The Learning outcome of using Augmented Reality Instruction to Enhance Students' English Vocabulary Learning in the EFL Elementary School

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ARTICLE INFO	ABSTRACT
	As for the rapid advance in technology, language instructors must search for a new methodology to educate students in technological instruction. This study aimed to explore the learning achievement with AR technology. This study examined the learning outcomes of English vocabulary learning in an AR instruction classroom with technological devices. 51 fourth -grader students participated in the instruction in Taichung city in Taiwan. The experimental method was employed to analyze learning data, including AR instruction (ARI) pre- and post-test, multimedia ppt instruction (MPI) pre- and post- test, and significant t -test. The total of 25 students from the experimental group experienced the ARI method, while 26 other students from the controlled group experienced the MPI method. The result revealed that AR instruction was a significant difference level($p<.001$). Comparing ARI and MPI group, the mean score post-test of the AR instruction group($M=92.59$) was better than the multimedia ppt group($M=84.86$). As for learning improvement, the improvement percentage of AR instruction($I=23.1$) was higher than multimedia ppt instruction($I=14.24$). Therefore, the results from the data analysis revealed that AR instruction facilitated EFL students' learning and significantly improved the students' English vocabulary achievement. *This is an open access article under the <u>CC BY-SA</u> license.*

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INTRODUCTION

One of the most important aspects of obtaining all four language skills is vocabulary (Staehr,2008). Learning vocabulary is an essential part of mastering a second language (Gorjian et al., 2011). Vocabulary learning is an essential part in foreign language learning (Alqahtani, 2015). In a word, vocabulary is an essential element to enhance EFL students' English ability. However, the

process of learning vocabulary is often a teacher-dominated lesson with a boring lecture (Zou et al., 2021). It's an important issue to promote students' interesting in learning English. Wang and Young (2014) explain about English vocabulary acquisition with technology can improve learners' motivation to learn English vocabulary. As a result, using various learning media can support the learning success (Haryadi & Pujiastuti,2020).

The use of technology in education is becoming more popular, which makes learning more motivating and meaningful (Lin et al., 2020). Additionally, teachers should create media that can attract students' attention (Rabu & Thalib, 2017). What is the appropriate media of technology to arouse students' motivation to learn English? The students taught by the technological media, PowerPoint activity, gained better learning achievement and motivation than those taught by visualization through pictures (Budasi, Ratminingsih, Agustini, & Risadi,2020).PPT activity seems to be a suitable instruction to trigger students' learning motivation and outcome. Besides, implementing AR-based technology in classes improves the students' language learning and learning achievement (Hadid et al., 2019& Hwang et al., 2016). Moreover, the most recorded advantage of AR is that aggrandized learning achievement. (Akçayır & Akçayır, 2017). From the previous researches, we can determine that Augmented Reality promoted students' learning performance and motivation. Especially for vocabulary learning, AR was found to be capable of improving vocabulary learning and motivation in an ESL context (Vedadi, Abdullah, & Cheok, 2019). For example, Lee, Chau, Tsoi, Yang, & Wu (2019) used mobile AR technology and developed a multi-player word-guessing game to enhance English learners' vocabulary learning. Consequently, AR is a suitable solution to assist EFL students to learn English Vocabulary efficiently.

Owing to the effectiveness of Augmented Reality learning, the researchers applied the StemUp application to the AR English Vocabulary instruction. StemUp is an English learning tool that combines Artificial Intelligence (AI) and Augmented Reality (AR) technologies and introduces an interesting game mode to provide fun and lively learning experience. StemUp AR application increased students learning motivation and enhanced English vocabulary learning achievement.

To sum up, vocabulary is an essential factor to affecting EFL students learning English outcomes. Ample vocabulary influences students' abilities for listening, speaking, reading, and writing. In the traditional class, students felt bored to recite words by words every day. Technological PPT activities or AR facilitates to increase students' learning motivation and achievement. AR has increased language learners' vocabulary size (Vedadi et al., 2018). Thereupon, performing Stem Up AR instruction in the class is to benefit students' Lexis acquisition. The researchers carried out Stem Up AR instruction to explore the effectiveness of students' vocabulary learning.

One of the authors designed an AR-based curriculum based on the StemUp English learning application to enlarge elementary school students' vocabulary learning outcomes in Taiwan. The research question guided this study:

RQ: How did the AR instruction (ARI) differ from the multimedia ppt instruction (MPI) with respect to the participants' English vocabulary proficiency?

The importance of this research lies in using AR-based English and multimedia ppt instructions to enhance the learning achievement of English vocabulary in an EFL learning environment. This research provides brand-new insights from the perspective of AR applications and multimedia ppt for designing the English curriculum for students' vocabulary learning.

RESEARCH METHOD

Research design

An experimental design was implemented to explore this research. The students were from different English classes, with 26 participants in the control group and 25 participants in the experimental group.AR instruction (ARI) was implemented in the experimental group, but multimedia ppt instruction (MPI) was used in the control group.

Participants

The participants in this current study were 51 fourth grade students taught by the same English teacher from two diverse classes at one elementary school in Taichung city in Taiwan. All participants had four years of English learning experience. The 25 experimental participants experienced AR instruction, and the 26 control participants involved multimedia ppt instruction during six weeks.

Instructional design

One of the researchers designed the six-week instruction, and chose the material from the English textbook, Hello Darbie! (Kang Hsuan Education Group, 2021). Vocabulary instruction themes were chosen from basic Color, Numbers, Food, Animals, Fruits, and Positions in the classroom. There were 6 classes and each class was 40 minutes amount for 240 minutes during six weeks. One of the classes was performed with multimedia ppt instruction (MPI) and the other class was implemented with the Stem Up AR instruction. The control group was taught with Microsoft PowerPoint. Vocabulary pictures, words, or sentences could be designed in the PowerPoint like interesting Slideshow. The experimental group was instructed with AR application StemUp. StemUp was an English learning application developed by the Institute for Information Industry (III), a non-governmental organization in Taiwan. Stem Up was a game-based Augmented Reality (AR) technology

that provides an interactive environment to promote elementary students' motivation in learning English. The significant characteristics of StemUp improve English vocabulary in the following ways: The use of AR APP allows students to have vivid three-dimensional vocabulary pictures, which increases learning interest, promotes attention in class, and improves learning effectiveness (figure1). It provides real-time learning and assessment with gamification to enhance student learning achievement (figure2). It provides personalized and class learning histories and study suggestions to help students effectively self-improve their learning (figure3).

To explore the participants' English vocabulary learning achievement, the participants completed the pre- and post- tests designed for fourth graders, including listening comprehension of vocabulary, reading comprehension of vocabulary, and basic writing ability of vocabulary from fourth-grade English textbook.   The test was arranged on a 100-points scale, with vocabulary listening accounting for 30 points, recognition of vocabulary for 60 points, and vocabulary writing of answering the question for 10 points.   The methods of the pre-and post-tests were conducted to compare differences. In addition, the t-test was investigated the students' English vocabulary learning proficiency achievement between the pre-and post-tests.
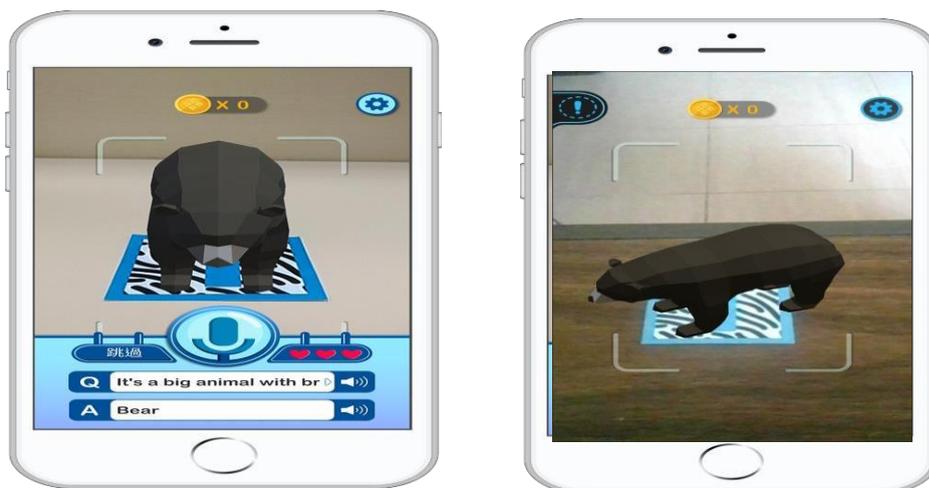

Figure 1. Vivid three-dimensional AR vocabulary
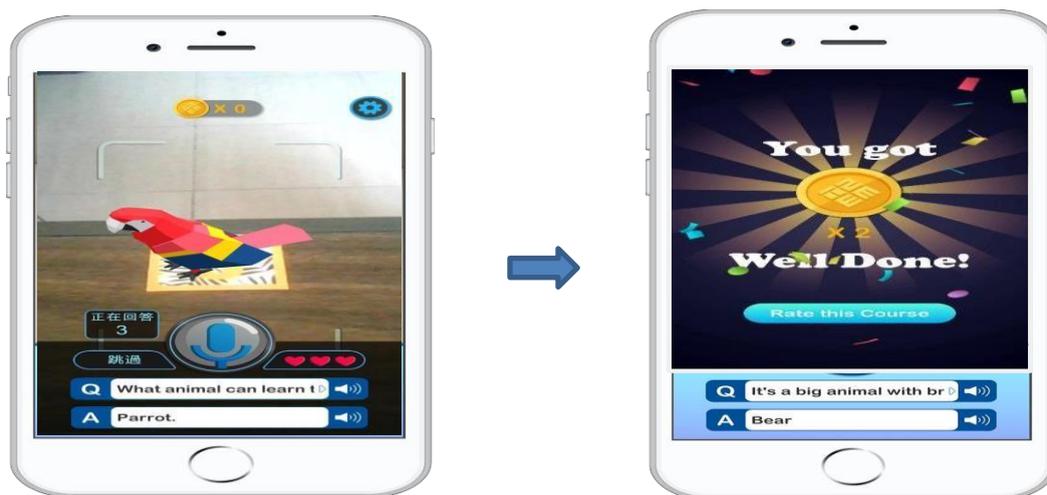*pictures in Stem Up*

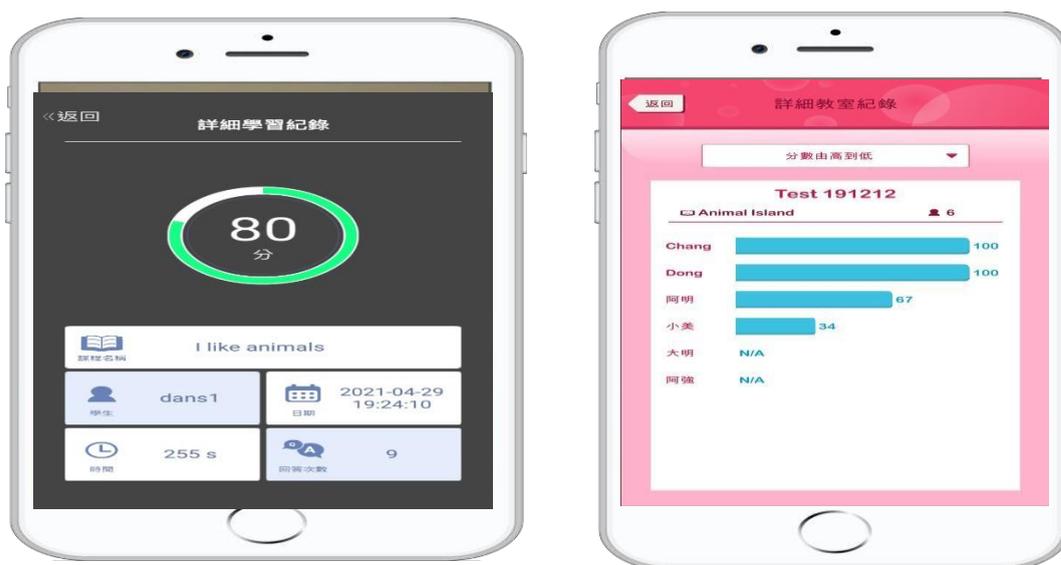*Figure 2. Game-based real-time learning and assessment in Stem Up*

Figure 3. Personalized learning and class history in Stem Up

RESULT AND DISCUSSION

The analysis of the comparison between AR instruction and multimedia ppt instructions indicated the outcome of EFL students' vocabulary learning. The findings of the current paper are presented in RQ.

RQ: How did the AR instruction (ARI) differ from the multimedia ppt instruction (MPI) with respect to the participants' English vocabulary proficiency?

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English Language Teaching Methodology

To examine the students' English vocabulary learning ability in answering the research question, the consequence of comparing the pre-test and post-test in the AR and multimedia ppt lecture disclosed as follows:

The Learning Outcome in Multimedia ppt Instruction (MPI)

The mean score of the post-test (M=84.86) was higher than that of the pre-test (M=74.28). The percentage of improvement was 14.24% (see Table1). The score of post-tests exceeded in pre-test indicated that students make progress after multimedia instruction. Therefore, multimedia teaching can still facilitate students' English vocabulary learning.

Table1. The mean score and improvement of students' vocabulary proficiency in MPI

No	Category	Mean Score		Improvement(%)
		Pre-test	Post-test	
1	Students' Vocabulary Proficiency in MPI	74.28	84.86	14.24%

The Learning Outcome in AR Instruction (ARI)

Table2. The mean score and improvement of students' vocabulary proficiency in ARI

No	Category	Mean Score		Improvement(%)
		Pre-test	Post-test	
1	Students' Vocabulary Proficiency in ARI	75.21	92.59	23.1%

The learning outcome of students' English vocabulary in AR instruction can be analyzed via the above table2. The average score of the pre-test was only 75.21. After AR instruction treatment, the post-test grade progressed up to 92.59. Moreover, the percentage of improvement was 23.1%. As a result, the achievement of students' English vocabulary in AR instruction was outstanding performance from the mean score of pre-tests(M=75.21) to post-test (M=92.59).

Comparing the learning outcomes of the multimedia ppt instruction (MPI) and AR instructions, the graphic reveals the improvement between ARI and MPI obviously. (Figure 1)
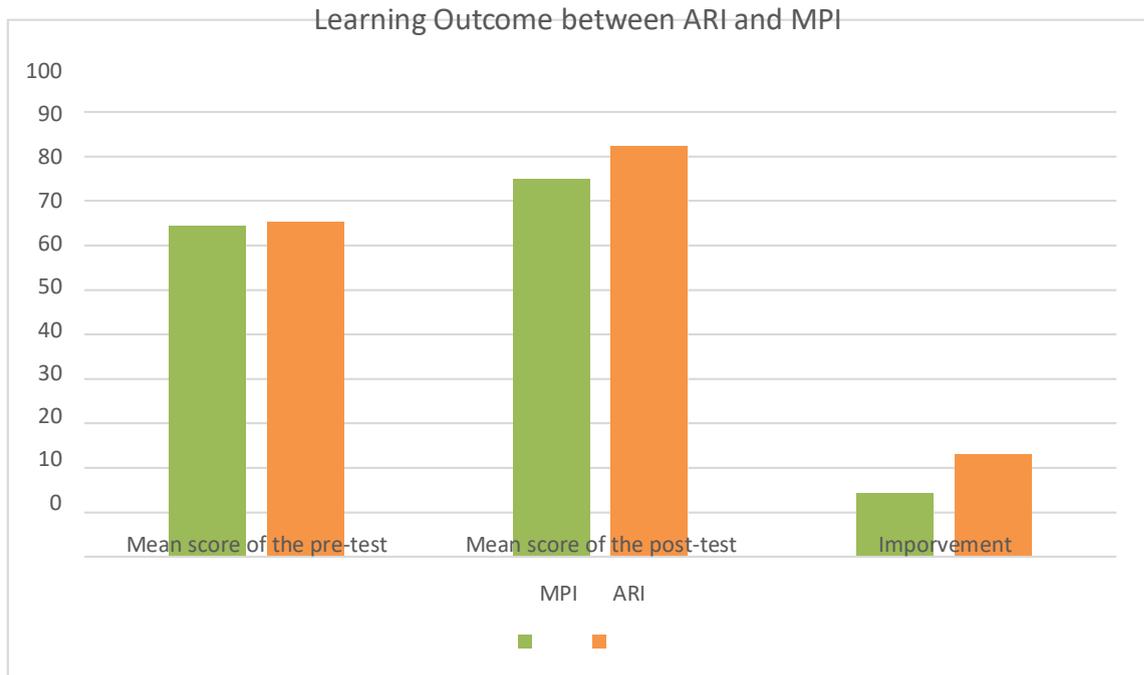

Figure.1. The mean score and improvement of students' learning outcome in the pre- and post- test

The analysis of graphic explained the crucial outcome that AR instruction was superior to the multimedia ppt instruction. In the beginning of the both the mean score of pre-tests between AR(M=74.28) and multimedia ppt instruction(M=75.21) were almost the same. This suggested that students have the similar prior knowledge in this research. After the treatment of instructions, the mean score post-test of the AR instruction group(M=92.59) was much higher than the multimedia ppt group(M=84.86). Moreover, the improvement percentage of AR instruction(I=23.1) was still better than the multimedia ppt instruction(I=14.24)

The Significant of ARI and MP Instructions in vocabulary learning

The t-Test revealed in Table3 explained that the participants of AR instruction manifested post-test was superior to the pre-test. These results indicated that AR instruction was effective in prompting the participants' English vocabulary outcomes. As a result, the method of AR instruction was superior to multimedia ppt instruction at a significant level($p < .001$). Additionally, compared to the mean difference and improvement between AR and MP instructions, the mean score improvement of AR instructions (M=17.38) was higher than the mean score improvement of MP instructions (M=10.57). This revealed that participants learned more efficiently from AR instruction because of the vivid, interactive, and interesting game-based AR learning.

Table3. T-test of the pre-test and post-test in the AR instruction and multimedia ppt instruction

	Paired differences					*t*	*df*	*Sig.* (two-tailed)
	Mean	SD	Std. error	95% confidence interval of the difference				
			mean	Lower	Upper			
AR instruction: Post to Pre	17.38	16.05	3.5	10.07	24.68	4.962	20	<.001
MP instruction: Post to Pre	10.57	31.13	6.79	-3.59	24.75	1.556	20	1.35
Post(AR) to Post(MP)	7.73	19.84	4.33	-1.30	16.67	1.78	20	0.89

Note. ***$p < .001$.

CONCLUSION

The results of this study suggested that the participants' vocabulary learning achievement was significantly promoted with AR instructional design. AR vocabulary activities with StemUp effectively encouraged the participants to learn English vocabulary efficiently. The technological mobile device with the AR (Stem Up) app applied in the current study is appropriate for students to learn English anytime, anywhere. Students' learning abilities were promoted in the AR instruction method.

On the basis of the discussion of this research, the researchers offer the following conclusions.

(1) The AR instruction strategy was useful and greatly improved students' English vocabulary learning. This was proved by the descriptive statistics of the pre-test and the post-test. The AR instruction mean score pre- and post- test was 75.21 values to 92.59. After treatment, the improvement reached 23.1%. Thus, AR instruction facilitated English vocabulary learning outcomes.

(2) AR-based instruction with Stem Up application performed better than multimedia with multimedia PowerPoint instructions. As for technological, interesting, interactive, and game-based AR instructions, participants learned more efficiently than only vocabulary picture learning with PowerPoint.

(3) After t-test analysis, participants' English vocabulary learning proficiency was significantly enhanced. The learning achievement of AR instruction was much better than the multimedia ppt lecture at a significant level($p<.001$). This result implied that the method of AR teaching was effective in elevating participants' vocabulary learning proficiency.

In conclusion, EFL students' vocabulary learning in AR instruction not only led to authentic and interesting Augmented Reality with StemUp applications, but also significantly enhanced students' vocabulary learning outcomes.

Future studies might concentrate on English teacher training about AR-based English instruction with technological mobile devices. The more teachers could apply technology to assist EFL

students to learn, the more students would benefit from AR instruction in the educational virtual and real integration.

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