# The Use Of Markerless Augmented Reality Flash Card For English Vocabulary building

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*Abstract— As the world grows ever so small with the advancing technology, language mastery is one of the key factors for success in many field. While learning language could occur in all stages of a human life, many studies shows that learning language from a young age is faster and easier. The use of physical flashcard as tool for language learning has been common in many places. However there some limitation to physical flashcard as they can be damaged, lost, and has no inherent ability to record its usage so that it can be analyze to enhance studies. This research proposed an augmented reality approach to flash card to learn basic English vocabulary in children. It is then shown that while the application did not speedup the learning process it does increase the interest of the children. This research then shows the limitation of using such approach to learning language in children.*

**Index Terms—***Augmented Reality, Flash Card, Education, Language,*

## I. INTRODUCTION

Learning a foreign language in this age of globalization and digitalization is obviously beneficial in numerous fields. Although there are numerous translation tools to help understand a foreign language, it is still better to communicate directly whenever possible. The act of learning foreign language (L2) has thus become ongoing research with many approaches. One such approaches is to digitalized language learning.

In the current explosion of digitalization, the process of learning a language has also been digitalized to an extent (Digital language Learning, DLL). Many research has been conducted, and although the basic media used in language learning (text, pictures, photos, audios, and videos) remains the same, the technology used to present them evolved at every turn [1].

Ping Li and Yu-Ji Lan [2] defined DLL as digitally enhanced or technology enhanced language learning platform or tools, or the practice of learning such platforms or tools. A subset of DLL is CALL (Computer assisted language learning). in his studies Levy[3] mentioned two types of CALL from functional standpoint. A tutorial CALL is a software that replaces the part of the language teacher/tutor. This means that the software will act as a teacher giving materials to students and testing them to learn a language. A Tool CALL is software that can be used to aid language learning, but it is not intended to replace teachers. These tools aid the student in many aspects of language learning like for example a grammatical check that does not remove the role of the teacher.

CALL can then be expanded based on the hardware that is being used. Ping Li et.al mentioned an increase in the use of Mobile device to aid language learning (MALL), Virtual Reality, and Augmented Reality. MALL has the benefit of interactivity, ubiquity, portability, and may enhance motivation of students [4] [5] with several downside such as lack of attention due to multi-tasking on phone. Jaroslav Kacetl et al in 2019 mentioned that MALL are mostly used as a support (i.e. Tool CALL ) therefore it is used in conjunction with blended learning [4]. One of the commercial example of MALL is Duolingo[6]. This App teaches language learning through gamification, and has been the subject of many research to evaluate it [7]. Kumar in 2022 [8] categorizes MALL into six categories which is "Vocabulary, reading and writing, speaking and listening, pronunciation, grammar , and conversation". In which case, 40% of the paper reviewed targeted vocabulary as their MALL target skill. This means that a lot of MALL teach student to grow their vocabulary. Some of the types of application listed in vocabulary are karaoke, dictionary lookup, flash card, wordplay, storytelling, mystery game, etc.

Hsiao [9] in 2016 used the virtual environment second life to create a language learning environment. This environment can be accessed using Virtual Reality Headset. Alwafi in 2022 [10] create a virtual reality application that mimics real-life situation of language learning by creating a simulated environment. This application didn't remove the role of teacher, rather the teacher is present in a virtual form. Many commercial VR applications for language learning has also been develop. In 2020 Anke bern [11] in his research listed 17 VR application on the google play store using several different approaches to teaching language. He concluded in his research that these applications have not fully implemented the potential of VR and that there are many rooms for improvements.

Augmented Reality (AR) is another technology that has also been researched to aid language learning. AR is the addition of digital content on top of actual reality. One of the factors impacting the acceptability of AR is that to use AR you don't need to use big and expensive additional hardware. Most AR applications can be used with a mobile phone without additional hardware. Karacan et.al mentioned that AR has the most potential to be a tool for language learning with the upcoming advancement ahead. [12]. While Taskiran in a research states that AR has been proven to increase

motivation on learning [13].

Aside from focusing on hardware and technology, other types of research focus on language learning concepts. Deconstructing the concept of language learning, one needs to know the component of it. Some researcher like Jean Barko [14] and Finegan [15] mentioned some of the component of a language which is phonology/phonetics ( the sound of the language), morphology (the form of the language ) , Syntax ( the structure of the language), and Semantics ( the meaning of the language). Other researcher such as [16] lists efforts ot learn foreign language into behavioral, cognitive, and constructivist approach. Where behavioral focused on behavior aspect such as direct conversations, cognitive approach studies the grammar and rule as a knowledge acquisition. Constructivist approach starts from a cognitive approach but also establishes connection between knowledge.

In their review study, Shadiev and yang [17] mentioned that Writing, vocabulary and speaking is the top 3 skill that is being targeted by researcher of DLL. While Oxford and Crookall [18] categorizes some of the strategy on language learning as follows :

1. Cognitive strategies – formal learning or through reasoning/ analysis
2. Memory strategies – learning by means of memorization.
3. Compensation strategies – using behavior that compensates missing knowledge while learning.
4. Communication strategies - learning by doing communication (it can be on reading, speaking, listening, or writing)
5. Metacognitive strategies – learning by arranging, planning, evaluating the process of learning itself.
6. Affective strategies – adding techniques like self-reinforcement and others like it to boost learning.
7. Social strategies – involving other individuals in the learning process.

Whatever the division of categorization may be, to master a language, a person should have obtained cognitive knowledge of the subject, which may be in form of the component mentioned above, then by means of behavior or constructivist means enforce a deeper link between said knowledge with the individual learning in order for that knowledge to be applied in daily lives.

Some of the approaches not mentioned above use Augmented reality. By using Augmented reality, it is expected that the user may achieve what is called as visuospatial bootstrapping [19], where the relation between visual and spatial aspect helps to retain cognitive knowledge which in this case be the vocabulary being taught.

This research proposed to test an approach on vocabulary building using augmented reality by means of AR flash card. There are several types of AR, namely Location based, Marker less, with Marker, and projection-based AR. This research fill focuses on the Marker-less approach. This approach was chosen as it doesn't require additional tools aside from the mobile phone to use the software.

While there are many techniques use to learn more vocabulary, Flash card are one of the most frequent methods used. Flash card is a card with different information on both sides. Usually, it will show an image or a character with text in one language and another language on the other side. Based on several research conducted    the use of flashcard is beneficial to vocabulary building. Several approach of digital flash card has also been recorded. In 2020 Maryam Zakian et. Al [20] conducted a research on digital flash card on mobile device and conclude that vocabulary acquisition is better when learning using the application. This approach simply replaces the flashcard with a digital quiz-like application using AR. And while in essence this approach imitates the use of flashcards the spatial aspect of the card itself is removed. By replacing the digital card to a Augmented reality card it is expected that the vocabulary acquisition aspect of digital flash be retained or improved while subject interest is expected to increase.

## II. PROPOSED METHOD

The proposed method uses digitalized version of a flashcard to teach foreign language. The digital flashcard is created in Unity game engine with the addition of 3D model to replace the usual image shown in a physical flashcard. The AR framework used within this experiment is the AR Core framework [21]. Figure1 shows the physical flashcard that's replicated into a digital one within the application.



Figure 1 Physical Card Example

The proposed method was tested in two groups of  ten children between the age of x n y. The children are chosen because they have low knowledge of foreign language and based on the research [ cite here] they learn faster and retain knowledge better. The test group is then divided into two test groups. One group will be tested with traditional physical flashcard while the other group will be tested with digital Augmented reality flash card.  The Test is conducted 3 times each with a one-week difference to evaluate retention.

Both physical and augmented reality card have the same shape. With each side of the card showing an image a word in one language. The subject and vocabulary used in this experiment is animal names since animals tend to be a favorite subject of children. [figure] show an example of the physical card used.

The student is then asked to memorize the vocabulary given and then given a 30 second test in which the teacher places several AR cards on the ground and ask the student to pick a card when the teacher calls on a specific word. The student will then be recorded for the time needed to guess and accuracy of the guesses. The experiment is conducted 5 times with a 1-week difference between the $2^{nd}$ test and the $4^{th}$ test to evaluate knowledge retention.

Some research using AR uses physical card or a type of marker to replace cards. But since it requires physical objects, the application is not as portable as an approach without one. The proposed method uses marker less AR by employing the AR Core API.

The AR application itself is divided into two separate sections. The first section is the teacher's section that will enable teacher to choose which AR card to present to their students and place them in the AR space. After the teacher places every card, the teacher can then ask the student to do a 30 second test in which the student will be given a word to guess. The student is then able to choose the AR card corresponding to the word given. For each right guess, the application will record the time needed, and on every wrong guess the application will record the quantity of wrong guesses and the word they got wrong.

Figure 2 shows the application from the teacher and student side. In this page the teacher may also look at previous records in the record button. The teacher can switch to the student phase with the confirm button.
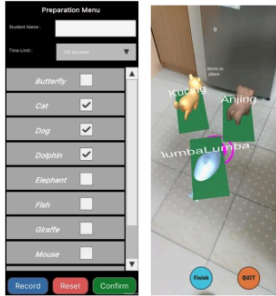

**Figure 2. Teacher phase on the application**

Figure 3 shows the application on the student phase. The student. On the top left corner, a score is being added every time the student guess right, and on the top right corner a timer number is added, and just below it the name of the card to be search can be found.
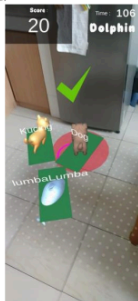

Figure 3. Student Phase

## III. EVALUATION

The experiment was successfully conducted 5 times and yields results as the tables shown. Accuracy is measured by how many times the subject guess right divided by the total guess the subject makes. Guess count is the total guess the subject makes while using the application or answering questions. Reaction time is measured by the number of times it takes from the initial question given to when the subject guess the first time.

Group A is the group of students given traditional physical flash cards, while group B is the group of students given digital flash card using AR.

|  | Group | Accuracy | Guess Count | Reaction Time |
|---|---|---|---|---|
| Test1 | A | 92.92 | 17 | 1.36 |
|  | B | 56.33 | 9 | 13.2 |
| Test2 | A | 91.47 | 16.4 | 1.34 |
|  | B | 65.98 | 10 | 12.52 |
| Test3 | A | 93.8 | 17.8 | 1.62 |
|  | B | 62.4 | 13.4 | 9.48 |
| Test4 | A | 98.9 | 16.2 | 1.76 |
|  | B | 78.3 | 10.8 | 11.98 |
| Test5 | A | 96.6 | 17.8 | 1.58 |
|  | B | 82.3 | 11 | 11.78 |

From the evaluation data it is then concluded that flashcard technique as several past research has shown does indeed help vocabulary acquisition in student, it is shown in both group that the accuracy of guesses increases with time and not severely affected by small time gap. **Figure 4** shows the accuracy comparison between the two-control group. Group A exhibits a high accuracy from the start of the experiment and keeps increasing till the fifth test. Group B shows an adaptation of student to AR technology and digital flashcard that it shows low accuracy at the beginning, but gradually improve through iteration. There is a slight decrease of accuracy between the $2^{nd}$ test and the third. It is suspected that the difference of time between the $2^{nd}$ and the third test resulted in that decrease. However, the accuracy increases from the $3^{rd}$ to the $4^{th}$ test that might be the result of repetition to gain retention.
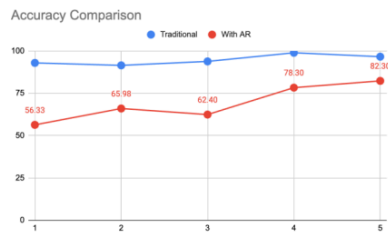
**Accuracy Comparison**



Figure 4. Accuracy Comparison

Figure 5 shows the chart for average guess count for each group. Due to technical difficulty of the AR application, the students have difficulties in guessing, resulting a low guess count, this improved for subsequent test although has not reach the amount shown in group A. this shows an adaptation on the student part towards the application.
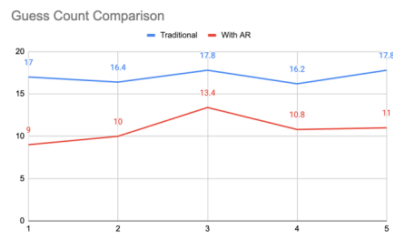
**Guess Count Comparison**



Figure 5 Guess Count Comparison

**Figure 6** shows the reaction time of the student which is the time needed for a student to give a guess when a card is shown. Group A shows a very quick response time while group B shows a significantly slower response time due to adaptation to digital application and limitation of AR technology used. However, the reaction time does improve with time.
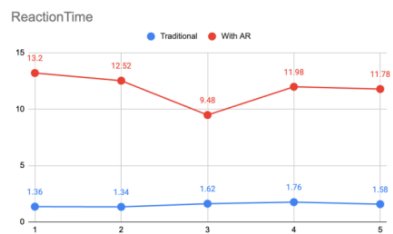
**ReactionTime**



Figure 6 Reaction Time Comparison

Several problems with the augmented reality implementation are recorded. These problems may cause the slow adaptation problem of the user.

Some of the problems listed during the experiment is as follows. The first problem is the inability of the software to recognize field. A marker less AR would need to establish boundary and position, and this process takes a bit of time. The other hindrance to the experiment is the faulty Recasting being done to hit the 3D card, this is caused by the AR framework automatically adjust its position so that the initial position is changed during gametime, causing some 3D Object to be un-selectable.

## IV. RESULT

From the numbers shown in the evaluation, it is then concluded that while using digital flash card as used in this research may remove the need for physical card. However, physical flash card remains superior for its ease of use and simple interaction. Although digital flash card has also shown to be somewhat beneficial in vocabulary acquisition, some aspect of the current technology of Augmented Reality limits its user and an adaptation is required.

## V. LIMITATION AND FUTURE WORKS

The amount of data used in this research is low, the number of words being used could be added to ensure vocabulary acquisition. Due to time limitation, the number of tests conducted is limited so further research could expand upon the timeframe to evaluate adaptation on augmented reality application. Further research might also be done to compare the current approach with another digital approach such as Virtual reality to compare adaptation and result of each approach.

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FINAL GRADE

GENERAL COMMENTS

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