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## Effects and Impressions of Digital Vocabulary-Learning vs. Paper-based Vocabulary-Learning: A Small-Scale Longitudinal Study

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### **Introduction:**

When it comes to learning a foreign or second language (L2), researchers suggest that vocabulary is of central importance. Numerous commentators highlight strong links between vocabulary knowledge and language skills (Krashen, 1989; I. S. P. Nation, 1990; Schmitt, 2010); famously, Wilkins states that while “without grammar little can be conveyed, without vocabulary nothing can be conveyed” (1972, p. 111). However, while some concepts and ideas regarding knowledge acquisition may remain relatively stable through the years, the means, methods and technology used to teach and learn L2s are liable to shift and change, as the technology of society at large prompts changes within the classroom.

Mobile, digital devices have all but become normalised in the societies of many MEDCs, and with them they bring a plethora of new and potentially useful applications. As a smartphone is essentially a small, portable computer, complete with internet access, many of the research enquiries previously associated with computer-assisted language learning (CALL) are making inroads into mobile-assisted language learning (MALL), also sometimes called mobile-learning (Mlearning). Generally, these studies focus on the use and impact of using mobile devices in and out of the classroom (Fujimoto, 2012; Levy, 2005; Lu, 2008; Martin, 2013; Stockwell, 2008; Tai, 2011), though there are increasingly specialised studies concerning the perceptions of using mobile devices as aids to learning (Fujimoto, 2012; Tai, 2011), the effects of using mobile devices to learn in general (Chen, 2008; Lu, 2008; Martin, 2013; Tai, 2011) and, more specifically, being used to learn vocabulary (Başoğlu, 2010; Chen, 2008; Levy, 2005; Lu, 2008; Nakata, 2008; Oberg, 2011; Zhao-Heng, 2012).

Clearly, research into the use of mobile devices for L2 vocabulary is expanding. However, despite being separated by less than a decade, the technologies and software used in these studies have no doubt changed. Additionally, as voiced by Oberg, many studies concerning L2 vocabulary acquisition focus either on traditional, paper-based methods or digital methods in isolation, with few comparing the two directly (2011, p. 118). Although in terms of practicality this may be as there are too many digital L2 vocabulary learning sites, software and applications (often known as “apps”) available to effectively compare at once, in fact the majority of these studies are concerned with the more theoretical end of the spectrum. Therefore, in this paper, while drawing on the theoretical research conducted in previous studies, we will focus more on the real-world application of the paper-based learning compared with digital vocabulary-learning methods. To that end, we will investigate Quizlet, an online web-browser and smartphone-based app. Quizlet gives users access to an ever-expanding, customisable database of pre-constructed vocabulary lists and word-cards for study, essentially transforming the smart-phone into a digital flash-card set and interactive learning-modules.

This paper will seek to quantitatively compare, through looking at learners’ results on standardised vocabulary tests, the bottom-line, real-world utility, impact and impressions of these digital learning methods with paper-based learning methods. Additionally, this paper will seek learners’ opinions concerning their vocabulary study-methods, in an attempt to establish a general, if rugged, side-by-side comparison of digital word-lists and cards with paper-based study. To achieve this, a literature review will first be conducted, in which the background concepts and ideas concerning L2 vocabulary acquisition will be examined, and the findings of previous studies examined for their import and guidance. The findings of the literature review will be used to posit some general research questions, following which a methodology will be constructed in order to gather data with which to attempt to answer these questions. The data collected from this experiment will be analysed, and the results discussed.

### **Literature Review:**

Learning vocabulary, being such an integral part of L2 acquisition, has had a substantial amount of research conducted on it, covering the main, general points (Krashen, 1982; I. S. P. Nation, 1990, 2001, 2010; Schmitt, 1997, 2010; Wilkins, 1972), as well as more specialised areas concerning vocabulary learning methods (Horst, 2005; Mondria, 1994; I. S. P. Nation, 2001; P. Nation, 1997) such as

word-lists, flashcards, and the more recent CALL- and MALL-based methods (Chen, 2008; Fujimoto, 2012; Groot, 2000; Lu, 2008; Nakata, 2008; Tai, 2011). In this literature review, we will cover some of the main points about vocabulary acquisition, briefly examine the methods relevant to this study, consider the learning context and the environmental factors in play, and finally use these points to posit research questions.

### ***Environmental Factors***

There are many different preferences and abilities when it comes to learning a language, as many researchers have recently noted (Schmitt, 2010, p. 152). Additionally, there are just as many different learning contexts, motives, and strategies in existence, and how these environmental factors influence the learning that takes place within them remains an extremely important topic to consider, for as stated by Wen & Keith, while "both non-learner and learner factors influence learning outcomes, non-learner factors do so *through* learner factors" (Wen, 1997, p. 30). These non-learner factors are separated into 'environmental' (covering social, linguistic, cultural, economic, home-situation) and 'institutional' (covering teaching aptitude, resources, assessment, direction), and they construct the reality in which all subsequent language learning takes place. As such, in trying to keep this study focused on real contexts (Schmitt, 2010), establishing the environment in which this study is situated is clearly necessary.

A brief glimpse at some of the general environmental and institutional factors in Japan brings up some important insight. First of note, Japan's society and education system is centred heavily on high-stakes examinations, such as school entrance exams, proficiency tests, and standardised qualifications (Barry, 2004; Berwick, 1989; Gunning, 2009; Sato, 2009). This central point, frequently criticised by educators (Clark, 2009; Gunning, 2009), overshadows much of L2 language learning through compulsory education, and potentially influences tertiary-level L2 learning. Previous studies by Berwick (1989) and Miura (2010) show that while immediate pre-test motivation and effort are quite high, there is a rapid post-test decline in motivation. Additionally, given that the styles of most standardised tests such as the Eiken, TOEIC, and the Centre-Shiken (mainly vocabulary and grammar-centred passive- and active-recognition tests) do not require a high degree of language production, instead relying on receptive knowledge, much vocabulary learning focuses on official, published *tango-chou* (word-books), and learners commonly can be seen on trains and buses using these books, as well as word-lists and word-cards constructed from them, to cram before tests.

Secondly, this institutional focus on "English as a test" (Barry, 2004, p. 54) tends to instil a 'use and forget' approach to EFL, both from the students and

teachers in particular, but also in the wider society in general. Echoing Berwick (1989) and Miura (2010), Seargeant (2009) suggests that the 'idea' of English, and indeed other foreign languages, as an 'other', 'outside' item, retains strong influence on all activities concerning it. When combined with the test-based educational system, and the essentially homogenous Japanese society, language learning can tend to be rather formulaic.

### ***Vocabulary Learning***

Vocabulary learning methods and strategies are the subject of much research. Schmitt (1997) lists 10 strategies employed by L2 learners and ranks the percentage of learners who reported using them; on this list, the two most commonly adopted by Japanese learners of English would be 'written repetition' (writing the same word many times) and 'word lists' (looking at a list of L1-L2 word translations), as pointed out in the previous section on environmental factors, as they are relatively simple to conduct, can be completed relatively quickly, and suit the nature of the receptive word-knowledge tests that characterise the majority of the short-tests and examinations that they are required to take. While not mentioned on this list, others note that 'word-cards', perhaps created from 'word-lists', should not be forgotten as a vocabulary-learning strategy (I. S. P. Nation, 2010, p. 32).

Putting strategies and methods aside for a moment, however, it is important to briefly consider L2 vocabulary learning. Although there currently is no overarching, united theory of how lexical knowledge is acquired (Schmitt, 2010, p. 36), several concepts from different fields of study are of note in this regard, as well as some general ideas concerning vocabulary acquisition in general. First, linked with Wilkin's comment that without vocabulary nothing can be conveyed in an L2 (1972, p. 111), it would appear that vocabulary size and grades on general tests to measure language-ability are positively correlated (Milton, 2009, p. 170; Schmitt, 2010, p. 5). While it should be admitted that "language level is not just knowing language knowledge, but using it communicatively", when it comes to language-measuring examinations, which tend to rely on written, receptive knowledge, a broader, deeper vocabulary tends to lead to higher scores (Milton, 2009, p. 171). Additionally, phonological vocabulary knowledge also correlates relatively well with listening test scores (Milton, 2009, p. 179).

Second, when considering vocabulary breadth, most research seems to suggest that while 6,000-7,000 word families are sufficient for informal daily conversation, native speaker university graduates know closer to 15,000 word families (Schmitt, 2010, p. 7). Achieving such a broad vocabulary requires a heavy time commitment, both in and out of classes (Milton, 2009, p. 256), as well as a large amount of

conscious interaction with the L2 (Krashen, 1989, p. 441; Schmitt, 2010, p. 29). Additionally, without frequent and regular revisiting of L2 vocabulary, attrition will begin to occur quite rapidly (Milton, 2009, p. 230), although previously-learned vocabulary is more quickly re-acquired than learnt anew (Schmitt, 2010, p. 23), and incidental vocabulary exposure is facilitative (Krashen, 1989, p. 461)

Thirdly, regarding depth of vocabulary knowledge, most consider that in order to correctly 'know' a word a learner needs to know the spoken form, the written form, its meaning, associated grammatical patterns and words, as well as its frequency and register (Schmitt, 2010, p. 16). Schmitt continues, stating that vocabulary learning is incremental mainly because these individual types of word-knowledge are incremental (2010, p. 20); additionally, we should remember that that these word-knowledge types also have cognitively discrete 'receptive' and 'productive' qualities (Milton, 2009, p. 229), which have been shown to both be acquired differently and atrophy at different rates (Milton, 2009, p. 230). Given the incremental nature and its varied methods of acquisition, it is possible that certain methods of learning could better lead to receptive-or productive-leaning word-knowledge.

Finally, there are several general caveats held regarding certain methods in general, and how best to learn L2 vocabulary in particular. Generally speaking, when learning vocabulary many commentators echo a need for spaced, long-term learning over massed, short-term learning. Given that word-knowledge atrophies (Milton, 2009, p. 230), and previously learned word-knowledge is more easily retrieved than new word-knowledge (Schmitt, 2010, p. 23), spaced repetition of the target vocabulary would certainly appear to be the more desirable of the two when considered from a theoretical standpoint, as it is more suited to aid with the long-term expansion of L2 vocabulary (Nakata, 2008). However, massed vocabulary-learning could also be said to have its own practical advantages, as it can be achieved relatively quickly through methods such as word-card or word-lists, and allows a large amount of vocabulary to be receptively loaded into the short-term memory. Despite this, however, spaced-learning is clearly of more long-term utility to L2 learners, and many of the more involved vocabulary-learning strategies require learners to space the words that they learn, and to move them between categories based on how well they know them (Nakata, 2008; I. S. P. Nation, 2001, 2010).

Another caveat concerns the use of L1 definitions when learning new L2 words. While there are several who would suggest that the use of L2-word and L2-definitions (perhaps through pictures or contextualising sentences) would prove more beneficial, from an accessibility point of view the inclusion of L1-definitions allows learners to easily check the meaning of the target vocabulary (I. S. P. Nation,

2010, p. 30), and from a methodological point of view helps learners to do receptive recall-exercises based on the pairs themselves in addition to recognition practice (I. S. P. Nation, 2010, p. 30), which provides a solid base for productive knowledge (Schmitt, 2010, p. 81). These points should prove useful when considering the design of this investigation.

### ***Relevant Methods***

While there is clearly a lot of work to be done to completely know a word, it is possible that different methods might aid the acquisition of certain words in different ways, and be both theoretically or realistically preferable. Generally speaking, the literature suggests that two methods, using vocabulary lists and variants of word-cards, are perhaps the most accessible to the majority of students. Among an expanded list including extensive reading, keywords, and dictionary use, Nation points chiefly to word-cards and word-lists as the two main direct methods for vocabulary learning (I. S. P. Nation, 2010), into which there have been many investigations. Long, official-use word-lists such as the General Service List (GSL) and the Academic Word List (AWL) continue to serve as the basis for extended courses, though for our consideration in this case the word-list is not so much an item as a method; that is to say, in order to learn a set of words, one would write them and their onto paper, perhaps fold the paper and repeat the practice, or even just look at them.

As previously mentioned, while word-lists are not held to be among the most effective of the vocabulary-learning methods available to students, they are not completely without use; roughly 54% of language learners report using word-lists regularly (Schmitt, 1997, p. 202). A quick skim-read of a simple L1-L2 associated-pair list will refresh knowledge of the terms in ones' short-term memory (Milton, 2009, p. 231), and could allow learners to cover either the L2 or the L1 column to practice recall or recognition (I. S. P. Nation, 2010, p. 31; Schmitt, 2010, p. 81). However, the word-lists themselves can give rise to learners internalising the order of words and their translations, prompting an exaggerated, artificial competence in practice sessions but not in reality (I. S. P. Nation, 2010, p. 30). Additionally, word-lists are not overly engaging, in both terms of interest and cognitive activation (Schmitt, 2010, p. 29). While the modified word-list method employed by many Japanese L2 learners (copying target vocabulary many times) offers a degree of interactive productive recall and receptive recognition, it does appear to serve more as a memory refresher than a stand-alone vocabulary learning method.

Concerning engagement, Schmidt further notes that along with focused attention, learners need to engage with the word many times in order to effectively

acquire it. Engagement might cover simply viewing the word, looking up its meaning, writing it, and choosing it from among multiple options as in a test, and as far as possible a range of engagement activities should be sought (2010, p. 27). Indeed, making word-lists or word-cards may also be held as a word-engagement activity, though whether the time spent making cards could be better spent on repetitions with pre-made cards has yet to be investigated (I. S. P. Nation, 2010, p. 42).

Word-cards, or flash-cards as they are sometimes known, are a separate method in which cards are made, on one side of which is written a vocabulary item and its associated definition on the reverse. While many variants exist, such as L2-L2 pairs and L2-picture pairs, most research points to L1-L2 translation pairs as being the most effective, for they allow recognition and recall (I. S. P. Nation, 2010, p. 31), and can also be used in massed or spaced practice sessions (Nakata, 2008, p. 5), as previously covered. Spaced learning in particular requires learners to put the cards into different categories, such as 'don't know at all', 'recognise', and 'know', move them between these categories as they succeed or fail to recall their definition correctly, and also to gradually increase their time between study sessions (I. S. P. Nation, 2010, p. 31). Studies show that such efficient, structured use of word-cards in methods such as this generally facilitate learners' vocabulary acquisition to a higher degree than word-lists (Nakata, 2008, p. 14). However, perhaps due to time and purpose factors, governed primarily by the social and institutional environmental factors as discussed in the previous section, the reality of vocabulary learning in the Japanese education seems to be that 29% of students use word-cards, with the remainder using simple word-lists and word-books (Schmitt, 1997, p. 203).

It is at this point, where tried and tested vocabulary-learning methodology comes into contact with the classroom and day-to-day realities of L2 learners, that one might turn to examine computer- or mobile-assisted language learning. As previously pointed out, there are many investigations concerning the acquisition of vocabulary using digital technology. Studies have found that students generally are receptive to the idea of using digital devices, such as their smartphones, for language study (Fujimoto, 2012, p. 193; Philpott, 2013, p. 34; Poulshock, 2011, p. 55), and although that they might become distracted, the degree to which a user might consider a smartphone useful for learning a language depends on their daily use (Stockwell, 2008, p. 379). Poulshock's investigation intimates that smartphone ownership amongst Japanese young learners is almost total (Poulshock, 2011, p. 55), suggesting that as a technology these online and portable digital devices have been all but normalised into Japanese society (Bax, 2003). Other studies, focused on older mobile phones' SMS-based technology and PDAs for learning vocabulary

(Başoğlu, 2010; Chen, 2008; Lu, 2008), found that while the processing abilities of the technology (Kozma, 1991, p. 3) might not allow for much scope or flexibility in its utilisation, its use as a delivery system is sufficiently accessible. More recent studies, focusing on smartphone- and computer-based applications, have also found that the use of digitally-based word-lists and word-cards appear to facilitate learners' L2 vocabulary acquisition to a statistically similar degree as paper-based methods, and also that participants tend to view digitally-based methods more favourably than their paper-based equivalents (Lees, 2014; Nakata, 2008; Oberg, 2011). However, these results were gathered from single study- and test-sessions; it is possible that over a longer period there may be difference in both vocabulary acquisition and opinion regarding the method itself.

### ***Review Summary***

In this brief literature review we have learned that word-cards, whilst occasionally rejected by educators, remain an important and effective method of vocabulary learning. Their L1-L2 translations provide a stable, pair-association link for acquisition purposes, and the physical functions support both receptive and productive learning patterns. While perhaps not as engaging as writing, reading or manipulating the words in context, word-cards are still able to provide engagement enough when used correctly, by recalling word-information such as spelling, category and pronunciation, as well as by constructing the cards themselves. The learners in question, tertiary-level EFL students in Japan, are familiar with both word-cards and the use of digital devices such as smartphones. Finally, while the volume of research is not conclusive, we have seen that previous research has demonstrated that short-term use of digitally-based vocabulary learning is comparable to paper-based methods, and also that contemporary learners view digital devices in a generally positive light, and will use them throughout their day-to-day lives when opportunities present themselves.

### ***Research Questions***

Based on the literature review, as summarised above, the following research questions are posited:

1. How do the participants' results of using a digital word-card program on a smartphone compare with the results of using paper word-cards over the course of a semester?
2. What are the participants' overall impressions and opinions regarding the use of digital word-cards as an alternative to paper word-cards?
3. To what extent do the participants tend to study the target vocabulary?



Next, I will briefly introduce Quizlet, the software program which was employed in this experiment, and explain its key technological features.

### **Digital Word-Cards:**

Quizlet (2007) is a learning tool, in which users are able to browse and study with a myriad of user-created word-lists, modify them, or create their own from scratch. iOS and Android OS applications allow the users to practice with the word-cards on their mobile digital devices, such as smartphones. The main software is free, though teacher accounts can distribute sets to multiple classes of multiple students.

Within the software itself, learners have access to many various features, of which the “Word-cards”, “Speller” and “Scatter” modules are available on smartphones:

- Word-lists - a list of words, which can be edited, highlighted, and aurally received.
- “Word-cards” - a flash-card application which can be shuffled, tagged for future revision, pronounced, auto-played or manually scrolled through.
- “Learning” - a module which tests your reception, production, and spelling, with multiple repeats and tracking of your performance.
- “Speller” - a module which pronounces the words in the word-list, testing your spelling and listening abilities. Highlights errors and repairs them.
- “Test” - tests the learner on typing, multiple choice translations and true-false questions, which are editable, and trackable.
- “Scatter” - a study game which requires users to drag-and-drop the L1 words onto the L2 words, and vice-versa. Trackable and competitive.
- “Space Race” - a game which requires users to type the translation of a word to "drop" it before it crosses the screen. Competitive and trackable.

Quizlet seems to promote a high degree of engagement with the word-cards. All of the modules have pronunciation support, all of them can be used L1-L2 for retrieval practice, or L2-L1 for recognition practice, and each set can be imported, modified and exported to and from various sources including spreadsheets and databases. Technologically speaking, Quizlet seems to possess many beneficial and interactive processing capabilities (how it can present and utilise the core word-list information) (Kozma, 1991: 3). While the creation of word-cards also plays a vital part in learning the target words (I. S. P. Nation, 2010: 42), it is possible that the opportunities presented by Quizlet's software suite fare comparably to paper-based

cards, while providing further benefits of portability, familiarity and convenience via its smartphone platform. As a utilitarian and practical vocabulary-learning tool, it clearly warrants study.

## **Method:**

### ***Context and Participants***

The study was conducted at a public university located in the Kansai region of Japan with 40 undergraduate students enrolled in classes designed to improve their TOEIC score. The programme had two classes each week, and focused on tactics, vocabulary-study, and modularised mini-tests to give students experience with the TOEIC test. As undergraduate students, the participants were between 18 and 20 years of age, and had all placed within the Intermediate band of the department's ranking system. All participants possessed current-generation smartphones, with iOS phones making up the majority. The students had been introduced to Quizlet at the beginning of the semester, so operational familiarity was satisfactory. As part of the course, the students were required to learn two sets of 12 TOEIC -sourced words per week, through methods of their choosing. These words were tested for pronunciation, spelling, meaning, and word-category recognition throughout the semester, and were then experienced through TOEIC test-modules and end-of-class, post-test reflection.

### ***Research Design & Data Collection***

A mixed-method research design was used to collect quantitative data - the results of the participants' vocabulary tests, their TOEIC test scores for each module, the number of modules that they used to practice for each class and when they practiced - and qualitative data, which sought their opinions on both paper-based and digital word-card learning.

First, participants were introduced to Quizlet itself, looking at the different study modules and its technological functionality, covering how to use the software on both smartphones and computers. Next, they were introduced to the "Test" module on Quizlet, where they were permitted to experiment with the settings to produce a mixture of different tests. After operational familiarity was judged to have been achieved, participants were asked to take a mock test using the "Test" module, to confirm that they were able to use the software independently; problems that arose were dealt with, though most of the problems stemmed from generally low-levels of computer literacy.

Following this introductory session, participants were informed of the structure of the course itself, and how their vocabulary learning would dovetail

together with the study-demands of said course. During the course, students were required to learn two sets of 12 business-related TOEIC words each week for 11 weeks, which, while being mainly used in the TOEIC test-tactic and mini-test modules of the lessons, would also be tested using the “Test” module on Quizlet, just as they had been introduced to previously. Each Quizlet “Test” would be situated at the start of each lesson, would be administered through their computers using the web-browser based software, and was to be completed in 5 minutes (to ensure that there were no “technical difficulties”, the computers were powered on before the students arrived). In this way, the TOEIC vocabulary needed for each class could be refreshed, and the data for this study collected.

At the end of this introductory session, participants were asked to choose, by themselves, which method of vocabulary study they would prefer; digital-based vocabulary learning using Quizlet and its learning modules as introduced previously, or paper-based vocabulary learning in which participants were given free-reign to learn, using a pen and paper, in the way that they held as best suited to them (as mentioned in the literature review, this essentially meant word-lists, with learners writing each word many times in order to acquire it). Their reasons for their choice were sought, collected, and their vocabulary-learning streams decided.

Going forward through the course, each data collection was done within one of the two lessons per week at random. Prior to each lesson, the researcher logged into Quizlet using the teacher account to record each digital-learning participant’s study activity, covering the number of modules studied to completion. For the paper-learning participants, the researcher visually confirmed their practice in their notebooks, and noted this into the log. The Quizlet “Tests” were administered in the following order: “Written”, “Matching”, “Multiple-choice”, and finally “True/False”, so as to test productive retrieval first. The lesson was then conducted as normal, and at the end of which the participants’ results from the mini TOEIC tests were collected.

Two-weeks after concluding the taught content course, participants were asked to take a post-test combining five of the studied word-sets chosen at random, and then they were also asked to take a short qualitative survey, seeking their opinions regarding their study method.

All of these results were graded and collated, and will be discussed in the following section.

## Results:

### *Participants' choices regarding paper-based vocabulary study and digital-based study*

Perhaps the first point to note amongst the results of this study concerns the number of participants who chose each vocabulary study method. Out of the 40 total participants, only 4 chose to use paper-based study methods during the course (and consequently during the course of this study). This is interesting in itself. The reasons for each participants' choice was recorded at the commencement of the study; these statements were categorised and are shown in Table 1 below:

<b>Digital</b>	n = 36	<b>Paper</b>	n = 4
<b>Reason...</b>	<b>Number</b>	<b>Reason...</b>	<b>Number</b>
convenient	<b>29</b>	prefer writing	<b>4</b>
saves time	<b>7</b>		
interesting	<b>6</b>		
ecological	<b>4</b>		
aural	<b>3</b>		
feedback	<b>2</b>		

Table 1: Participants' choices and their main reasons

While not raw quantitative data, the participants' choices and their reasons do demonstrate that the majority strongly preferred the idea of using their smartphones to do their vocabulary-learning, with the main reason being cited as *convenience*, i.e., that they can do their learning anywhere and everywhere, at any time, as long as they have their smartphone (which, for most university-aged students, would most likely be all of the time). Many also believed that using the Quizlet digital application would *save time* when compared to using paper, and that the study modules in Quizlet looked *interesting*. A few participants focused on the *ecological* aspects of not having to use paper, and a few also focused on the *aural* information and *corrective-feedback* possibilities of the Quizlet application. For the paper-based learners, however, they all chose paper stating that they preferred writing when learning vocabulary. Also of note here is that, as predicted, the standard paper-based vocabulary-learning technique used within the Japanese education system is that of copying from a word-list and writing repeatedly (oftentimes for a whole page of a notebook).

***Participants' Test Scores and Modules Studied***

This next table (Table 2) shows the number of practice modules (from the “Word-Cards”, “Learner”, “Speller”, “Scatter” and “Space-Race” modules) that each Quizlet-using participant completed, and the scores that they achieved on the “Written” part of the Quizlet test. Given the large amount of data displayed here, the following abbreviations have been used to save space: (n) denotes each participant; M stands for “Modules Completed”; T stands for “Test Score”; P means that the participant studied using the paper-based method; X shows when a participant was absent, and therefore did not take the test.

n	Test 1		Test 2		Test 3		Test 4		Test 5		Test 6		Test 7		Test 8		Test 9		Test 10		Test 11	
	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T
1	0	10	3	12	3	12	3	12	3	12	3	12	3	12	3	12	3	12	3	11	0	12
2	2	10	3	12	3	11	3	12	3	12	3	12	2	11	3	11	1	10	2	12	3	12
3	2	9	2	8	2	9	2	8	1	8	2	12	2	12	2	9	2	12	2	12	3	11
4	3	5	3	9	3	6	3	12	3	12	3	12	5	12	3	10	4	12	3	12	4	12
5	5	11	4	10	5	11	5	12	3	12	5	11	5	12	5	11	2	12	3	12	1	12
6	1	11	2	11	5	11	4	11	5	12	4	11	3	12	3	12	5	12	5	11	1	11
7	2	9	3	12	4	11	3	10	3	11	4	12	5	12	5	12	2	12	5	12	5	12
8	2	10	3	12	3	12	2	12	2	12	2	12	2	12	2	11	4	12	2	12	3	11
9	5	9	5	12	4	11	4	12	4	12	4	12	4	12	4	12	5	0	4	11	4	11
10	5	12	5	12	5	12	5	11	2	12	5	11	5	12	5	12	2	12	3	12	4	12
11	2	11	1	12	3	11	2	12	1	10	1	11	1	12	1	12	4	X	2	12	1	12
12	4	11	4	12	5	12	4	12	4	12	5	12	4	12	5	12	3	12	4	12	2	12
13	3	12	3	12	3	12	3	11	1	11	3	12	2	12	3	12	4	12	3	11	3	11
14	4	11	4	12	4	12	4	11	5	12	5	12	5	12	3	11	4	12	4	12	4	12
15	P	11	P	12	P	12	P	11	P	12	P	12	P	12	P	11	P	11	P	12	P	12
16	5	11	3	11	5	12	5	12	2	10	5	11	5	12	5	12	2	12	5	11	4	12
17	4	12	3	11	3	11	2	10	2	11	2	12	2	12	2	11	5	12	2	12	2	12
18	5	11	5	10	4	12	4	10	5	12	5	10	5	12	1	12	5	11	5	12	5	11
19	4	11	5	12	5	12	5	12	3	12	5	11	5	11	5	12	5	11	4	11	5	12
20	P	10	P	12	P	11	P	12	P	12	P	12	P	12	P	12	P	12	P	12	P	12
21	5	12	5	12	5	11	5	12	4	12	5	12	5	12	5	12	5	12	5	12	5	12
22	4	12	4	12	4	12	5	12	4	12	5	12	2	11	4	12	5	12	5	12	4	11
23	2	12	2	12	5	12	3	12	3	12	5	12	5	12	2	11	4	12	3	11	4	12
24	2	12	1	12	3	12	3	12	3	12	3	12	3	12	3	12	3	12	2	12	1	11
25	5	11	5	11	5	12	4	11	3	11	5	11	3	11	4	10	4	10	3	10	2	11
26	3	6	3	11	3	12	3	11	3	12	3	11	2	12	3	11	3	11	3	9	2	11
27	2	12	3	12	3	12	3	12	3	12	3	12	3	12	3	12	2	12	3	11	3	12
28	2	10	3	12	2	10	2	11	2	11	2	11	1	11	2	11	2	11	2	10	1	11
29	P	10	P	12	P	12	P	11	P	12	P	12	P	10	P	12	P	11	P	12	P	12
30	2	12	4	12	4	12	4	12	2	12	2	12	2	12	2	12	5	12	2	12	0	12
31	1	12	1	12	1	12	1	12	1	12	1	12	1	12	1	12	3	12	1	12	1	12
32	4	12	3	12	4	11	4	12	3	12	4	12	3	12	3	12	3	12	3	12	3	12
33	2	11	3	12	3	12	3	12	3	12	3	11	3	12	3	12	5	12	3	12	2	11
34	5	12	5	12	5	12	5	12	5	12	3	12	5	12	5	12	5	12	5	12	5	12
35	5	12	5	12	5	12	5	12	5	12	5	12	5	12	5	12	5	12	5	12	5	12
36	3	11	3	12	2	11	2	12	2	12	3	11	2	12	3	11	3	12	2	12	1	12
37	P	12	P	12	P	12	P	12	P	12	P	12	P	12	P	10	P	11	P	10	P	10
38	3	12	2	12	3	12	3	12	3	12	2	11	2	12	2	12	1	12	3	12	2	12
39	3	11	3	12	3	12	3	12	2	12	3	12	3	12	3	12	3	12	3	12	3	12
40	3	11	3	12	3	12	4	12	3	12	2	11	3	12	3	11	3	12	3	12	3	12

Table 2: Participants' Test Scores and Modules Studied

While no doubt confusing, this main data highlights several main points, which will be displayed in the subsequent tables:

Group	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11
Quizlet (n=36)	11	12	11	12	12	12	12	12	11	12	12
Paper (n=4)	11	12	12	12	12	12	12	11	11	12	12

Table 3: Average Test Scores for Each Group

Table 3, above, shows the average scores for each group. As we can see, there was very little change throughout the period of study, with almost all of the participants achieving full marks on each written test each week. An independent-samples T-test was conducted on the entirety of the raw data, and there was found to be a no significant difference in the scores between the *Quizlet* group participants (M=11.53, SD=0.09) and the *Paper* group participants (M=11.54, SD=0.72) as the data demonstrates;  $t(59) = 0.13$ ,  $p = 0.899$ . The two participant groups, despite the large difference in sample size, produced extremely similar results across the board. At first glance, this would seem to suggest that with regards to simple standardised testing there may be little difference between paper-based and digital-based study methods, though this is not quite certain.

Table 4, below, shows the mean number of Quizlet study-modules that were completed by the digital-based group prior to each test.

Group	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11
Modules	3.2	3.3	3.7	3.5	2.9	3.5	3.3	3.2	3.5	3.3	2.8
Test Score	11	12	11	12	12	12	12	12	11	12	12

Table 4: Average Test Scores and Average Modules Studied for Digital-based Group

As we can see here, the number of modules studied remains quite consistent throughout the course of study, although there is a slight drop on the last test; this could perhaps be attributed to general fatigue as the semester came to a close. Additionally, the raw data and the averages suggest that the majority of participants used smartphones to study vocabulary rather than computers, as the Quizlet smartphone application only has three modules in addition to the word-lists, “Word-Cards”, “Speller” and “Scatter”. This is perhaps not too surprising, as the vast majority of participants who chose to study using Quizlet reported doing so due to its perceived convenience. Finally, the raw data intimates that learners generally establish a pattern for their language learning, and that they do not frequently change from it; the same can be said for the paper-based participants as well, as the amount of writing that they did each week tended to remain relatively consistent, with the only changes being when they “did not have time” and practiced less.

The post-test was administered two weeks after the final standardised test, and was conducted without prior warning at the beginning of the last lesson of the semester. The final test featured 15 words chosen at random from the word-sets used throughout the course of study, and again the participants' "Written" test scores were recorded. Table 5 shows the averaged results, below:

Group	"Written" Post-Test
Quizlet (n=36)	9
Paper (n=4)	8.5

Table 5: Average Post-Test Scores for Each Group

These results show that the digital-based group had a slightly higher mean than the paper-based group. However, after conducting an independent-samples T-test on the raw data, and there was found to be a no significant difference in the scores between the *Quizlet* group participants ( $M=9.08$ ,  $SD=6.19$ ) and the *Paper* group participants ( $M=8.50$ ,  $SD=3.00$ ) as the data demonstrates;  $t(5)= 0.61$ ,  $p=0.570$ . While there is no significant difference in the results, the standard deviation of the data shows that the range of results in the digital-based group's post-test results expands both higher and lower than the average, whereas the paper-based group's results are less variable. However, this is potentially due to the lower number of samples in the paper-based group.

### ***Participants' impressions of their chosen study method***

After the post-test, participants were asked to answer several Likert-scale questions about their experiences using their chosen study method; they were also given the chance to free-write their impressions and thoughts about study vocabulary using their chosen method. The questions asked, and the participants' responses to the survey concerning their impressions and opinions on each study method are shown in Table 6 below:



Questions	Strongly disagree		Neutral		Strongly agree
	1	2	3	4	5
I think Digital cards are...					
<b>3)...effective</b>	0.00%	0.00%	4.76%	50.00%	45.24%
<b>4)...easy-to-use</b>	0.00%	0.00%	0.00%	30.95%	69.05%
<b>5)...convenient</b>	0.00%	0.00%	0.00%	45.24%	54.76%
<b>6)...engaging</b>	4.76%	11.90%	30.65%	33.33%	19.05%
I...					
<b>7) ...like using digital devices to study</b>	2.38%	7.14%	21.43%	45.24%	23.81%
<b>8) ...dislike using digital devices to study</b>	30.95%	35.71%	16.67%	11.90%	4.76%

Table 6: Percentages showing opinions on digital-based vocabulary study

Table 6 displays the percentages for each answer across the 36 surveyed *Quizlet* group participants. The highest-percentage answers have been highlighted, showing that overall the digital word-cards viewed on smartphones and computers seemed to have been received rather positively; notably, roughly 54% strongly thought the digital word-cards to be convenient, and almost all of the participants thought positively about their effectiveness regarding vocabulary learning. Participant’s also thought digital-based vocabulary study to be relatively engaging, though not as notably positively so as the previous questions. In general, though, it would seem as if the *Quizlet*-group participants are positively inclined towards studying vocabulary using digital devices; although the inverted question 7 and question 8 do not show an exact mirroring of the results, there is a sufficient degree of overlap to suggest that the positive impression remains valid.

In addition to answering these Likert-scale questions, many participants from both groups wrote a few thoughts about their chosen study-methods. A selection of these comments follow, and have been edited for clarity:

*“When I was (a) high school (student), I always studied with paper, so I like paper practice.”*

*“I chose paper. But with paper, I became tired because I had to move my hand many times.”*

*“Quizlet seem(s) useful (useful), but I think we should not rely (rely) on it.”*

*“At first, I thought that paper is good because writing is good. But when I got busy, I didn’t have time to write. I think that when people have time, they should write, though.”*

The paper-based group generally seemed to feel positively about their study method, commenting that they felt that it helped them better remember the target vocabulary, however, there were two interesting points about the time-consuming nature of paper-based study. These comments are echoed by the majority of the responses regarding Quizlet:

*“Quizlet is more useful than I expected, because I can listen (to) how I pronounce English words and I can check spelling using a variety of tests. It’s fun for me. I think Quizlet is very useful to learn English words everywhere, enjoying leraning (learning).”*

*“I feel it is better than using paper because we can learn anytime and anywhere”.*

*“I felt that doing Quizlet was very good for me. With (while) doing it, my skill of typing improved a little. I had very nice tome (time) with doing it!”*

*“When I get busy, it’s good to use Quizlet.”*

*“Portable study tool is great because we can study everywhere, every time.”*

As we can see, a number of participants echoed concerns about time and convenience, noting for them that they like Quizlet and digital-based vocabulary study methods as potential time-savers. Many of the *Quizlet* group participants also commented on the different study options, the pronunciation, as well as the level of engagement. It would appear that language learners tend to like what methods they like, and while this might not always match the expectations of their teachers, it is this reality that teachers and researchers should strive to accommodate.

## **Conclusion:**

To conclude, the results of this brief study are relatively straightforward. The main data, that concerning the test-scores of the participants, shows that vocabulary learning using digital word-cards, such as Quizlet, produced roughly equivalent results when compared with the more traditional paper word-lists, even over a long-term period of investigation. Both sets of participants tended to study throughout the semester in a consistent manner, perhaps at home or most likely on their respective commutes to university. Post-test data, also, does not demonstrate

a notable nor statistically significant difference in recall between using paper-based methods and digital-based methods. The findings of the qualitative survey show that digital vocabulary learning was viewed relatively positively by the participants, with recognised benefits such as pronunciation functions, typing modules and the range of study options, though these are notably overshadowed by the perceived convenience of using smartphones and portable digital devices to study.

While limited in scope, it is hoped that this short study can provide a template for future research. The longitudinal nature of this study does provide a look at more realistic, day-to-day aspects of Japanese learners of English in an elective-course university setting, though there are several flaws which would need to be addressed before continuing this avenue of enquiry. Firstly, the nature of the vocabulary study was not strictly controlled; as most participants mentioned that they liked using Quizlet to study while commuting, it is quite likely that many were practicing mere minutes before the lessons commenced. This condition would need to be better controlled in the future, although it does represent a very realistic and typical snapshot of the “test-based” mentality regarding foreign languages prevalent in the Japanese education system. Secondly, the words chosen for the investigation were not screened for frequency; as part of a high-level, business-orientated TOEIC textbook, they served the dual purposes of being tested in this study and required for the course of study that the participants were enrolled in. This, of course, would dilute the difficulty of the vocabulary to some extent, though it would also hopefully increase the relevance of learning them.

Despite these drawbacks, however, this simple study does posit several more questions to investigate; chiefly, how often and to what extent students “study” vocabulary required for their course of study; how this might differ depending on the methods, be they digital or paper-based, which one used; and to what extent would the vocabulary be retained over a delayed period. It is hoped that this study can provide a few glimpses into a more realistic, applied approach to investigations into vocabulary-learning.

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