as shown in Figure 1(b). At this point, students could better understand the relationship between sound and its letter character.

3. Blending: students learn to blend the listened sound into word by playing a 2D game, as shown in Figure 1(c). Students have 15 seconds for each word, 10 words a game. If they couldn't finish each word on time, the question will change to another in a random order. At this point students can blend each letter into words as an essential bridge to the final stage of phonics learning.

4. Identifying the sounds in word: students will have to listen to the word and will be able to recognize its sounds by using a camera to detect a marker card of missing letter, as shown in

Figure 1 (d). This final stage allows student to apply existing knowledge of phonics sound to identify the correct word.

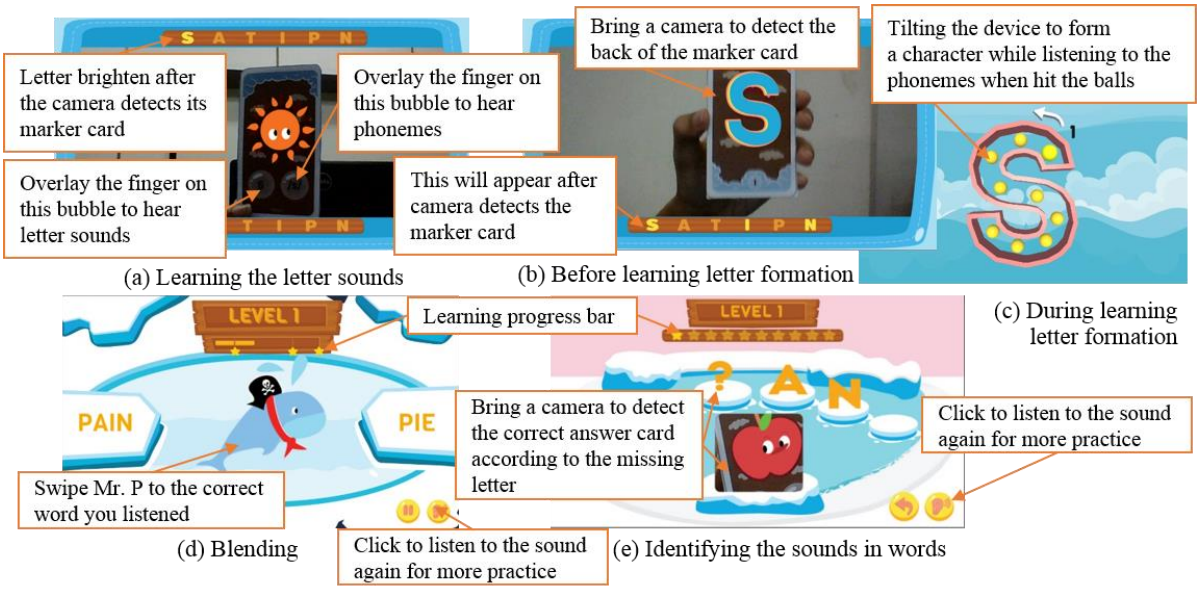

Figure 1. Illustrative Examples of P-Whale Screenshots

By using P-Whale, students can cultivate the phonics learning from the basic foundation of letter sound and letter formation through searching and matching with the right AR marker cards, to the more advanced steps of blending and identifying the sounds from words trough mini matching games facilitated with AR. This could motivate students to learn each step to enhance their phonics learning performance.

4. Experimental Design

4.1 Procedure and Participants

In order to examine the effectiveness of the application, we conducted an experiment with 36 students in grade 1 of a primary school in Thailand. All students participating in the experiment had similar understanding of phonics and were taught by the same English teacher.

The experiment was conducted in 1.5 periods of their regular English class in the following steps: 1) The students were asked to do the pretest to examine their prior knowledge on the phonics for 10 minutes, 2) Prior to the experiment, learning orientation and demonstration of the application were introduced to students for 10 minutes, 3) While being facilitated by 3 teacher assistants, the students learned phonics by following the guidance on the application for 30 minutes, 4) Students were then asked to take a parallel posttest for another 10 minutes to evaluate their learning performance, and 5) At the end, they took a questionnaire to evaluate their attitude towards the application for 10 minutes.

4.2 Research Tools

Pretest and posttest were designed to evaluate the phonics understanding by 2 experienced English phonics teachers and 3 linguists. Each test consisted of 5 pairs of words for blending and identifying, worth 10 scores in total. The reliability of the test has been judged by the majority of 5 above-mentioned experts' opinion.

In addition, a questionnaire was developed to investigate students' attitude towards the application, consisting of 9 items of 5-point Likert scale. The questionnaire was designed by 3 experts in computer, multimedia and gamification fields. The Cronbach's alpha of the questionnaire was 0.83,

indicating good reliability, while its composite reliability ranged between 0.81 and 0.93, indicating internal consistency among dimensions.

5. Results

5.1 Phonics Learning Performance

Based on the results of pretest and posttest, students' phonics learning performance was analyzed. After testing data for normality, paired sample *t*-test was used to compare the difference between both scores. As shown in Table 1, it was found that students had significantly better phonics learning performance after using the application (t = -12.44, p = 0.00), indicating that the application could help students to improve their phonics learning performance.

Table 1: Students' pretest and posttest results

Test	*n*	*M* ± *SD*	*t*	*p*
Pre-test (Score = 10)	36	0.86 ± 0.86	-12.44	0.00***
Post-test (Score = 10)	36	4.77 ± 2.01		

***$p < 0.01$

5.2 Attitude and Feedback towards The Application

Based on the questionnaire data, it was found that students revealed positive attitudes toward the application on 3 dimensions ranging between: 4.36 and 4.47 on graphic user interface, 4.31 and 4.53 on composition and 4.25 and 4.33 on interaction, indicating that students were highly satisfied with the application to improve their phonics learning performance.

Nevertheless, their feedback was also analyzed in order to be a useful information to improve the quality of this application. As shown in Table 2, we could summarize them into 3 categories.

Table 2: Qualitative feedback towards P-Whale

Category	Feedback
Mobile with language learning	• I feel learning language is that boring as usual. • It is easy to learn. • It's attractive when I can interact on mobile screen.
Game with fun learning	• It's fun and challenging. • It helps learning phonics more meaningfully. • I feel that each mini games are interesting to promote learning.
AR with phonics learning	• It's more realistic when overlay the app onto the card. • I feel enjoy when finding the right card to match the sound listened • It's a new approach to learn phonics informally.

6. Conclusion and Discussion

This study proposed an Augmented Reality-supported mobile application to enhancing English phonics learning based on Jolly Phonics approach. Students were engaged with mini games to challenge and motivate their learning with their physical interaction on mobile and AR marker cards from the foundation step of letter sound and letter formation to the advanced step of blending and identifying the sounds from words. According to the experimental result, it was found that P-Whale can promote students' phonics learning performance; moreover, they revealed highest satisfaction towards the proposed application.

Regarding the findings reveal better phonics learning performance, this might be in flavor of the benefits of Jolly Phonics Approach in making students to construct the phonics knowledge and skill

in sequence, which was in line with the result of Ekpo, Udosen, Afangideh, Ekukinam and Ikorok (2007); moreover, AR could also develop the phonics learning through the virtual medias and interactions on the mobile leading to better achievement, as reported by Liarokapis & Anderson (2010).

However, the generalization of this research findings are limited due to a small size number of samples conducted in the experiment as a preliminary study. In addition to the experiment, there are several points to be addressed regarding the application. First, the usability of the application, we have to concern about students' learning environment that need to be quiet enough for more effectiveness in learning (Gordon, 2013). Second, it should be expanded to cover all 5 steps of Jolly Phonics learning for more effectiveness in reading and spelling since this version did not cover 'Tricky words' stage, which students will learn to read and write irregular words when they have knowledge of letter sounds and can relate the sounds to symbols (Lloyd, 1998). Finally, the quality of devices should be in high performance to avoid the learning distraction.

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