An Action Research Study Exploring the Effects of Augmented Reality for English Vocabulary Learning in an Elementary School in Taiwan

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Abstract
The purpose of this study is to compare the use of traditional English flash cards and the vocabulary learning method of Augmented Reality to see which English vocabulary learning method is more efficient for elementary school students. The study was conducted at an elementary school in Taiwan, and there were 60 student participants in total. This study adopted an unequal pre-test and post-test experimental design. The study was conducted in two stages in terms of data collection. In the first stage, the control and experimental group took the English vocabulary test, without any teacher instruction, as the pretest. In the second stage, the control group used flashcards to learn 20 target English words by themselves for 40 minutes. The experimental group adopted the Augmented Reality 3D effect on the 20 target words by themselves for 40 minutes. After that, both groups took the same English vocabulary test again, as the posttest. On the whole, Augmented Reality teaching effects apparently exceed the effects of the traditional vocabulary learning method. The results of this study show that the learning method of Augmented Reality was more efficient than that of learning with English flash cards among the various proficiency levels (high, intermediate, and low) in terms of English vocabulary learning. The way of using English flash cards showed significant differences between high and low level groups, as well as between intermediate and low level groups, with the exception being the difference between high and intermediate level groups. It is worthwhile improving children's English vocabulary learning by using Augmented Reality, by incorporating it into their daily lives through mobile learning.

Key Words: Augmented Reality, English Flash Cards, English Vocabulary Learning
Introduction

In recent years, as the era of the global village has arrived, being able to communicate through a common language for worldwide public communication has become relatively important. Therefore, the importance of English increases daily, because English has become the main language in the world, and is regarded as our foreign language. Because technology is being applied ever more widely, how to use the improvement of information technology to increase English learning efficiency and the disposing of traditional English learning methods has become a global trend. Several scholars think that a multimedia learning system which combines words, graphics, sounds, and animations is interaction-driven with learner-centered characteristics and provides an ideal learning environment. During the learning process, learners can select their own learning content as well as progress and repeat, based on their own needs, which is helpful in raising learning efficiency (Juan, et al, 2010; Kerawalla, et al, 2006; Richardson, 2016).

English, a common language in the world, has become increasingly valued by Taiwanese parents. Accordingly, the question of how to strengthen children's English vocabulary ability has drawn everyone's attention, and the resulting cram schooling atmosphere has become extremely prevalent. However, in such intensified English education, numerous methods are employed in the cramming teaching content, so learners feel bored. Because of this, learners are always full of enthusiasm and interest when starting learning, but then their learning motivation disappears fairly quickly. Nowadays, there are a variety of flash cards and English vocabulary learning books, but all of them are limited to words and graphics printed on paper.

In order to solve this problem, we intend to apply more interesting and interaction-like learning methods to help learners learn. Take learning English vocabulary, for example. If the to-be-learned English vocabulary is not only made into flash cards but also integrated into Augmented Reality, the meanings of words with images and voices can be expressed more vividly and interestingly, as well as helping the students to memorize the words more easily. In addition, now more and more studies reveal that multimedia-assisted language teaching can indeed help learners promote their language learning (Bower, et al, 2014; Bull &Wasson, 2016; Kerawalla, et al., 2006). Apart from the rise of learners’ English learning efficiency, how to boost learners’ learning interest, as well as learning motivation, has also gradually become a trend in scholarly discussions. In recent years, English teaching has been highlighted domestically by all parties. “Edutainment”, immersing English in our daily lives to get children accustomed to English, is the
most viable method of the time. During the children’s learning process, plenty of materials and media assist children in their learning activities to increase the entire learning efficiency as well as interest (Mahadzir & Phung, 2013). With the development of digital technology, teaching media have become more diversified. Not only do they enrich the entire learning content and way of presentation, but they also bring new learning interaction. Children can experience the learning content in more abundant and interactive learning ways, such as games, since multi-sensory stimulation can enhance learning outcomes (Richardson, 2016).

English learning for children focuses on four skills: listening, speaking, reading, and writing; nevertheless, while children are learning English, colorful and animated graphics draw their attention first, and then they feel interested, so that they can learn English unconsciously. Using lively interaction flash cards with 3D images to recognize English vocabulary and reading vocabulary to intensify users’ listening and pronunciation can help users easily increase their interest in learning English and better boost their learning efficiency (Kirova, Petkovska, & Koceva, 2012; Rose & Bhuvaneswari, 2014). Hence, the purpose of this study is to compare the use of traditional English flash cards and the vocabulary learning method of Augmented Reality, to see which English vocabulary learning method is more efficient for elementary school students. The research questions are as follows:

1. In comparison between traditional English flash cards and the vocabulary learning method of Augmented Reality, which increases elementary school students’ English vocabulary learning efficiency?
2. How does the vocabulary learning method of Augmented Reality influence elementary school students’ English vocabulary learning efficiency among high, intermediate, and low proficiency groups?
3. How do traditional English flash cards influence elementary school students’ English vocabulary learning efficiency among high, intermediate, and low proficiency groups?

**Literature Reviews**

**Mobile Learning**

The application of information and communication technology to education and training has made numerous changes in the paragons of education and learning over the past ten years (Hossain & Prybutok, 2008). Among them, mobile learning, m-learning for short, has currently become one of the most highlighted learning trends, followed by remote learning, as well as digital learning. Yang and
Yang (2010) stated that mobile learning can be conducted through mobile computing devices. Furthermore, Traxler (2007) mentioned that mobile learning was not only digital but also movable, and by means of handy mobile learning devices and wireless networks, it offered a real opportunity – information was accessible. Apparently, compared to other technologies which support learning strategies, mobile learning tends to be less restricted by time and space. According to Stockwell (2008), mobile learning can be categorized into four types – indoor individual m-learning, outdoor individual m-learning, indoor cooperative m-learning, and outdoor cooperative m-learning.

Not only can mobile learning make learning unlimited by time and space, enlarging teaching places from traditional classrooms to the network environment, free of space and time limitations, but it also can help educational institutes enhance their teaching quality with mobile learning, because of a large increase of the penetration rate of mobile carriers (Shin, 2007). Mobile learning connects to cloud servers via the Internet, placing teaching materials, tests, etc. in the cloud, so that on the school teaching side teachers can share information with students to construct an educational platform for information sharing, and students can instantly access teaching resources (Sole, Calic, and Neijmann, 2010). Thus, the links between teaching content and students become closer. Students’ learning processes can also be recorded in the system in detail, which can be referred to by teachers and parents to better understand students’ learning statuses, in order to establish a seamless learning environment, either at school, at home, or in other places of learning.

**Augmented Reality for English Vocabulary Learning**

Van Krevelen and Johnson (2010) stated that AR can be used as a teaching tool, which allows learners to smoothly interact with virtual objects in virtual and real environments. Besides, learners’ using AR as a teaching tool will lead to new types of teaching and learning. AR can help learners immerse themselves in the characteristics of the learning content, rather than merely learning being static memorization of information. Yuen, Yaoyuneyong, and Johnson (2011) proposed that Augmented Reality can provide learners with a new type of learning tool. Benefits from applying AR to education include: 1) Interaction: students are able to operate it easily, as well as have discussions about it; visual and audio stimulation can arouse school children’s curiosity and increase their learning motivation. 2) Sensory feedback: the 3D real-time model presented in front of school children helps them enter the space formed by virtual objects and the real environment as a way of immersion. 3) Spatial association: the spatial association between
each virtual object, each real object, and the environment can be easily identified.
4) Learning novelty: owing to AR's novel way of presenting knowledge and its simple and intuitive interaction, AR can also act like multimedia, which can make learning fun for students and trigger their learning motivation and interest.

In the Taiwanese field of English teaching, several researchers have begun using the technology of Virtual Reality and English learning results to do relevant teaching research. Lin (2009) took Elementary School English as an example, applying Augmented Reality to his teaching research and assisting school children's English learning with Augmented Reality, in hopes of promoting school children's learning outcomes and intensifying learning processes by means of new teaching media applications. Its teaching effects apparently exceed the effects of the general teaching methods. Furthermore, it had a remarkable effect on English learning for the school children of the highest and the lowest English levels; students of different genders all received remarkable learning results. Huang (2009) tried to apply Augmented Reality to English teaching research on nouns, verbs, and adjectives and to assist students' English vocabulary learning with an Augmented Reality computer, expecting that the AR applications could enhance students' learning outcomes. Meanwhile, the differences in students' English learning with respect to nouns, verbs, and adjectives were discussed when the AR computer was used to assist teaching. The results showed that teaching with Augmented Reality was helpful in promoting English learning ability in elementary school.

**Method**

**Participants**

The study was conducted at an elementary school in Taiwan, and the participants were 60 fourth grade students in total. On the whole, the group of fourth grade students had the same characteristics in terms of their English proficiencies. The 20 target words were chosen from the Happy Playground Learning Box, which is produced by the Happito Creative Company. These 20 words are basic level for students, and all words are nouns. The researcher adopted these 20 target words to assess students as their pre-test. The highest possible pretest score was 100. Based on the results of the pretest, students were classified into three English vocabulary proficiency groups: low, intermediate, and high. 20 students who received scores below 60 were classified into the low level group; 24 students between 60–79 points were classified into the intermediate level group; and 16 students who obtained above 80 were classified into the high level group.
According to stratified random sampling, in the high level group, 8 students were randomly assigned to the experimental group (using AR to learn English vocabulary) and the other 8 students (using flashcards to learn English vocabulary) were assigned to the control group. In the intermediate level group, 12 students were randomly assigned to the experimental group (using AR to learn English vocabulary) and the other 12 students who used the traditional vocabulary learning method (using flashcards to learn English vocabulary) were assigned to the control group. In the low level group, 10 students were randomly assigned to the experimental group (using AR to learn English vocabulary) and the other 10 students (using flashcards to learn English vocabulary) were assigned to the control group. They were given a time limit of 40 minutes to learn 20 English vocabulary words.

**Materials**

The 20 target words were chosen from Happy Playground Learning Box, which is produced by the Happito Creative Company. These 20 words are basic level for students, and all words are nouns. In order to help students learn all English vocabulary with letters of the alphabet, we made some letters of the alphabet into flashcards, which were presented to them as displayed in Figure 1, including Chinese and English names and the pictures which represent the vocabulary. As mentioned above, the control group used this method to learn English vocabulary. With respect to the experimental group, the participants were asked to download the Augmented Reality (AR) App to the ipads that the school provided, so that participants could view the Augmented Reality 3D effect of the vocabulary on the screens of their ipads. Not only can the English vocabulary be displayed, but also sound effects and actions can be made via learners’ gentle touches with their fingers. Sound effects refer to the pronunciations of the vocabulary. The Augmented Reality 3D effect of the vocabulary on the screens were presented as displayed in Figure 2.

![Figure 1. An example of the English vocabulary flashcard](image-url)
Data Collection

Students’ English vocabulary acquisition was measured through a multiple-choice test. The tests had 20 items, with four choices for each item. Scores ranged from 0–100 on the multiple-choice test. The study was conducted in two stages in terms of data collection. In the first stage, the control and experimental groups took the same English vocabulary test, without any teacher instruction, as the pretest. In the second stage, the control group used flashcards to learn 20 target English words by themselves for 40 minutes. The experimental group adopted the Augmented Reality 3D effect of the 20 target words by themselves for 40 minutes. After that, both groups took the same English vocabulary test again as the posttest.

Data Analysis

In order to analyze the study results, a paired-sample t-test was conducted to evaluate effects between the control (traditional English flash cards) and experimental (the learning method using Augmented Reality) group on students’ English vocabulary learning. A One-way ANOVA was used to evaluate influences between the control (traditional English flash cards) and experimental (the learning method using Augmented Reality) group on students’ English vocabulary learning on various levels of low, intermediate, and high level participants.

Results

Overall, the paired-sample t-test showed that whether the method of learning through the use of traditional English flash cards, or the learning method of Augmented Reality was used, both had a significant effect on English vocabulary learning, as shown by the t value \( t(59)=5.70, p<.0001 \) (See Table 1). In addition, the results also showed that the learning method using Augmented Reality was more

Figure 2. One example of augmented reality information
efficient than the learning with English flash cards with various proficiency levels (high, intermediate, and low levels) with respect to English vocabulary learning (See Table 2).

**Table 1.** Paired Samples Test (A comparison of English flash cards and augmented reality training effect overall on participants (n=60)

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.60</td>
<td>13.10</td>
<td>5.70</td>
<td>59</td>
<td>.000*</td>
</tr>
</tbody>
</table>

**Table 2.** A comparison of English flash cards (FC) and augmented reality (AR) training effect on each proficiency level (high, intermediate, and low)

<table>
<thead>
<tr>
<th>Level</th>
<th>AR M(SD) 95% CI</th>
<th>FC M(SD) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>5.31(4.52) (1.53, 9.09)</td>
<td>1.25(2.99) (-1.25, 2.99)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>12.71(4.19) (10.05, 15.37)</td>
<td>6.25(4.71) (3.26, 9.24)</td>
</tr>
<tr>
<td>Low</td>
<td>20.75(5.90) (16.53, 27.97)</td>
<td>13.25(7.82) (7.65, 18.85)</td>
</tr>
</tbody>
</table>

Note: CI refers to confidence interval

The One-way ANOVA identified that the learning method using Augmented Reality had a significant effect on students’ English vocabulary learning with various levels of low, intermediate, and high groups, as shown by the F value (2.27)=22.23, \( p < .0001 \) (See Table 3). Besides this, the results also showed that the high proficiency level group was higher than intermediate and low level groups. The intermediate level group was higher than the lower level groups (See Table 4).

**Table 3.** One-way ANOVA (A comparison of students’ English vocabulary learning efficiency overall on participants by using augmented reality)

<table>
<thead>
<tr>
<th>Sources</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>between groups</td>
<td>2</td>
<td>1069.22</td>
<td>534.61</td>
<td>22.23</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>within groups</td>
<td>27</td>
<td>649.32</td>
<td>24.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>29</td>
<td>1718.54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4. A comparison of Students’ English vocabulary learning efficiency among various proficiency levels (high, intermediate, and low) when using augmented reality

<table>
<thead>
<tr>
<th>Proficiency groups</th>
<th>Mean Differences</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>high vs. intermediate</td>
<td>7.4</td>
<td>(1.60, 13.19)</td>
<td>*</td>
</tr>
<tr>
<td>high vs. low</td>
<td>15.44</td>
<td>(9.41, 21.46)</td>
<td>*</td>
</tr>
<tr>
<td>intermediate vs. low</td>
<td>8.04</td>
<td>(2.60, 13.48)</td>
<td>*</td>
</tr>
</tbody>
</table>

Note: * refer to $P < .005$

However, the One-way ANOVA identified that the learning using English flash cards also had a significant effect on students’ English vocabulary learning among various levels of low, intermediate, and high groups, as shown by the F value ($2.27$) = 10.40, $p < .0001$ (See Table 5). High and intermediate level groups were better than the low level group. Interestingly, there was no significant difference between high and intermediate level groups (See Table 6).

Table 5. One-way ANOVA (A comparison of students’ English vocabulary learning efficiency overall on participants when using flash cards)

<table>
<thead>
<tr>
<th>Sources</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>between groups</td>
<td>660</td>
<td>2</td>
<td>330</td>
<td>10.4</td>
<td>0.0004</td>
</tr>
<tr>
<td>within groups</td>
<td>856.88</td>
<td>27</td>
<td>31.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>1516.88</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. A comparison of students’ English vocabulary learning efficiency among various proficiency levels (high, intermediate, and low) when using flash cards

<table>
<thead>
<tr>
<th>Proficiency groups</th>
<th>Mean Differences</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>high vs. intermediate</td>
<td>5</td>
<td>(-1.66, 11.66)</td>
<td></td>
</tr>
<tr>
<td>high vs. low</td>
<td>12</td>
<td>(5.08, 18.92)</td>
<td>*</td>
</tr>
<tr>
<td>intermediate vs. low</td>
<td>7</td>
<td>(0.75, 13.25)</td>
<td>*</td>
</tr>
</tbody>
</table>

Note: * refer to $P < .005$


**Discussion and Conclusions**

Overall, the results of this study have showed that the learning method of Augmented Reality was more efficient than that of learning using of English flash cards among the various proficiency levels in terms of English vocabulary learning. In other words, Augmented Reality teaching effects apparently excelled the effects of the traditional vocabulary learning methods. In addition, it had a significant effect on English learning for the school children of the highest and the lowest levels of English. As mentioned above, the results of this study are in tune with Lin’s (2009) study. By contrast, the learning method using English flash cards produced significant differences among high and low level groups as well as intermediate and low level groups, with the exception being between high and intermediate level groups. It appears that the learning method using Augmented Reality is more efficient and suitable for various proficiency level groups with respect to learning English vocabulary.

Currently, Augmented Reality is being applied to diversified aspects of learning, such as teaching assistance, guidance, exhibition, and so forth. The technology of Augmented Reality has been also melded into our lives. Meanwhile, if we can apply this technology to teaching, not only can it increase the fun of interaction between students and teaching materials, but also characteristics of the Augmented Reality technology can solve problems encountered in the current teaching of language (Bordbar, 2010). Augmented Reality has been in development for decades. It differs from Virtual Reality in that Augmented Reality puts real-life scenes into users’ perceptions and superimposes virtual objects on real scenes, so that users’ will have more explicit perception as regards space. Besides, it is also applied more widely than Virtual Reality; for example, Augmented Reality can be seen in clothing, education, and entertainment. At present, the technology of Augmented Reality has turned into a popular trend, instead of being a professional skill used by experts, becoming a main goal of development for our daily commodities such as games and cell phones (Carmigniani, et al, 2010).

In children’s English vocabulary learning, this paper uses the technology of Augmented Reality, simultaneously overlapping virtual objects and scenes in the real world, to create the feeling of being personally in the scene. By means of this technology with 3D images presented in the real world, the original boring English learning will become more interesting, so that students’ learning interest and motivation will be triggered. Therefore, using colorful and lively pictures can draw children’s attention. With the effects of games and interaction entertainment, children can subconsciously directly associate an object with its English word and
are happy to learn, so that children can gain learning interest from the games. It is worthwhile improving children’s English vocabulary learning by using Augmented Reality in their daily lives via mobile learning.

References


