

EFFECT OF DIGITAL FLASHCARD ON LOW FREQUENCY VOCABULARY RETENTION BY GRADUATE STUDENTS

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ABSTRACT

Advance learners of English often put too much effort and energy in learning low-frequency vocabulary most of which they forget and cannot retrieve after a certain period of time. Exposure to multimedia can reduce learning time and cognitive load (Lin & Yu, 2016), but the existing literature is inconclusive in describing the effect of multimedia in the retrieval of low-frequency vocabulary. This study explores the impact of mobile applications on learning, and the retention of low-frequency vocabulary by non-native speakers of English. Research shows that exposure to vocabulary through multimedia creates a mental connection between the verbal and visual information which facilitates better learning outcome (Mayer & Moreno, 2005; Mayer, 2014). The objective of this paper is to identify the difference of learning rate of low-frequency vocabulary between the paper flash card and Mobile Assisted Vocabulary Learning (MAVL) users. In addition, it measures the difference of retention rate of the learnt vocabulary between the paper flashcard and digital flashcard users. The study was conducted on 30 graduate students (divided into two groups: control and experimental). Students in the control group used paper flashcard, whereas students in the experimental group used the digital flashcard through Magoosh Vocabulary Builder- an MAVL application. The collected data of several tests were analyzed using R programming. Findings suggest that mobile application or digital flashcard can enhance both vocabulary learning and retention rate among graduate students. The findings imply that usage of MAVL application can smoothen the process of vocabulary learning with better retention rate, and multimedia models can track the progress of the learner in real-time and reduce cognitive load.

Keywords:

Low-frequency vocabulary, Vocabulary retention, Vocabulary learning, Digital flashcard, Word acquisition, and Multimedia

INTRODUCTION

Learning a second language is a difficult task especially when the word, grammar, and pronunciation of the target language is distinctively different (Shahrom, Halim, & Hoon, 2018). In this connection, technology, especially the usage of mobile phone, is creating a paradigm shift in our education systems. More and more students are enrolling for online courses and using electronic devices (e.g., mobile) for vocabulary learning. Study has found that 32% students took at least one online course while joining higher education in 2013 (Allen & Seaman, 2013; Muljana & Luo, 2019) and a good number of these students were using mobile phones for online courses.

Vocabulary learning is a process of acquiring building blocks in Second Language Acquisition (SLA). As Nation (2011, p.34) says, “vocabulary learning is an indispensable part of learning a new language” and development in technology has made it inevitable to use them in language learning while giving special attention to Mobile Assisted Vocabulary Learning (MAVL) (Gurkan, 2018). In this regard, the usage of mobile/digital flashcard in Vocabulary Learning (VL) is an important area of research (Ramos, 2015). VL has not been given the due space it deserves during 1980s and 1990s, and 30% research on VL was conducted in the last 12 years in Applied Linguistics (Nation, 2011). Nielsen (2002) states, “[S]econd language vocabulary acquisition is a field of investigation that has seen an explosion of experimental research in the past 25 years.” It clearly indicates that the roots of VL research is very old; however, the usage of technological material in VL is new which requires further scrutiny.

The popularity of online and multimedia learning is the result of the advantages it provides (flexibility and up-to-date information); yet, it has been found that the retention rate of technological learning is poor (Muljana & Luo, 2019). Existing literature is uncertain in establishing a relation between the use of mobile flashcard or digital flashcard in learning low-frequency L2 vocabulary and the retention of the learnt word by non-native graduate students. Early studies mostly targeted the intermediate level learners (e.g., German undergraduate students) or only studied high-frequency vocabulary. Considering the mentioned circumstances, this study investigates the retention rate of low-frequency L2 vocabulary among graduate students of Bangladesh. The goal is to know whether digital flashcard users score better compared to paper flashcard users in low-frequency vocabulary tests and to know the retention rate of vocabulary among students in both control (paper flashcard users) and experimental group (digital flashcard users).

In addition, this study compares the retention rate of L2 words between paper and digital flashcard using student of Bangladesh. A study of this nature will help both the learners and the software developers to work for more effective models so that low-frequency vocabulary learning will be easier and learnt items will be more perpetual in long term memory. This study aims to contribute in the fields of Second Language Learning (SLL) specially in VL by assisting students in selecting the right tool. A study of this nature is not only helpful for self-assisted learners but can be equally significant in developing and designing technological materials for SLL. The idea of retention of low-frequency vocabulary is not clearly understood in previous researches but after the completion of this study, understanding on the retention rate of low-frequency L2 vocabulary will be more conclusive. The findings of this research can broadly contribute in psycholinguistics and cognitive psychology by raising questions of how muscle memory and long-term memory works specifically in the areas of word recognition and how technology can contribute in enhancing long-term memory.

The research questions guiding this study are:

RQ1: Do digital flashcard users score better in low frequency vocabulary test compared to paper flashcard users?

RQ2: What are the retention rates of digital flashcard users and paper flashcard users in low-frequency vocabulary after certain time interval?

RQ3: What is the difference between the retention rates of digital flashcard users and paper flashcard users after a certain time interval?

LITERATURE REVIEW

The use of multimedia learning has maximized the reservoir of words (Mayer, 2014; Ramezanal, 2017) but the concern in this study has shifted from VL to vocabulary retention because retention helps in using the word in specific context. In this connection, this research has focused on Mayer's (2014) Cognitive Theory of Multimedia Learning which suggests that multimedia learning equipments and methods can enhance and affect the learning process. This research is *critical* to the use of multimedia for learning low-frequency L2 vocabulary because multimedia models help in L2 vocabulary acquisition (Al-Seghayer, 2016) but are they equally competent in enhancing retention rate of L2 words? Multimedia can enhance word knowledge for short term gain but their usage for long term retention is not beyond question. In contrast with the maintained propositions, Cyril's (2016) study on the use of multimedia instruction has found that students who are given multimedia instruction have performed better in retention. Research has found that multimedia platforms like YouTube has an influence on learners' cognitive development and can significantly ease the process of learning English at tertiary level in Bangladesh (Hasan, Ibrahim, Mustapha, Islam & Al Younus, 2018).

Nation (2011) raised the question on the number of words learnt at a particular point of time. In this regard, many foreign language learners especially English language learners are prioritizing the use of digital flashcard via mobile application for word memorization. A mobile device can help in consuming more words in comparatively less amount of time as the device has an inbuilt sophisticated application /software that trains the language learners to consume words in rotate formation. A number of studies (Cavus & Ibrahim, 2009; Gromik, 2012; Motiwalla, 2007; Abbasi & Hashemi, 2013; Agca & Ozdemir, 2013; Chen, 2013) were conducted to check the efficiency, and applicability of using mobile devices for vocabulary and language learning and they have come out with mixed outcomes.

Undoubtedly, both digital flashcard and paper flashcard help in learning new vocabulary of both high and low-frequency. A study on Indonesian kindergarten students (n=13) found that learners' posttest scores increased up to 30% than the pretest scores after using paper flashcard for a period of three weeks (Seaputri, 2017). A similar study on Japanese undergraduate low proficiency students (n=139) who had used digital flashcard reported that digital flashcard has a significantly higher vocabulary gain compared to paper flashcard (Ashcroft, Cvitkovic, & Praver, 2018). Nikoopour and Kazemi (2014) studied the vocabulary gain of Iranian advanced learners (n=109) using digital flashcard as a tool and found that after a ten-week program, students' posttest score significantly improves.

Gurkan's (2018) assumes that mobile devices are equally beneficial for all learners but Mahdi's (2017) study revealed that mobile devices function better with adult learners compared to young learners and with a moderate word size. Mahdi's (2017) study concluded that mobile devices can provide great advantage in vocabulary learning but learners age, level of anxiety, type of vocabulary, and aspect of vocabulary learning are important factors for VL. Among other reasons, Mahdi (2017) includes that the availability and multi-tasking capacity of a mobile makes it popular over other methods. Mahdi (2017) concludes that both inside and outside classroom convenience, and real-time learning opportunity are enhancing the demand of using mobile device for vocabulary learning. Basoglu and Akdemir (2010) compared the effectivity of mobile and paper flashcard in a target time of six weeks and their study revealed that mobile users can outperform traditional paper flashcard users. Research has also reflected that learners who uses various paper flashcards as a method of memorizing vocabulary fails to recall words after a given period of time.

So, there is a strong correlation between the use of flashcard as a resource and its outcome in vocabulary learning and retention. For vocabulary retention, the environment and resource are as important as the size, and the frequency of vocabulary (Kersten, 2010). Paul Nation, the American-New-Zealander linguist mentions on how the frequency of vocabulary can play an important role in foreign language acquisition and can motivate language learning strategy. Since the arrival of communicative approach in 1980's, the importance of translation has shifted to the acquisition of frequent words in the target language. In this connection, Stephen Krashen's Natural Approach is interlinked with Nation's (2011) vocabulary frequency theory which emphasizes on the acquisition of frequent lexical items for daily communication. Indeed, frequency of vocabulary or frequency of occurrence of a word can serve the purpose of vocabulary acquisition. In addition, Nation (2011) advices learners to move from high frequency vocabulary to low-frequency vocabulary in a gradual process.

Learners gradually move from high to low-frequency word acquisition, a phenomenon also known as *word frequency effect*. Word frequency effect is psychological where the learner frequently recognizes words that appears multiple times. Because low-frequency words appear less in day-to-day activities of reading and listening, the learning and retention rate is also low. Learners acquire new vocabulary in two ways: incidental and intentional learning. As Hung says, "method of learning new words with deliberate attempts is known as the intentional process in vocabulary research" (2015, p. 34). In contrast, much vocabulary is learnt through incidental learning but Elgort (2011) disagrees and concludes that intentional learning is much more effective as it requires long-term and extensive

exposure to a word. Because low-frequency vocabulary is learnt less frequently, their retention rate is also lower compared to high-frequency words.

Webb's (2015) research on incidental vocabulary learning emphasizes on the number of times a 'word' is encountered and that encounter determines whether that 'word' would be learnt or not. It is generally assumed that vocabulary that recurs more are often easy to remember. Studies suggest that young learners' retention rate is better compared to adult learners in high frequency vocabulary because of multiple encounter. Roediger and Karpicke's (2010) study found a clear line between short-term gain and long-term retention among learners but Schuetze's (2014) limited study (conducted upon Beginning German Class Undergraduate Students) found that function words are particularly difficult to recall. Empirical evidence according to Chen and Li (2010) suggests that MALL has definitely multiplied the chances of learning new vocabulary and in a recent study by Lin and Yu (2016), it is found that audio representation with high frequency vocabulary can reduce learning time, cognitive load and can enhance chances of retaining the learnt word.

In contrast, no single study has a conclusive evidence regarding the retention of L2 low-frequency vocabulary learnt in a digital medium and studies conducted on high-frequency vocabulary are only limited to non-graduate students. Moreover, the design of most of these researches that target to determine the effectiveness of mobile application in vocabulary learning do not focus on the sustainability of the learnt word.

Research has found that obliteration process of words starts within few minutes of trial and students who feel isolated and unsupported by peers forget more words (Pinchbeck, Jessica, Heaney, and Caroline, 2017). In addition, some students' motivation for using technology is poor or the usage of technology enhances anxiety among others during learning. Study found that low sense of belonging could hamper performance in retention and a positive attitude towards technological material could be an attributing factor in higher retention rate.

Measuring vocabulary retention rate can be an important aspect as Milton (2009) found that students can remember little after two-years of university language program when it comes to vocabulary retention. Although completion rate in blended learning models is significantly higher compared to other modes for leaning (Fridriksdottir, 2018), it is common to many students to forget textbook words after a certain period of time. Textbooks and reading materials recycle high-frequency words but pay little attention in repeating words low frequency (Nation, 2011; Zimmerman, 2010). In this regard, mobile softwares hardly recycle word of any category.

Flashcard is a popular method, tool, or strategy for learning new words (Ngarofah & Sumarni, 2018). VL in digital flashcard (mobile application) do not concentrate on the root word such as <legal> that can generate words like <illegal>, <paralegal>, or <legalities> rather it considers a word (e.g., veneration) as a single unit. As a result, the usage of the 'single unit' in diverse circumstances become difficult for the learner. Webb (2005) argued that words need to be practiced to get attention. Schuetze (2014) studied the retrieval and retention rate of content and function words and concluded that function words could be difficult to recall for learners when given expanded intervals. For future research, Schuetze's (2014) suggests to concentrate on the rate of forgetting and to design tests that can be conducted outside classroom setting (refereeing to online platform or mobile learning application).

High and Low Frequency Vocabulary

Speakers of a language use both high and low-frequency words during conversation and writing but in the beginning, they get command over with high-frequency words and gradually develop expertise over low-frequency words. Learning of high-frequency words are mostly incidental. *Incident* refers to the acquisition of words while doing other tasks such as reading a comprehension. In contrast, low-frequency vocabulary learning is an intentional process. "High-frequency words make up a relatively small, very useful group of words that are important no matter what use is made of the language",

says Nation (2011, p.9). Learners quickly learn high-frequency words because of their consistency (appearance in a page). In addition, learning high-frequency vocabulary has better productive outcome compared to learning low-frequency vocabulary. Low frequency vocabulary is “consist of tens of thousands of words that occur very infrequently and, are often restricted to certain subject areas, thus do not deserve any substantial amount of classroom attention” (Nation, 2011, p. 9). So, Nation (2011) suggests teachers to deal with high and low frequency words differently and the best possible way of teaching low-frequency words is to use them with relevant strategies. Nation (2011) emphasizes that if low-frequency words appear more in different mediums (for example in mobile application), the possibility of learning will be higher.

Vocabulary Retention

Vocabulary learning is both an *intentional* and *incidental* process in SLL as mentioned before but MAVL is an approach popularly known as *Deliberate Vocabulary Learning* (DVL). In contrast, reading influences *Incidental Vocabulary Acquisition* or passive learning (Gu, 2003). Words that appear less on paper are considered as low-frequency vocabulary, for example, <transducionalify>. According to Nation, the most frequent word in English language is <the> with 1st position whereas <transducionalify> ranked 1,23,567th position (read Nation, 2011 for details). So, <transducionalify> is a low-frequency word. Vocabulary retention refers to the ability of providing ‘meaning’ of a learnt word after a certain interval. Vocabulary retention could be of two type: short-term retention and long-term retention. The immediate performance in vocabulary test after instruction is called short-term retention in contrast, recalling of word after certain time interval is called long-term retention (Remezanali, 2017).

METHODOLOGY

This study employs a quantitative approach in research design where “flashcard” is an independent variable, “score” is a dependent variable, and “time-interval” is considered as the treatment. The participants for this study are 30 graduate students of Hajee Mohammad Danesh Science and Technology University, Bangladesh. Participants are divided into two groups (control group and experimental group) and they are given 08 tests (04 pretests and 04 posttests). Each test has 10 questions of low-frequency vocabulary and each test is taken using learning platform Edmodo. Each test has 10 questions (8x10= 80). The average score of the first 04 tests are considered as the mean of the pretest score and the average score of 04 tests after ‘treatment’ are considered as the mean of the posttest score. The scores of pretest and posttest are collected using Edmodo and the data is compiled using Microsoft Excel (.csv). The statistical analysis, reliability, and consistency of the data are tested using R programming language (version 3.5). Students in the control group used the traditional paper flashcard whereas students in the experimental group used digital flashcards in the mobile application called Magoosh Vocabulary Builder. This research argues that students who are using digital flashcard over paper flashcard for vocabulary learning would perform comparatively better but both groups would forget equal percentage of words after a certain time interval meaning their retention rate is almost similar and digital flashcard does not make any significant impact on the retention rates.

Meara and Miralpeix’s book *Tools for Researching Vocabulary* (2017) is considered as a milestone in vocabulary research, gives an idea on how to deal with vocabulary data, measure lexical variations and vocabulary size, and develop models for vocabulary growth (Clenton, & Uchiyara, 2018). The primary focus of this study is to know the retention rate of low-frequency vocabulary in L2 and to conduct the study, an experimental design is taken into consideration where digital flashcard and paper flashcard are the independent variables and time intervention is the control. After obtaining ethical permission from the participants, the researcher collected all the required data for analysis.

The first was to collect the pre-test scores using a multiple choice productive recognition test administrated by Edmodo application. Multiple-choice test items are commonly used in standardized testing procedures (Nation & Hunston, 2013; Chen, Grangier, & Auli, 2016) and are able to measure various taxonomies of word knowledge. Each test is time bound (10 minutes). For each correct answer, the binominal score was '1' and for an incorrect answer '0' was applied for all tests. Each student's pretest score (participating in experimental and control group) is the average of score gained in 04 consecutive tests (T1, T2, T3, T4). Perez, Caltrebutm, Peters, and Desmet (2014) suggests the criteria that learners need to remember at least 70% words in retention tests.

After an interval of 15 days (time interval), each participant was given another 04 consecutive tests (T5, T6, T7, T8) and each students' average score was considered as the post-test score. In case of the control group, their test was parallel to the test of the experimental group with similar multiple choice questions but they only used paper flashcards whereas the experimental group used Magoosh Vocabulary Builder mobile application. The difference between the pretest and posttest score and their mean has a descriptive interpretation. Prior to analyzing the data, reliability coefficient of the pre and post-test score was computed using KR 20 (Kuder-Richardson 20) as a measure to check the internal consistency. A comparison of participants' mean scores of vocabulary posttest and pretest shows participants word retention (Ramezanali, 2017). To check the statistical significance and for an inferential interpretation several t-test are conducted. A total of 30 participants were selected for the purpose of this research (see Krejcie & Morgan, 1970). The ratio of the two groups (one experimental group and one control group) was 1:1 and no international student was involved.

The study was conducted in three stages. In the first stage, the vocabulary size of all 30 students were measured using yes/no test (see Meara, 1992). In stage two, the experimental group was asked to use digital flashcard as a stimulus. For the purpose of the study, participants of the experimental group (n=15) used a mobile software called Magoosh Vocabulary Builder and the control group (n=15) uses traditional paper flashcard for vocabulary learning. Both group used flashcard for 15 days. Each group sat for online tests consist of 10 vocabulary questions. The score of the first 04 tests (average of 04 tests was considered as one pretest score) were collected using Edmodo learning application. In stage three, after an interval of 15 days, all students sit for another 04 vocabulary tests (the combined average was considered as one posttest score) and their scores were also collected using Edmodo learning network. A meta-analysis was conducted by Lin and Lin (2019) on time intervention and found that most researches (68%) lasted within a range of 01 to 06 weeks, only 24% of the research lasted for more than 02 months or more, and only two studies lasted for a whole semester for vocabulary research. The general tendency was to keep the research within the range of a short period of time (14 to 30 days) but that would challenge the reliability and validity of the acquired data at times. Considering the time frame of earlier studies, this research was also conducted for a period of 02 weeks. All collected data were automatically transferred into an Excel sheet (.csv format) from Edmodo learning network. Then, the excel sheet was transferred into R programming, a data analysis software (v. 3. 5) for testing the mean, standard deviation, and consistency among data. A comparison was conducted between various scores of various groups to know the changes in retention rate of vocabulary. The design of the study compared the performance of the two groups.

Step 1: Control group's pretest mean was compared with the experimental group's pretest mean using unpaired two sample one tail t-test.

Step 2: Control groups' pretest mean was compared with posttest mean using paired two sample one tail t-test.

Step 3: Experimental groups' pretest mean was compared with posttest mean using paired two sample one tail t-test.

Step 4: Experimental group and control group's posttest mean was compared using paired two sample two tail t-test.

RESULTS

For the purpose of this research, a total of 30 participants formed the study sample among whom 9 were female and 21 were male. The female to male ratio is 3:7. This study found that participants for the research know an average of 23% common words in English language (test conducted using Meara online vocabulary test, 1992).

To answer the research question 01, data was gathered from 30 students (15 in the control group and 15 in the experimental group). Each student was given 04 consecutive multiple-choice test. The average score of the 04 tests were considered as the pretest scores of each group. The mean of the score of the control group was 28.26 whereas the mean of the experimental group is 32.13 which clearly indicates that the performance of the experimental group (participants who have used digital flashcard) in vocabulary learning is better than the control group (participants who have used the paper flashcard). An independent sample two tail t-test was conducted to compare the means of the control and experimental group. The 15 participants who have used the digital flashcard ($M=32.13$, $SD=4.43$) compared to 15 participants in the control group ($M=28.26$, $SD=5.75$) demonstrated significantly better score, $t(28)=-2.06$, $p=.04$ (Figure 1)

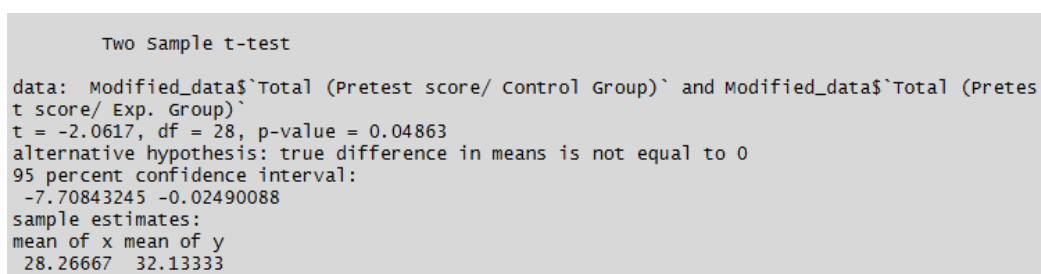


Figure 1: Two Sample t. test of Pretest Scores of Control and Experimental Group

To answer the research question 02, data was gathered from 15 students of the control group. Each student was given 04 consecutive multiple-choice tests in pretest and 04 consecutive tests in the posttest. The mean of scores of the control group in the pretest was 28.26 whereas the mean of the posttest was 20.06 which clearly indicates that the performance of the Control group in vocabulary learning reduced after 15 days' time interval. After 15 days' of time interval retention of words reduced and the difference between the mean was -27.12% which indicates that participants failed to retain 27.12% words (on average) after 15 days' interval. A paired sample one tail t. test (Figure 2) was conducted to compare the means of scores of the pretest and posttest. The pretest mean of 15 participants who used the paper flashcard ($M=28.26$, $SD=5.75$) compared to posttest mean ($M=20.06$, $SD=7.11$) demonstrates a significant drop in posttest score, $t(14)=3.75$, $p=.001$.

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Paired t-test
data: Modified_data$`Total (Pretest score/ Control Group)` and Modified_data$`Total (Posttest score/ Control Group)`
t = 3.7595, df = 14, p-value = 0.001057
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 4.074833      Inf
sample estimates:
mean of the differences
      7.666667
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Figure 2: Paired t. test of Pretest and Posttest Scores of Control Group

To answer the second part of the research question 02, data was gathered from 15 students of the experimental group. Each student was given 04 consecutive multiple-choice tests in pretest and 04 consecutive tests in the posttest. The mean of scores of the experimental group in the pretest was 32.13 whereas the mean of scores the posttest was 25.26 which clearly indicates that the performance of the experimental group (participants who have used digital flashcard) in vocabulary learning reduced after 15 days' time interval. After 15 days' time interval retention was visible and the difference between the mean was -22.06% which clearly indicates that participants failed to retain 22.06% words (on an average) after 15 days' interval. A paired sample one tail t-test (Figure 3) was conducted to compare the means of scores of pretest and posttest of the experimental group. The pretest mean of 15 participants who used the digital flashcard ($M=32.13$, $SD=4.43$) compared to posttest mean ($M=25.26$, $SD=7.31$) demonstrates a significant drop in posttest score, $t(14)= 4.77$, $p = .0001$.

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Paired t-test
data: Modified_data$`Total (Pretest score/ Exp. Group)` and Modified_data$`Total (Posttest score/ Exp. Group)`
t = 4.778, df = 14, p-value = 0.0001473
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
 4.335402      Inf
sample estimates:
mean of the differences
      6.866667
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Figure 3: Paired t-test of Pretest and Posttest Scores of Experimental Group

To answer the research question 03, data was gathered from 30 students (15 in the control group and 15 in the experimental group). Each student was given 4 consecutive multiple-choice tests. The average score of the 04 tests were considered as the posttest scores of each group. The mean of scores of the control group was 20.06 whereas the mean of scores of the experimental group was 25.26 which clearly indicates that the retention rate of the experimental group (digital flashcard users) in vocabulary learning was better than the control group (paper flashcard users). An independent sample two tail t-test (Figure 4) was conducted to compare the means of the control and experimental group. The 15 participants who used the digital flashcard ($M=25.26$, $SD=7.31$) compared to 15 participants who used paper flashcard ($M=20.6$, $SD=7.11$) demonstrated significantly better score, $t(28)= - 1.77$, $p = .08$.

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Two sample t-test  
data: Modified_data$`Total (Posttest score/ Control Group)` and Modified_data$`Total (Posttest score/ Exp. Group)`  
t = -1.7708, df = 28, p-value = 0.08749  
alternative hypothesis: true difference in means is not equal to 0  
95 percent confidence interval:  
-10.0650636  0.7317303  
sample estimates:  
mean of x mean of y  
20.60000  25.26667
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Figure 4: Two sample t.test of Posttest Scores of the Control and the Experimental Group

DISCUSSION

After the statistical treatments, this study finds that students who use digital flashcard for L2 low-frequency vocabulary learning can perform better compare to paper flashcard users (32.13 > 28.26). In addition, digital flashcard users' retention rate is also better compared to paper flashcard users (25.26 > 20.06). Control group fail to retain 27.12% words whereas experimental group fail to retain only 22.06%. The findings also show that mobile flashcard users can retain 74.88% vocabulary after certain time interval and the retention of mobile flashcard users ($M=25.26$, $SD=7.31$) compared to paper flashcard users ($M=20.06$, $SD=7.11$) is significantly better, $t(28) = 1.77$, $p = .0437$ with 5.06% more retention than paper flashcard users. The findings conclude that the usage of mobile application can enhance performance in both L2 learning and retention.

CONCLUSION

This study aims at investigating the effect of digital and paper flashcard on learning new vocabulary and the retention of the learnt vocabulary items after a certain time interval. The findings of this study claim that learning in both models of flashcard enriches vocabulary but in comparison with the paper flashcard users, the digital flashcard users' performance in both learning and retention of new words is better. This study shows that digital flashcard users retain 5.06% more word than paper flashcard users but that does not indicate a significant change in retention in vocabulary as well. Based on Mayer's (2014) Cognitive Theory of Multimedia Learning, it concludes that multimedia tools work as a catalyst in engraving the process of learning. In addition, multimedia tools help in better retention than traditional tools of learning vocabulary. Multimedia provides exposure to learners with new vocabulary and enhance word retention for both high and low-frequency vocabulary. Previous studies on high-frequency words have found that retention rate of high-frequency vocabulary in digital medium is higher compared to paper flashcard but with the findings of the current study, I conclude that digital flashcard is also better than the traditional formats of vocabulary learning and retention. This study predicts that repeated visualization (multiple exposure) of low-frequency word can help in learning and in retention at least for a brief period of time. The present study has pedagogical implication for the learners, teachers, curriculum designers, and above all, material developers. The limitation includes the time frame used in the design of the study and further investigation can be conducted by focusing on 'time and retention rate' of learnt items (other than vocabulary) in multimedia models and digital formats.

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