The Application of Augmented Reality in English Phonics Learning Performance of ESL Young Learners

I-Chun Chen
Graduate School of Education Communications & Technology
National Taipei Uviversity of Education
Taipei, Taiwan
lisa2chen2@gmail.com

Phonics is an essential foundation needed to build up reading and writing abilities for English learning. However, most students who learned English as a second language have not learned phonics systematically and appropriately, resulting in failed pronunciation in reading and writing English words. For eliminating struggles and barriers in the process of English learning, the new technology and interactive apps are a dynamic avenue assisting with understanding and retention for ESL elementary students. The study was conducted with augmented reality (AR) technology to integrate virtual objects and video clips into the interactive learning environment for second language learning. The effects of students' phonics learning performance were assessed. The results indicated that AR technology had validated the possibility of carrying out digital immersive language learning and embodied cognition, regardless of the drills of rote memorization. The concerns of the curriculum design based on the incorporation of the AR technology and learning materials are discussed further to improve phonics efficiency and competency for English as second language learners.

Keywords—augmented reality, phonics learning, ESL

I. 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). Analytic phonics learners learn to analyze letter sounds after seeing the word in which this approach cannot sustain over time. Students taking clues from recognition of the whole word, the initial sound and the context tend to memorize or guess the word as their learning strategy. Accordingly, there are significant numbers of children failing to learn to read, facing problems in reading comprehension performance.

Conversely, there have been several studies showing that students who learned phonics, especially those who learned synthetic phonics outperformed in reading (Ekpo, Udosen, Afangideh, Ekukinam, & Ikorok, 2007). Synthetic 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).

With the advent and accelerated development of augmented reality (AR), this new technology has been conducted to facilitate the effectiveness in education. (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' perspectives. 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 et. al, 2013).

II. LITERATURE REVIEW

A. Phonics Learning

Phonics learning could be regarded as a bridge nicely to cultivate the abilities in spelling, writing and reading for ESL learners. An essential part of the language learning process for ESL beginners involves learning the alphabetic system, including, letter-sound correspondences and spelling patterns, and learning how to apply this knowledge in their reading (National Reading Panel, 2000). Scientific studies have shed light on the findings that explicit systematic phonics instruction is the most effective way to teach children how to read and write (Snow, Burns, & Griffin, 1998). Without it, some children will end up having serious learning difficulties. Phonics are necessarily to be taught in the ESL classroom, including making use of sound-symbol, vocabulary, and meaning to decode and comprehend texts of primary importance in the prereading stage. The ESL teachers should provide ample opportunities for ESL students to apply their language skills to many meaningful,

informative, and enjoyable phonics reading and writing experiences, they will see the utility of the phonics skills they are learning and grow as independent learners.

B. Augumentated Reality

Augmented Reality (AR), defined as "a variation of Virtual Environments (VE), allowing the user to see the real world, with virtual objects superimposed upon or composited with the real world, " has aroused much attention in the educational area, which can be used to support ESL students in overcoming the language barriers and challenges. According to Wu, Lee, Chang, and Liang, of Graduate Institutes of Science Education in Taiwan, AR is the "coexistence of virtual objects and real environments," which allows learners to see and visualize the real world in a different way. Students interact with a mix of two- and three-dimensional objects overlaid onto a target image or background in the real world (Wu et. al, 2013). One widely AR app used in education, entertainment, and retail is Aurasma, allowing for the user to layer an image, video, or 3D object on top of the physical world by using a trigger or real-world image. Apps like Aurasma involve sounds, visuals, and tactile interaction, creating a more meaningful experience for students (Wu et. al, 2013).

There are a variety of ways to use Aurasma in the classroom. Aurasma can be used to support and enhance vocabulary, sight words, reading, bulletin boards, and more. Klein(2013) shared how vocabulary words can be made into augmented reality flashcards and students can have a way to interact with the otherwise boring flashcards, that shows how students can create their own Auras and share them with each other. Students learn from peers and collaboration, so if we allow them to create and view the peers' work, thus providing more interaction and experience working channels with others.

C. Theories and AR-assisted Language Leaening

Using AR with students builds on the constructivism theory, which encourages students to work collaboratively and take learning into their own hands. AR also relates to other theories like situated learning theory, self-determination theory (SDT), and flow theory. Situated learning is when learning occurs naturally during activities. AR will create experiences and opportunities that allow natural learning. Self-determination theory says learning occurs through motivation. Using AR is interesting and fun for students, which can motivate them to engage more with the learning activities. Finally, flow theory describes how people who are doing meaningful activities are more likely to be focused. AR and the projects that can be created using tablet can be meaningful to students because it is something they love working with. The meaningful experience can increase their focus on the topic, thus increasing their retention and learning (Antonioli, Blake, & Sparks, 2014).

AR-assisted language learning is known as an innovation that motivate students' language learning anywhere anytime on mobile devices. Nowadays technology has become an effective tool to enhance learning, help students to learn certain contents, and increase skills when they are involved.

Moreover, students are motivated to learn with happiness and enjoyment during the learning process (Cornillie, Clarebout, & Desmet, 2012). By far, AR-assisted language learning could be considered as an interesting trigger to promote language learning performance.

III. THE RESEARCH DESIGN

According to the term AR refers to technology that enhances the students' sensory perception of a real world with a computer-generated overlaid layer of information. With the characteristics of AR, it is possible for the ESL teacher to show the students a seamlessly coexistent virtual and real space, in which 3D models, video, or English learning text can be superimposed onto an image taken from a real environment. Through the AR-assisted English learning environment, it enables ubiquitous, collaborative and situated learning atmosphere for ESL students.

In order to enhance students' phonics learning performance, the Aurasma app was integrated into the application to make learning more engaging by enabling students to interact on the tablet device, and bridging the virtual experiences and interactive medias with phonics learning. The current research question aims to discuss whether AR can lead to an increase of on-task behaviors and foster better learning efficacy and knowledge retention with regard to ESL students' phonics learning performance and feedback. The research questions are as follows:

• Do students have better phonics learning performance after experiencing AR-assisted English phonics learning?

• How are the students' attitudes and feedback towards AR-assisted English phonics learning?

A. Particiapnts

In order to examine the effectiveness of the application, the research was conducted with 23 6th graders who were learning English as a Second Language (i.e., ESL) and studied English for 80 minutes a week in an elementary school in Taiwan. All students participating in the experiment had similar understanding of phonics and had previous experience of using a tablet or personal computer.

B. Experimental Design

The experimental design was aimed to assist students' phonic learning and help them to decode letters into the respective sounds, forming an essential skill to read unfamiliar words by themselves. From learning the letter-sound rules, the synthetic phonics approach are adopted in the experimental design in teaching students the sounds made by individual letter or letter groups (for example, the letter "c" makes a k sound), and teaching students how to merge separate sounds together to make it one word (for example, blending the sounds k, a, t makes CAT).

The learning content of the English AR educational materials was concerned with the learning objectives of the six grade students, which are related to their English learning textbook. The textbook adopted by the school for the ESL

students was the "Hello, Kid" series Book 7 published by Kang Hsuan Educational Publishing Group.

The implementation of the experiment took a total of 8.5 periods of 40 minutes each. Before the experiment, the students took the English phonics pretest. Thereafter, they learned the phonics rules and how to make the Aurasma AR board game operated on the tablet PC. Finally, the posttest of phonics learning effectiveness was conducted and the students' attitudes and feedback were investigated as well.
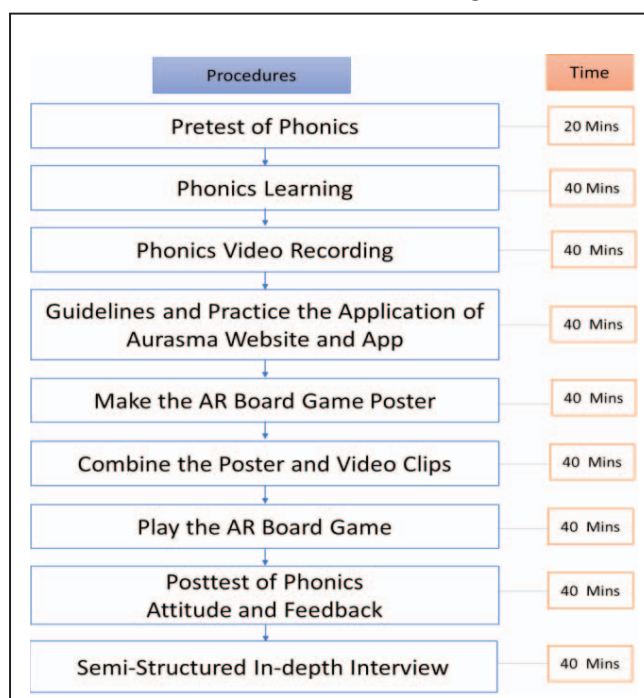

Fig. 1. Experimental design.

C. Procedures

The experiment was proceeded for 8.5 regular English classes and the procedures are as follows:

1) The students were asked to do the pretest to examine their prior knowledge on the phonics for 20 minutes before they participated in the phonics learning activity.

2) The phonics rules instruction was implemented in the ESL classroom. For this experiment, the word family chart was also provided to increase the vocabularies concerning how to connect the sounds of spoken English with letters or groups of letters (e.g., that the sound /k/ can be represented by c, k, ck, or ch spellings) and teaching them to blend the sounds of letters together to produce approximate pronunciations of unknown words.

3) Students were divided into four groups of three or four each. Every two groups were worked as the cooperative groups in which each took turns as the keepers of the AR board game. Each cooperative groups had to finish the A1 size paper poster consisted of 25 phonics word cards on it.

Students recorded the phonics words as video clips. Each video was the overlay which are launched when Aurasma views a trigger of the board game.

4) The students were learned the operation and application of Aurasma website and app, including how to create the trigger image, add overlay, finalize aura (the connection between the trigger image and the overlay), and share.

5) The students drew the phonics word cards on the poster to creatively design their AR board game. Each poster has 25 phonics word cards, and each card uniquely created by the student was the trigger of the AR board game.

6) The students went to the Aurasma website and signed up for the free account. Then upload the trigger image (word card) and the overlay(video clips). Finalize the aura and share this unique augmented reality experience.

7) Students started to play the self-made AR phonics board game.

a) Students of one group took turns rolling the dice and moving their game pieces along the phonics cards path on the board game poster.

b) Students of other group played as the game keepers who would write the words on the tablet according to the phonics card.

c) The player scanned the phonics word card in the Aurasma app to unlock the aura, then the question of the recorded video showed up. Based on the phonics rules, the player had to choose the correct words written on the tablet by the game keepers.

d) If the played chose the right the answer, he would keep playing the AR board game.

Fig. 2. Self-made AR phonics board game and poster.

8) The students took a posttest of phonics learning and questionnaire to evaluate their attitudes towards the application.

9) At the final stage, the semi-structured in-depth interview was conducted with an English teacher and three students and that allows for spontaneous and instant responses.

D. Data Analysis

In this study, the paired sample t-test was employed to analyze the effects of AR-assisted English phonics learning experience on the students' phonics learning performance and attitude.

Pretest and posttest were designed to evaluate the effects of phonics understanding by two experienced English teachers. 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 above-mentioned teachers' 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 one teacher in computer and one English teacher.

In order to present the meaning and practicality of AR-assisted English phonics learning for ESL young learners, the results of semi-structures in-depth interview were analyzed in accordance with the answers and responses from the interviewees. The interviewees were chosen from the research participants, including one English teacher and three students that represent high, middle, and low achievement in academic performance.

IV. RESULTS

A. 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 I.   PRETEST AND POSTTEST OF PHONICS LEARNING

Test	n	M ± SD	t	p
Pre-test (Score = 10)	23	0.86 ± 0.86	-12.44	0.00***
Post-test (Score = 10)	23	4.77 ± 2.01		

***p < 0.01

B. 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 AR 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, 3 categories were summarized and analyzed.

TABLE II.   QUALITATIVE FEEDBACK TOWARDS AR-ASSISTED ENGLISH PHONICS LEARNING

Category	Feedback
Mobile with language learning	• *I feel learning language is not boring as usual.* • *It is easy to learn.* • *It's attractive when I can interact on mobile screen.*
Board game with fun learning	• *It's fun and challenging.* • *It helps learning phonics more meaningfully.* • *I feel that board game is interesting to promote learning.*
AR with phonics learning	• *It's interactive when overlay the app onto the card of the poster.* • *I enjoy when finding the right word to match the sound listened* • *It's a new approach to learn phonics informally.*

C. Interview Responses towards the Application

The interview content was transcribed and decoded into three dimensions. The interview outline of study was divided into three categories as follows: the learning motivation, the personal feelings and suggestions regarding each region of the AR-assisted English phonics learning, and the feasibility of this learning method. All the interviewees had a positive and optimistic attitude toward the application of AR-assisted English learning. However, some issues including the time consumption and the limitations of devices and curriculum were left to be considered and further discussed.

TABLE III.   INTERVIEW RESPONSES TOWARDS AR-ASSISTED ENGLISH PHONICS LEARNING

Category	Feedback
English learning motivation	• *I feel English learning is so much fun. (S1)* • *It is so different from the traditional teaching method. (S2, S3)* • *This method can activate students' attention, engage them in the phonics learning, and facilitate the interaction among the group students. (T)*
Personal feelings and suggestions	• *I like this learning approach, and I hope I can continue to learn in this way. (S1, S2, S3)* • *It takes time to design the lesson materials. (T)* • *The curriculum should be incompatible with the application. (T)* • *The class time takes longer than usual. (T)*
Feasibility of AR-assisted phonics learning	• *It's possible to learn in this way. (S1, S2)* • *The supported environment, and physical facilities are essential. (T)* • *The interdisciplinary curriculum is needed to be designed and cooperated by the teachers in different subjects. (T)*

V. CONCLUSION AND DISCUSSION

This study proposed an Augmented Reality-assisted application combined with the self-made board game to enhance English phonics learning based on Aurasma app. Students were engaged with AR board game to intrigue, challenge and motivate their learning with interactive mechanism on mobile device and AR marker cards from the processes of letter sound and letter formation to the advanced blending and identifying of the sounds from phonics words. According to the research result, it was found that AR-assisted phonics learning application can promote students' phonics learning performance; moreover, they revealed highest satisfaction towards the proposed application.

Regarding the findings reveal better phonics learning performance, this strategy might be in flavor of the benefits of Augmented Reality in making students to construct the phonics knowledge or scaffold the phonics mechanism in a more efficient way. 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, some issues are highlighted to be addressed regarding the application. First, the usability of the application and the comprehensive learning environment of the devices are considered to be indispensable conditions for achieving more effective efficient in learning. Second, the learning content should be expanded to cover the materials from the textbooks and adhere to the students' formative and summative evaluation for more connection in reading and spelling, thus building the knowledge of meaningful learning experience. Finally, the quality of devices should be in high performance to avoid the learning distraction.

By utilizing multiple senses and showing an augmented reality, rather than a regular text, the AR-assisted phonics learning application is validated as a more intriguing and interactive way to engage students in English phonics learning. However, the curriculum design should be taken into account for better incorporation with AR board game and formal learning materials. Moreover, it would be valuable to analyze the learning patterns of students using AR learning materials for personalized learning for future studies.

REFERENCES

[1] D. R. Bear, S. Templeton, M. Invernizzi, & F. Johnston, Words Their Way: Word Study for Phonics, Vocabulary and Spelling Instruction. Upper Saddle River, NJ: Merrill, 1996.

[2] M. Antonioli, C. Blake, and K. Sparks, & Sparks, K., "Augmented reality applications in education," Journal of Technology Studies, 2017, vol.40, pp. 96-107.

[3] V. Connelly, R. Johnston, & G.B. Thompson, "The effect of phonics instruction on the reading comprehension of beginning readers," Reading and Writing, 2001, vol.14, pp. 423-457.

[4] L. C. Ehri, S. R. Nunes, S. A. Stahl, and D. M. Willows, "Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis," Review of Educational Research, 2001, vol. 71, pp. 393-447.

[5] C. M. Ekpo, A. E. Udosen,, M. E. Afangideh, T. U. Ekukinam, and M. M. Ikorok, "Jolly phonics strategy and the ESL pupils' reading development: A preliminary study," Mid Term Conference, University of Ibadan, Nigeria, 2007.

[6] E. Fry, How to Teach Reading. Fourth Edition. California, USA: Teacher Created Materials, 2005.

[7] R. Johnston, and J. Watson, The effects of synthetic phonics teaching on reading and spelling attainment: a seven-year longitudinal study, retrieved from http://www.gov.scot/Resource/Doc/36496/0023582.pdf, 2005.

[8] E. Klein, Tons of classroom examples using augmented reality with Aurasma - A complete how-to guide, retrieved from http://www.kleinspiration.com/2013/05/using-augmented-reality-via-aurasma-in.html, 2013.

[9] L, Fotis., and A. Eike.Falk, "Using augmented reality as a medium to assist teaching in higher education," Proc. of the 31st Annual Conference of the European Association for Computer Graphics (Eurographics 2010).

[10] N. R. Panel (2000). Teaching Children to Read: An Evidence-Based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction: Reports of the Subgroups. Washington DC: National Institute of Child Health and Development, 2000.

[11] P. Liu, and M. Tsai, "Using augmented-reality-based mobile learning material in EFL English composition: An exploratory case study," British Journal of Educational Technology, 2013, vol. 44, E1-E4.

[12] C. E. Snow, S. M. Burns,and P. Griffin, (1998). Preventing Reading Difficulties in Young Children. Washington, D. C.: National Academy Press, 1998.