**DIGITAL FLASHCARDS FOR ACADEMIC VOCABULARY**

**ACQUISITION WITH STUDENTS WITH LEARNING DIFFICULTIES**

by

FAYE SINOU

A thesis submitted in partial fulfillment of the

requirements for the degree of

MASTER OF ARTS

in

Applied Educational Psychology

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THESIS APPROVAL

"Digital Flashcards for Academic Vocabulary with Students with Learning Difficulties" a thesis prepared by Faye Sinou in partial fulfillment of the requirements for the Master of Arts degree in Applied Educational Psychology was presented April 5, 2022, and was approved and accepted by the thesis advisor, internal examiner and the School of Graduate and Professional Education.

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Title: **Digital Flashcards for Academic Vocabulary Acqusition with Students with Learning Difficulties**

Students today are native to technology and a large portion of their academic work is completed online. Secondary-level students with learning difficulties (LDs) struggle with the academic curriculum and vocabulary. The purpose of the study was to compare the effects of a digital flashcard (DF) intervention, Quizlet, to paper flashcards (PF) as a method for teaching new academic vocabulary to students with LDs. Research conducted on comparing flashcard types is limited and studies including adolescents with LD is scarce. The participants of the study were a small group of $7^{th}$-grade students with learning difficulties, who are currently enrolled in the learning center of a secondary school. Prior to beginning the intervention, students were asked to fill out a questionnaire indicating flashcard use and perspectives on their usefulness. Data in PF and DF conditions on vocabulary acquisition were collected using pretests and posttests to measure gains in receptive and productive vocabulary knowledge. The results indicated a significant difference when students studied the digital flashcards, suggesting this may be an effective

tool for secondary-level students with LDs for learning academic vocabulary. However, differences between types of vocabulary knowledge in each condition were not found.

*Keywords*:  flashcards, technology, learning difficulties, academic vocabulary, secondary school, adolescents

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**EPAPSY (Association of Regional Development and Mental Health)**

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- Coordinator in groups of theatrical games, dance/movement, learning English and Creativity
- Coordinated, facilitated, lead and engaged clients in group discussions
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06/2015 **Youth Lacrosse** - Ashland High School
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**Learning Difficulties**

Nowadays, technology plays a major role in educational settings. Modern technology has a crucial role in the development of the education system and in the curriculum instructed. Instruction delivered through technology has gained traction because instruction is progressively shifting from traditional materials such as paper and books, to digital based media such as educational games, instructional videos, and electronic textbooks (Li & Tong, 2018; Sage et al., 2019). Although technology in the classroom was implemented in the previous decade, the start of the COVID-19 pandemic, expanded the implementation of web-based instruction as a new means for teaching educational material globally. It is now widely accepted that the use of technology in the classroom is beneficial in relation to students' learning and as a means for increasing motivation and engagement in the material (Byrd & Lansing, 2016; Chen et al., 2021; Chien, 2015; Kennedy & Deshler, 2010).

The use of technology specifically for language learning began in the 1980s with computer-assisted language learning (CALL) (Chapelle & Jamieson, 1986). This approach became popular for learning both language and vocabulary. Computer-assisted instruction (CAI) and computer-based learning (CBL) are used interchangeably to describe instructional technology that emphasizes the use of computer-based technologies. Learners engage with CAI through technological tools such as tablets, cell phones, laptop computers and desktop computers. The main advantage of CAI is that these tools can be used beyond the classroom environment to enhance learning. CAI also engages learners by providing immediate feedback, and with various activities to promote motivation. However, earlier

studies suggested that the technology implemented at the start of CALL did not produce

the desired results for vocabulary activities that would enrich learning (Joseph, 2012;

Riasati et al., 2012). For example, previous research suggested that earlier instructional

technology did not include the element of interpersonal interaction, and thus was lacking

the interaction needed in teacher-student relationships (Joseph, 2012). The central focus

was on the use of technology, and not its implementation for enhancing learning within the

classroom. Additionally, other factors considered in earlier years were the presence of poor

computer skills and a lack of availability of access (Joseph, 2012; Riasati et al., 2012).

However, advances in technology in recent years allow educators to not only create

opportunities that may encourage self-reliant study methods for students to learn

vocabulary (Yuksel et al., 2019), but also provide educators with powerful tools to enhance

classroom instruction.

**Students with LD and Vocabulary Knowledge**

Facilitating the retention of vocabulary concerning its context or the multiple

meanings associated with the word is the primary goal of vocabulary instruction (Fore et

al., 2007). The goal of secondary level education is for students to comprehend and use the

words while reading and writing (Baumann & Graves, 2010). Students with learning

difficulties (LD) often have a limited vocabulary, which consequently impacts their

reading, writing, and comprehension skills (Jitendra et al., 2004; Kuder, 2017; Williams &

Martinez, 2019). Students with LDs tend to have difficulties with more than one aspect of

reading (Roberts et al., 2008). Some students may have difficulties at the word level and

others at the comprehension level. As a result, older students with reading difficulties tend

to spend less time reading independently and therefore limit their exposure to new

vocabulary. Secondary school students with LDs require interventions that accelerate their vocabulary development (Beach et al., 2015; Fore et al., 2007; Kuder, 2017; Roberts et al., 2008). For this reason, it is important to determine effective strategies to increase engagement with new vocabulary words and concepts within the general education curriculum.

There are different aspects and types of vocabulary knowledge educators and researchers may study. From a developmental perspective of word learning, the strategies, and types of instruction for shallow word knowledge will differ from ones aimed to develop a deeper knowledge of a word (Nitzkin et al., 2014; Paribakht & Wesche, 1997). The ability to use a word in a novel context demonstrates the deepest level of word knowledge. On the other hand, shallow knowledge may include the recognition of a word in a text and increased familiarity through images and definitions.

Beck and colleagues (1987) proposed an alternative way to analyze and categorize vocabulary. They highlighted that teachers and educators should place a large emphasis on words' usefulness and frequency of use. The researchers have categorized vocabulary into three tiers depending on their frequency, complexity, and meaning (Beck et al., 2008; 1987). Tier One includes basic words and sight words, which do not typically require direct instruction, nor do they tend to have multiple definitions. The second tier consists of high-frequency vocabulary words also known as academic vocabulary (Baumann & Graves, 2010; Beach et al., 2015). These words include the academic vocabulary of students' curriculum; however, the meaning of these words is most likely unknown to the students. Tier Three consists of rare and highly content-specific vocabulary words. Beck and colleagues (1987) suggested that for teaching purposes, educators should disregard

Tier One and Tier Three words and focus on Tier Two words. The reason for this is that Tier One words are already known by the students and Tier Three words should be taught when encountered in a text through direct instruction. The present study focuses on Tier Two vocabulary words, as these are critical for secondary school students to work more efficiently and comprehend the text they encounter regularly in their academics. Additionally, general academic vocabulary appears frequently across a range of subjects and is not limited to only one academic course which focuses on specific terminology as seen in Tier three vocabulary.

**Importance of Academic Vocabulary**

Academic vocabulary knowledge is an example of a necessary skill associated with comprehension and academic achievement in addition to other information processing tasks necessary within secondary-level coursework (Baker et al., 2014; Kennedy et al., 2015; William & Martinez, 2019). Vocabulary contributes to reading comprehension to a large extent (Nitzkin et al., 2014; O'Connor et al., 2019; Perfetti & Stafura, 2014; Williams & Martinez, 2019). The role of vocabulary in reading comprehension applied to both neurotypical students, and students with learning difficulties. Students with LD experience additional difficulties with reading comprehension which also relate to difficulties in word reading, fluency, and vocabulary (Sanchez & O'Connor, 2019). Although the specific processes relating to reading comprehension differ depending on the framework and individual, word meaning is a major contribution to both aspects (Perfetti & Stafura, 2014; Sanchez & O'Connor, 2019). Individuals with larger vocabularies can access greater semantic resources to activate background knowledge, in addition to the eased ability to integrate new information with previous knowledge (Moody et al., 2018; Sanchez &

O'Connor, 2021). However, students with LDs have limited vocabulary knowledge which becomes more apparent in secondary level education. Gaps in expressive and receptive semantic development beginning at an early age seem to have a large impact on listening and reading comprehension, and generally to further academic progress (Nitzkin et al., 2014).

In addition to the impact that academic vocabulary knowledge has on reading comprehension in students with learning difficulties, the impact on academic achievement is also widely researched (Beach et al., 2015; Jitendra et al., 2004). The presence of a rich vocabulary plays an important factor in academic achievement (McKeown et al., 2018; Sanchez & O'Connor, 2021). Without sufficient vocabulary, it is difficult to read, write, listen, and especially comprehend a written text. Students who lack enriched vocabulary, are likely to face difficulties in reading as they progress in their education because subjects become more complex. Learners are exposed to new vocabulary in a variety of ways: explicitly by a teacher, implicitly through their textbooks, and their environment. Since vocabulary development is essential for students to succeed in different areas of their education, effective and explicit vocabulary instruction is a major concern for educators and researchers.

Generally, there are two approaches to vocabulary learning: incidental and intentional vocabulary learning (Paribakht & Wesche, 1997). Incidental, also known as implicit vocabulary learning, refers to acquiring vocabulary indirectly through exposure to words and texts during classroom activities and lessons. However, this approach does not require intentional effort and therefore is achieved subconsciously. Intentional, also known as explicit vocabulary, learning requires conscious effort to acquire the vocabulary. As

students enter secondary schooling, it is critical to increase their vocabulary both orally and written, thus allowing them to increasingly comprehend more complex text that they encounter in their course work (Kuder, 2017; William & Martinez, 2019).

In the secondary grades, content area texts frequently use a range of academic vocabulary words which are commonly seen in history, science, geography, English literature books, and essays (William & Martinez, 2019). Generally, secondary instructors assign reading from textbooks that students are expected to read, interpret, evaluate, and answer questions relating to the content (Sanchez & O'Connor, 2021; Williams & Martinez, 2019). Students with learning difficulties who have not mastered early reading skills and strategies, frequently find this method difficult and frustrating (Beach et al., 2015; Fore et al., 2007). Additionally, in classrooms, the primary methods used to teach new vocabulary encountered in texts include mentioning the definition during class time and assigning students to search for the definition in a dictionary (Kennedy et al., 2015). As research suggests, traditional instructional methods at the secondary level result in the unlikelihood of students with LDs receiving the necessary instruction to improve their skills and progress in the academic setting (Jitendra et al., 2004; Kennedy et al., 2015; Kuder, 2017). Simply reading more does not imply enhanced vocabulary knowledge and comprehension skills, especially for students with LDs. Additionally, limited exposure to new vocabulary and solely searching for the definition does not guarantee acquired vocabulary. Therefore, explicit vocabulary instruction is crucial especially when focusing on academic vocabulary that students encounter in all subjects, and words that are vital for comprehending a written text. For the reason stated above, the present study focused on academic vocabulary specifically targeting secondary students.

Previous literature on vocabulary instruction with secondary-level students with learning difficulties has identified several methods for effectively teaching vocabulary. Of the studies conducted with students with learning difficulties, mnemonic instruction, cognitive strategy methods, semantic feature analysis, and semantic mapping are all found to be effective methods for secondary LD students to learn new vocabulary (Jitendra et al., 2004; Jozwik & Douglas, 2017; Kuder, 2017). Several studies have researched different CAI programs and methods which produce significant results concerning vocabulary development (Kennedy & Deshler, 2010; Kennedy et al., 2015; Sanchez & O'Connor, 2019). For example, Kennedy and colleagues (2015) investigated the use of content acquisition podcasts with secondary-level students with LDs as a means of learning history related vocabulary. The researchers developed one-to-three-minute content acquisition podcasts containing content-specific instructional methods and compared the different types which included explicit instruction on vocabulary, mnemonic techniques, or a combination of the two. The students with LD who used the podcasts which included both methods attained significantly higher scores.

Among the available methods of instruction, the flashcard method is found to produce successful results. Advances in technology have allowed flashcards to transfer into technology-based platforms to enhance instructional strategy. Studies using digital flashcards (DF) with various platforms and applications have been researched for vocabulary development across populations. College students, elementary school students, and second language (L2) learners were included. Also, content was taken into consideration: technical vocabulary, academic vocabulary, and sight words were the focus (Alanazi, 2017; Basoglu & Akdemir, 2010; Dizon & Tang, 2017; Yüksel et al., 2020).

Although the context, group of learners, and type of vocabulary targeted vary from research to research, studies have attempted to establish the effectiveness of technology-based flashcards on students' learning. The current study aimed to contribute to the research findings by focusing on secondary level students with learning difficulties and academic vocabulary as the target.

**Research on Digital and Paper Flashcards**

Flashcards are a direct instructional approach that includes repetition and focuses directly on the target vocabulary. Generally, students are exposed to new words in a textbook, by a teacher, and through reading excerpts. Students with LDs typically require multiple exposures when presented with new vocabulary in their academic learning. The use of flashcards provides an easy and simple way for students to study and learn new vocabulary. Repeated exposure to flashcard use is typically utilized until students demonstrate an understanding of the correct response. Flashcards allow students to spend more time reviewing words they have difficulty with while placing known or learned words to the side.

In recent years there is growing literature that investigates digital flashcards with several populations (Dizon & Tang, 2017; Yüksel et al., 2020). Digital flashcards provide learners with unique features such as spelling, audio pronunciations, visuals, and repeated learning for mastery. This type of flashcard method may be perceived as an updated version of the traditional paper flashcards due to the different functionalities offered for learning and memorizing content material. However, research on specific online tools for flashcards and their application to secondary students with LDs remains limited (Grillo &

Dieker, 2013). The present study aims to contribute to the scarce research currently available on digital flashcard use with LD secondary students.

Researchers have compared the differences between the use of digital flashcards and paper flashcards across different populations (Basoglu & Akdemir, 2010; Dizon & Tang, 2017; Yüksel et al., 2020). Basoglu and Akdemir (2010), investigated the use of digital flashcards and paper flashcards on vocabulary development with the English language learners at a Turkish university. The participants of this study were exposed to a list of vocabulary words over six weeks. The participants in the experimental group were exposed to the DFs through a program embedded in their mobile phones. Their results suggested that students using the digital flashcards to learn new vocabulary words in their non-native language, made greater improvements when compared to the paper flashcards.

Byrd and Lansing (2016) conducted a study with seventeen high school French and German foreign language students. The researchers compared the effects of digital and paper flashcards on learning new vocabulary. Participants were divided into two groups in which both were exposed to and studied vocabulary with paper and digital flashcards. In the paper flashcard group, participants were required to create their own flashcard set and create their illustration for each word. Participants in the DF group, reviewed vocabulary using a program called *Before You Know It,* featuring different modes for practicing the vocabulary. Their results suggested that participants studying with the digital flashcard program showed a significant difference in performance on the vocabulary quizzes when compared to the paper-based flashcards.

Similar results were found when DF and PF were compared with undergraduate students learning technical vocabulary in their pharmacy degree program (Yuksel et al.,

2020). Researchers in this study used Quizlet as the program for the DFs. The experiment consisted of two phases which lasted for a total of ten weeks. During the first phase of their intervention, students were provided with the vocabulary words in a paper-list form. In the second phase, they were provided with the DFs. At the end of each phase, students were administered a vocabulary test. The results from this study indicated that participants scored significantly higher on the vocabulary assessment in the DF condition than in the wordlist condition, suggesting that DFs are a useful approach to studying technical vocabulary.

However, other studies have found an equal or a stronger effect of PF as opposed to DF on vocabulary knowledge (Grillo & Dieker, 2013; Dizon & Tang, 2017; Sage et al., 2019, 2020). Some studies have further expanded the comparison between paper and digital flashcards, by including specific technology-based devices such as laptops, tablets, and computers to investigate how they differ from one another. Sage and colleagues (2019) investigated the differences between PF and DF in vocabulary development. Participants of this study were exposed to paper, computer, and tablet flashcards that were either ready-made or self-created. The results from this study suggest that students learned equally well from paper and tablet flashcards, but less well from computer flashcards. Similar results were found in a study conducted after the findings of Sage and colleagues (2019) indicated the effectiveness of tablet and paper flashcards over the computer flashcards. However, in Sage and colleagues (2020) research, paper, tablet devices, and laptops were compared instead of computers. The findings of this research suggested equal effects across all three devices, highlighting the difference between laptops and computers. Researchers suggested

that the difference between computers and laptops is that computers are not portable, whereas the other devices are.

Similar results were found in a study conducted by Dizon and Tang (2017). Researchers of this study investigated differences between receptive and productive vocabulary knowledge of a group of language learners attending a university that used PFs and DFs. Participants in this study were divided into two groups and studied vocabulary with either PFs or DFs, using *Quizlet* and *Cram*. Both PF and DF groups made improvements with receptive and productive vocabulary knowledge from pretest to posttest, however, the gains were not significantly different between the conditions. This outcome suggested that the type of knowledge acquired in both conditions was similar and the two methods of flashcards were equally effective.

Grillo and Dieker (2013), compared the effectiveness of digital and paper flashcards on learning subject-specific vocabulary with a group of high school students with learning disabilities over six weeks. The participants were assessed through a pretest, posttest, and delayed posttest vocabulary assessment. The participants were assigned to use either the DFs created via a website called Study Stack or PFs. Participants were required to study the flashcards for five minutes of every class period.  Researchers concluded that there were significant gains in vocabulary development from both flashcard methods and their effect on semester grades over time. Additionally, their findings suggest that through repeated exposure and daily practice, participants' long-term memory was accessed which allowed for mastery of the vocabulary words.

Findings from previous research remain inconclusive for several potential reasons. Firstly, participants included in recent studies were university students who most likely

were exposed to the traditional flashcard method from an early age. Therefore, it is more likely they would prefer a method that is known to them as opposed to a newer method involving technology. Secondly, primary and secondary students nowadays are native to technology and these methods are implemented in the classroom from primary level education. Therefore, it is likely they would prefer digital modalities or digital flashcards only. Grillo and Dieker (2013) are the only researchers to the author's knowledge who compared digital and paper flashcards with secondary students who have learning difficulties. The present research aims to contribute to this research while also including academic vocabulary as opposed to technical vocabulary limited to only one academic area.

Students' preferences and attitudes toward the use of digital and paper flashcards also present mixed results. Some studies found a preference for DF (Basoglu & Akdemir, 2010; Chien, 2015; Dizon & Tang, 2017; Sage et al., 2020; Yüksel et al., 2020), while other found a preference for PF (Sage et al., 2019). Learners' attitudes and preferences toward the two flashcard methods provide researchers and educators insight into factors that may impact their performance and motivation to engage and learn the material. The factor of motivation plays a role because students' preferences and attitudes toward instructional material may impact their motivation to study and perform well. Preferences for the two methods also depend on students' experiences with flashcards, technology use, and the use of online material for studying. Studies that found a preference for digital flashcards over paper flashcards indicated the perceived usefulness of DFs, in addition to favorable attitudes toward the usefulness and facilitated use of digital flashcards (Basoglu & Akdemir, 2010; Dizon & Tang, 2017). In addition to the favorable attitudes toward

digital flashcards, preferences for the type of flashcard are also previously found to relate to performance on outcome measures (Sage et al., 2020, 2019; Yüksel et al., 2020). It is likely that favorable attitudes toward one flashcard method over the other would also reflect on performance on assessments as seen in the research findings. The present study also surveys participants to identify perceptions of each flashcard type.

**Theoretical Framework**

This research study is grounded in principles from Mayer's Cognitive Theory of Multimedia Learning (CTML). The use of digital flashcards as a means of acquiring vocabulary is supported by multimedia learning. Additionally, traditional instructional materials developed may not support students with learning difficulties who often present cognitive processing and working memory deficits (Greer et al., 2013). The reason may be that text on its' own is not sufficient for practice and retention of information. Therefore, multimedia technology offers researchers and educators an opportunity to create instructional materials that meaningfully deliver academic content while supporting students' motivation to learn (Kennedy et al., 2015; Kennedy & Deshler, 2010; Moreno & Valdez, 2005). CTML aims to describe the processes that occur when learners are presented with multimedia instruction and guide researchers in developing the instructional materials (Mayer, 2005; Mayer, 2008; Mayer & Sims, 1994). The principles from CTML were initially proven using paper-based materials in addition to oral or recorded audio presentations (Greer et al., 2013; Mayer, 2008). Later, the principles were extended and confirmed with technology-based materials (Kennedy et al., 2015; Kim & Gilman, 2008). This theory is based on three main assumptions: there is two independent channels processing visual and auditory information; there is a limited capacity in each channel; and

that learning requires active processing of information by filtering, selecting, organizing, and integrating knowledge (Mayer & Valdez, 2005). The assumption of active processing claims that individuals actively engage in the processing of information to build a mental representation of their experiences. The active processes include actively paying attention, organizing the entering information, and incorporating the information with prior knowledge (Li & Tong, 2018; Mayer, 2005). For this research, however, two of the three main assumptions will be further analyzed.

The assumption of dual channels was first introduced by Paivio (1971) and supported by Baddeley and Hitch (1974) and refers to individuals using verbal and visual channels to process information presented. The Dual-Coding Theory (DCT) supports the idea that individuals possess separate channels for processing auditory and visual information. Mayer and Sim's (1994) version of DCT describes how visual and verbal material is integrated into individuals' working memory during the learning process. Although these systems are separate and can be activated independently, they are also interrelated, meaning, that either system can activate the other. For example, when visual material is presented, learners build mental representations and construct visual representational connections. Similar processes occur when individuals are presented with verbal material and engage in visual encoding. The two systems building representational connections for visual and verbal stimuli independently, also work together to build referential connections by linking images to words and vice versa. Researchers, therefore, have combined the two subsystems of cognition when developing vocabulary instructional materials (Kennedy et al., 2015; Kim & Gilman, 2008; Moreno & Valdez, 2005). Paivio (1971) claims that word representation with the use of text and images is better than using

only text. One of Mayer's principles, known as the 'multimedia principle', supports this claim by Paivio (1971) and suggests that deeper learning can occur when new instructional material is presented in both text and images. However, Mayer furthers this claim by arguing that merely combining words and pictures is not an effective way to achieve multimedia learning. Instead, the information presented in images and text should complement each other with each mode adding additional meaning and facilitating the retention of material.

The second assumption, limited capacity, was introduced by Baddeley (1974) and Chandler and Sweller (1991) and suggests that individuals can only process a limited amount of presented information in each channel. This assumption is directly related to individuals working memory capacity which is severely limited and processes approximately four words at a time (Baddeley, 1974; Chandler & Sweller, 1991). For example, when an image or animation is presented to an individual, they can retain only a few images in their working memory. Similarly, when text is presented to an individual, they can hold only a few words in their working memory of the presented material. Chandler and Sweller's (1991) Cognitive Load Theory, is based on the idea that the working memory of individuals is limited by the amount of information held. If individual's cognitive load exceeds working memory capacity, learning is hindered, and individuals will struggle to make progress in the task at hand. Thus, information not held in working memory will also fail to transfer to long-term memory and working memory becomes burdened. Therefore, the aim of the development and design of instructional materials is to reduce the cognitive load of individuals by breaking down the material introduced and delivering content in such a way in which tasks are broken down and taught

individually before being explained together. The reason for this method is that the learner is not overwhelmed by the amount of new material introduced from the beginning. The present study considers this assumption when developing the materials. The author attempted to reduce cognitive load by limiting the amount of new academic vocabulary words presented to the participants each week in addition to including clear definitions with images to enhance learning. Previous research has also considered the application of the cognitive load theory when developing instructional materials for vocabulary development (O'Connor et al., 2019; Sanchez & O'Connor, 2021).

**Receptive and productive vocabulary knowledge**

To assess the outcome of vocabulary instruction and learners' performance, instructors can assess productive and receptive vocabulary knowledge. Receptive, also known as passive knowledge, refers to the capability to comprehend a word when an individual listens to or reads it. For example, receptive tasks may include matching words to their definitions, looking up words in a dictionary, and learning from word pairs (Webb, 2005; Webb, 2008). Typically, receptive tasks may be more common because they are easier to design, correct, and complete compared to productive tasks. If educators know their students' receptive vocabulary size, they can then indicate whether the students can comprehend a text or listening task (Webb, 2008).

On the other hand, productive, also known as active vocabulary knowledge, refers to the ability to produce a word and its meaning when an individual can use it in their writing or speech (Faraj, 2015; Webb, 2005). Productive activities may include teaching students semantic mapping, as well as strategies to learn words from context or word parts (Jitendra et al., 2004; Webb, 2005). If educators know their students' productive

vocabulary size, it may help them provide some indication of students' speaking and writing abilities (Webb, 2008). A widely observed research outcome regarding productive and receptive vocabulary is that learners' receptive vocabulary develops quicker than their productive vocabulary (Dizon & Tang, 2017; Faraj, 2015). Generally, individuals first learn vocabulary receptively and then gradually progress to productive knowledge when vocabulary is learned more in-depth (Faraj, 2015; Webb, 2008). Previous research investigated the relationship between receptive and productive vocabulary size of native Japanese-speaking students learning English as a foreign language (Webb, 2008). The results of this study showed that the total receptive vocabulary size of the students was larger than their productive vocabulary. Moreover, the researcher suggested that students who have a larger receptive vocabulary are more likely to know the words productively as opposed to students with a smaller receptive vocabulary (Webb, 2008). The present study includes measures for productive and receptive vocabulary knowledge to assess academic vocabulary acquisition among students with learning difficulties. The study also expects receptive vocabulary knowledge to be greater when compared to productive vocabulary knowledge.

**The Present Study**

Overall, during a time when technology is highly immersed in educational practices, it is important to investigate how technology can be used with students with LDs to their advantage regarding vocabulary acquisition. More specifically, educators and researchers face difficulties with teaching academic vocabulary to secondary-level students with LDs (Beach et al., 2015; Jitendra et al., 2004). This research can provide teachers with recommendations for course materials and more effective approaches to teaching academic

vocabulary to students with LDs. Among the tools and methods available for vocabulary instruction, digital flashcards are reported to be frequently used in various contexts. Although positive potential advantages of technology-based flashcards in vocabulary learning are documented, we know little about the effect of DFs on academic vocabulary learning with secondary students with LDs and how they compare with traditional methods. The present study aims to fill in the gap in the literature by investigating the effects of DFs on learners with LDs' academic vocabulary learning and surveying students' perceptions regarding its use. Therefore, the importance of the study is to provide effective tools for teaching students with LDs when learning academic vocabulary.

The development of academic vocabulary acquisition is exaggerated for students with LDs in the secondary grades who have not mastered academic skills from primary schooling (Beach et al., 2015; Jitendra et al., 2004; Kuder, 2017). Students with learning difficulties often struggle with reading comprehension and academic achievement. Therefore, they require further explicit instruction on academic vocabulary to improve understanding of the text and overall academic achievement. Flashcards as a method for teaching vocabulary have been researched across ages, academic areas, bilingual learners, and languages. The use of digital flashcards is also found in the literature; however, the research presents mixed results when comparing the two methods (Dizon & Tang, 2017; Yuksel et al., 2019). Moreover, research with secondary-level students and the use of digital flashcards is also limited and requires further investigation (Grillo & Dieker, 2013). However, considering the evidence in combination with the theories on the advantages of multimedia learning, technology-based flashcards pose a greater advantage over traditional paper flashcards because of the various modes of presentation and features (Mayer, 1994;

Moreno & Valdez, 2005; Yuksel et al., 2019). Moreover, research outcomes with bilingual individuals are promising, suggesting a beneficial effect on vocabulary acquisition (Basoglu & Akdemir, 2010; Dizon & Tang, 2017). Concerning the theoretical framework, two of Mayer's assumptions in the CTML, describe how individuals possess two separate systems for verbal and nonverbal information and how they are limited in their capacity. Visual and verbal material is combined in the working memory of individuals during the learning process. These systems can work independently from one another and jointly, activating each other. Therefore, multimedia technology allows learners to combine material in order to enhance the retention of information through verbal and visual stimuli. Thus, the present study expected digital flashcards to result in greater vocabulary acquisition when compared to traditional paper flashcards.

Additionally, most research examining participants' preferences and perceptions of the two flashcard methods indicate favorable attitudes toward digital flashcards due to their perceived usefulness and ease of use (Basoglu & Akdemir, 2010; Chien, 2015; Dizon & Tang, 2017; Sage et al., 2020; Yüksel et al., 2020). Considering research findings, the present study hypothesized that students would prefer the use of DFs as opposed to the traditional paper flashcard method. Additionally, the researchers of these studies have found positive associations between perceptions and preferences of flashcard type and test scores (Sage et al., 2020, 2019; Yüksel et al., 2020). Thus, the present research also expected a positive association between students' preference for flashcard type and test performance.

Considering the type of vocabulary knowledge acquired, a widely observed research outcome concerning productive and receptive vocabulary knowledge is that

learners' receptive vocabulary develops at a much faster pace than their productive

vocabulary (Dizon & Tang, 2017; Faraj, 2015). Typically, individuals first learn vocabulary

receptively and then progressively advance to productive knowledge when vocabulary is

learned more in-depth (Faraj, 2015; Webb, 2008). Previous research has examined the

relationship between receptive and productive vocabulary size of second language learners

acquiring new vocabulary in a foreign language (Faraj, 2015; Webb, 2008). The findings of

this research repeatedly suggest a much larger receptive vocabulary size when compared to

productive vocabulary. In view of previous findings, the present study hypothesized that

test scores will be higher in measures of receptive vocabulary knowledge when compared

to measures of productive vocabulary knowledge across conditions.

The purpose of this research study was to examine the effect of digital flashcards

when compared to paper flashcards as an educational intervention for students with

learning difficulties in learning academic vocabulary. This study aimed to do the following:

(1) Show that DF will be a great tool for students with LDs to learn new vocabulary. (2)

Help mainstream teachers with teaching new vocabulary to their classrooms and to English

language learners and (3) expand the vocabulary of students with LDs.

## Method

### Participants

The participants were selected using a non-probability convenience sampling method. The study included a small group (*N*=6) of seventh-grade students eligible for special educational needs services from a private English-speaking secondary school in Athens, Greece. The average age of participants is 13 (SD=.57) The students are currently enrolled in the learning support center of the school in which they attend and present with learning difficulties. The participants have received an eligible diagnosis for their enrollment in the special educational needs program of the school. Most of the participants have been diagnosed with a specific learning difficulty in reading. More specifically the diagnoses of the participants include specific learning difficulties in reading, dysgraphia, fluency, Asperger's syndrome, attention deficit disorder and attention deficit and hyperactivity disorder, and auditory processing disorder. See Table 1 for participants' specific diagnoses. Additionally, all participants in the sample are bilingual with 50% (*N* = 3) of students' native language being English. The study first received consent from the school and the guardians of the students (see Appendix A). Participants were also given an assent form to inform them about the study and what they would be asked to do (see Appendix B).

### Instruments

#### *Pilot Study*

A pilot study was carried out for the vocabulary assessment included in the study, which assessed vocabulary knowledge after studying with flashcards. Prior to the start of the intervention, a pilot study was conducted to ensure that the definitions and sentences

provided in the assessment were clear. A sample of five students without learning difficulties from eighth grade attending the same school as the participants that were not later included in the experiment were prompted to complete the vocabulary assessment, and express any difficulties or misunderstandings related to the definitions and sample sentences presented. The assessment took on average 16 minutes to complete. Based on feedback from the participants, two definitions were modified in the vocabulary assessment.

### *Background Questionnaire*

The background questionnaire was adopted from Sage and colleagues (2019) and only slightly modified to ensure participants' understanding of the questions. The questionnaire was administered to the participants asking questions relating to their past flashcard use and perceptions of their helpfulness. All items were identical to the original questionnaire except for two parts. Specifically, the word "purpose" used previously was changed to "reason" and "study strategy" was omitted from "how helpful are flashcards as a studying strategy?" and replaced with "for learning new words". With the use of a 5-point Likert scale, participants' preference for paper or digital materials, and their perceived usefulness were assessed. The scale consists of ten items (e.g., do you prefer your class materials on paper or online?) (See Appendix C).

### *Academic Vocabulary Word List*

A total of 50 vocabulary words were selected for this study (see Appendix D). The academic vocabulary words were selected with the use of the glossary section of a history and English textbook, currently used by the school in which the participants attend. The vocabulary words were selected with the collaboration of the seventh-grade English

teacher currently working and teaching the participants at the school. The list was created

based on several criteria. First, the words chosen were selected using the history and

English textbooks included in the students' curriculum. Secondly, the words were

evaluated and rated by the teacher as relevant and most likely unknown to the participants.

To ensure unknown words, a preliminary test was conducted with the participants to

finalize the vocabulary word list for the intervention. Additionally, fifteen of the words

included in the vocabulary assessment were filler words. Therefore, the filler words were

not included in the intervention and as such, they were not selected following the criteria

previously described.

The definitions provided, are derived from an online dictionary, *Merriam-Webster*

*Learner's Dictionary* (Merriam-Webster, 2018), which include student-friendly definitions,

with simple explanations. This online dictionary also provides example sentences for each

target word which are also included in the present study.

***Vocabulary Assessment***

The vocabulary assessment was administered as a pre- and post-test to the

participants. The test contained the 50 words derived from the academic vocabulary list

which was developed for the current study. The test included two sections: matching and

gap-filling. The gap fill portion of the test was an adapted and modified version of the

Productive Vocabulary Levels Test (PVLT) developed by Schmitt and colleagues (2001).

This section of the assessment measured participants' productive knowledge with gap fill

sentences and a word bank to choose the correct missing word (E.g., The mother's apology

_____ the pain and sadness her child felt; mitigated) (see Appendix E). The second section

of the assessment measured participants' receptive knowledge with a matching exercise. In

this section, participants were asked to match the vocabulary term to its corresponding definition (see Appendix F). The total score of participants was the sum of their overall answers with possible scores ranging from 0 to 1.

### *Paper flashcards*

The researcher prepared flashcards for each participant for the intervention phase of the study. The flashcards were created using index cards and the vocabulary terms and corresponding definitions with an example sentence were handwritten. Fifteen flashcards were prepared for each participant depending on their performance on the pretest administered. The words included were those marked incorrectly and unknown by the participants. More particularly, the words were examined and split between the two interventions based on specific criteria. The criteria include the following: the word length, similarity in appearance or sound, and the meaning (O'Connor et al., 2019). The definitions and example sentences provided are derived from *Merriam-Webster Learner's Dictionary* (Merriam-Webster, 2018). See Appendix G for a sample flashcard.

### *Digital Flashcards*

The digital flashcards used for the intervention phase of the study were created through the online website Quizlet. The vocabulary word was filled in on the term side and the corresponding definition, example sentence and an image are presented on the opposite side (see Appendix H). Fifteen flashcards were prepared for each participant depending on their performance on the pretest administered. The words included were those marked incorrectly and unknown by the participants. The participants were presented with the digital flashcards on a tablet device.

Quizlet is a powerful online platform, which allows users to study and learn vocabulary through a set of flashcards, incorporating several features. It is one of the most well-known technology platforms for flashcards, and is available for desktop, tablet, and mobile use. Quizlet has around 60 million monthly users with over 500 million study sets created (Quizlet, 2021). The flashcard sets which were created, consist of terms for the lexical side and corresponding definitions in which pictures may also be added. This program comes with a collection of features that can help students enhance their learning of new material. These features include flashcards, spelling, learning through multiple choice or filling in the correct term, a matching game, and a test. Each of these features targets either receptive or productive knowledge (Dizon & Tang, 2017). Previous research on Quizlet supports its effectiveness in vocabulary learning across ages, academics, bilingual learners, and languages (Dizon & Tang, 2017; Yüksel et al., 2020).

On the *Flashcard* feature, learners can review the words, in the same manner, they would review vocabulary with the paper flashcards. Users are given a choice about which side of the card to display during this feature. The *Learn* feature allows users to view one side of the card and are then asked to either type the content of the opposite side or choose the correct term from multiple choice. The words which are responded to incorrectly will be presented repeatedly until the learner can successfully provide the correct response. Lastly, the *Match* feature is a game, in which users are timed and required to match both sides of the flashcards, by dragging them together for the words to disappear. The features mentioned above were all utilized during the intervention with the participants.

### *Perceptions of flashcard type*

The questionnaire was adopted from Dizon and Tang (2017) which asked participants questions regarding their perceptions of each flashcard type. Participants responded to statements based on their agreement to each (1 = 'strongly disagree', 5 = 'strongly agree'), indicating their preference for each flashcard method. The scale consists of sixteen items (e.g., using paper flashcards made it easier to learn English vocabulary) (see Appendix H). The total score of participants was the sum of their overall answers with possible scores ranging from 16 to 80 (see Appendix D).

## Procedure

The study was carried out in a classroom during the learning center sessions in which the participants currently attend. The study first received approval from the Institutional Review Board (IRB) at the American College of Greece. The school in which the students attend, and their guardians were provided with an informed consent to describe the nature of the study. Participants of the study were also provided with an assent form describing the nature of the study and the activities which would be asked of them to complete. Data was collected by using a pre-intervention survey, three academic vocabulary tests, and a post-intervention survey.

### *Pre-Intervention phase*

Prior to the start of the intervention, students completed a test assessing their current vocabulary knowledge through the academic vocabulary list developed for the study. Of the 50 words assessed which also included the filler words, the list was narrowed down to a total of 30 words for the intervention portion of the study. The preliminary assessment was carried out to ensure that the words studied and assessed during the

intervention were unknown to the students. The two sub lists were created and separated into different sets based on words that were similar in their appearance or sound (*adequate, advantage*) or meaning (*erratic:* not consistent or unsteady and *fluctuate:* to vary irregularly). Additionally, participants completed a brief background questionnaire asking them questions relating to their past flashcard use and perceptions of their helpfulness.

### *Intervention phase*

The intervention, consisting of 2 phases (3 weeks per phase), lasted for a total of 6 weeks. All participants in the study completed both phases of the intervention. The participants were provided with a total of 30 academic vocabulary words for the intervention phase of the study. The word list was split into two sub-lists in which each was studied through paper or digital flashcards. The first sub-list consisting of 15 words, was distributed to the students with digital flashcards (DF), and the second sub-list also consisting of 15 words was studied with paper flashcards. The DFs were prepared with the use of the learning application Quizlet. The participants met with the researcher twice a week during their learning center hours and studied the flashcards with the researcher for the first 15 minutes of class. Participants were presented with five words per week to reduce a large cognitive load. Each week, five additional words from the sub-list were added to their flashcard set. The materials were kept by the researcher and brought to the class each session.

### *Post-Intervention phase*

At the end of each intervention phase, participants were given the same test administered in the pre-intervention phase with the relevant vocabulary words included in each sub-list. This test was completed by participants to assess their receptive and

productive vocabulary knowledge after studying the vocabulary words with each flashcard method. Participants were first administered the modified version of the PVLT followed by the matching portion to exclude definitions provided by the matching section prior to completing the PVLT. Participants did not have a time limit to complete the test. Following the completion of both vocabulary tests at the end of the intervention, participants completed the questionnaire assessing their perceptions of each flashcard method.

**Design**

The research methodology used for this study is a quasi-experimental design. A quasi-experimental design was chosen because participant's placement in the learning center classroom was pre-determined. The independent variable in the study was the treatment condition using a within design with two levels: paper flashcards and digital flashcards. The outcome measure was the assessment on vocabulary knowledge for each condition based on the number of items they could name correctly in the post-intervention test. Additionally, preference of flashcard type was examined as a predictor for test performance.

## Results

The purpose of this research study was to examine the effect of a digital flashcard intervention compared to a paper flashcard intervention on students with learning difficulties learning academic vocabulary.

A background questionnaire was administered to the participants asking them questions related to their past flashcard use and perceptions of their helpfulness. Participants' responses on this questionnaire were analyzed individually, calculating scores for each item on the questionnaire. Possible answers to each item ranged from either (1 = 'never', 5 = 'always') or (1 = 'totally disagree', 5 = 'totally agree') depending on the question in the survey. A descriptive analysis was conducted to determine frequencies for each response. From the responses, 50% of the participants reported they sometimes use flashcards and 33% only rarely use flashcards. Additionally, most participants generally agreed that flashcards are helpful for learning new words (66.6%). Although most participants reported in the questionnaire that they often use printed textbooks instead of an online textbook 66.6%, they would prefer to use online textbooks (83.3%) (see Table 2).

**Differences in Total Test Scores for Paper and Digital Flashcard Conditions**

Due to the small sample size of the study (N=6), a normality test was carried out before conducting the analysis. The results of the analysis indicated that there was normality in the data, $p > .05$, therefore a parametric test was carried out. The participants scores on the vocabulary test after studying the digital flashcards were compared with their scores after studying the paper flashcards. A paired samples t-test was conducted to determine if test performance in each condition was statistically significant. The student's total mean vocabulary test score was higher in the digital flashcard (DF) condition

(M=25.83, SD=2.71) than in the paper flashcard (PF) condition (M=10.33, SD=1.86); yielding a statistically significant difference between the two treatment conditions t(5)=11.396; p < .0001 (see Table 3). This finding suggests that in the DF condition participants learned more academic vocabulary than they did with PFs.

**Differences of Receptive and Productive Vocabulary Knowledge Between Conditions**

Additionally, a paired samples t-test was conducted to compare type of vocabulary knowledge gained across the two conditions to further investigate the extent to which students learned the academic vocabulary in the digital flashcard condition. The results from the analysis yielded a statistically significant difference in test scores between the DF condition and the PF condition in receptive vocabulary knowledge, t(5) = -14.1; p < .0001. Participants scored higher in the receptive sub section of the DF condition (*M*=15) compared to their test scores in the PF condition (*M*=6.3), contributing to the previous finding of the effectiveness of DFs for learning academic vocabulary when compared to PFs. Likewise, the analysis revealed a significant difference t(5) = 4.39; p =.007, between mean test scores in the productive sub section of vocabulary knowledge. Specifically, students' scores were higher in the DF condition (*M*=10.83. SD=2.71) as opposed to their scores in the PF condition (*M*=4.0, SD=1.79). These findings further expand the effect of digital flashcards on students' vocabulary development in both receptive and productive vocabulary knowledge (see Table 3).

**Differences of Receptive and Productive Vocabulary Knowledge Within Conditions**

An additional paired samples t-test analysis was conducted to compare the posttest scores of receptive vocabulary knowledge and productive vocabulary knowledge across conditions. The results of the analysis yielded a marginally significant difference of

receptive and productive vocabulary knowledge in the DF condition, t(5)=3.76; p<.05. The mean scores of the receptive sub section of the vocabulary test were higher (*M*=15.0) than the productive section of the vocabulary test (*M*=10.83) however the difference was only marginally significant. On the other hand, the mean test scores of receptive vocabulary knowledge (M=6.33) and productive vocabulary knowledge (*M*=4.0) in the PF condition did not produce statistically significant results t(5)=2.09; p>.05, indicating type of vocabulary knowledge acquired did not differ in the PF condition (see Table 4).

A factorial repeated measures ANOVA was conducted to further investigate differences between receptive and vocabulary knowledge in each condition. An interaction between intervention and type of knowledge was not found to be significant $F(1, 5)$=.894, p=.388, partial $\eta^2$=.152. The results of this analysis echoed the findings from the paired samples t-test, suggesting that the type of vocabulary knowledge acquired by the participants did not differ when comparing the two conditions.

**Preference of Flashcard Method**

A Wilcoxon signed rank test was performed to determine whether participants preferred one type of flashcard method over the other. Participants were administered the *Perceptions of Flashcard Type* questionnaire post intervention to assess their perceptions of each flashcard method. Results from the analysis indicated that participants' preference of digital flashcards over paper flashcards was marginally significant z = -2.214, p=.027. Despite the marginal significance, the use of DFs was preferred (M=30.33) over the use of paper flashcards (M=14.33).

**Correlation of Preference of Flash Card Type and Test Scores**

A Spearman correlation was conducted to assess the relationship between preference of flashcard type and test performance. The results of the analysis indicated a weak correlation between the preference of digital flashcards and performance on both the paper flashcard condition $r_s$= -.18, p=.73, $N$=6 and the digital flashcard condition, $r_s$=.36, p=.49, $N$=6. The results also indicated a weak correlation between preference of paper flashcards and test performance on both the digital flashcards condition, $r_s$= -.19, p=.73, $N$=6 and the paper flashcards condition, $r_s$= -.49, p=.32, $N$=6.

## Discussion

The purpose of this study was to evaluate the effectiveness of using digital flashcards when compared to paper flashcards in reviewing new academic vocabulary regarding secondary students with LDs. The current study is the first of which compared the effects of digital and paper flashcards on academic vocabulary acquisition among secondary-level students with LDs. Overall, the findings of this research, suggest that digital flashcards are a valuable tool to enhance students with learning disabilities' academic vocabulary knowledge. The findings certainly indicated the effectiveness of digital flashcards and specifically Quizlet, over the traditional paper flashcard method. Receptive and productive vocabulary knowledge was assessed to determine the degree to which participants acquired the new academic vocabulary terms, and more particularly if they were able to surpass the recognition of the definition and be able to apply it in a novel context. Participants' receptive and productive vocabulary knowledge substantially increased in the digital flashcard intervention as opposed to the paper flashcard

intervention. Additionally, preference for type of flashcard and performance on the assessment, did not present with an association between the two.

Methods for vocabulary learning have received extensive attention in the previous decades. Investigating different strategies, applications, and methods for acquiring vocabulary knowledge across ages, languages, and populations has been a growing concern (Byrd & Lansing, Dizon & Tang, 2017; 2016; Sage et al., 2019). Quizlet was the chosen application for the technology-based flashcard intervention which equips learners with multiple features to enhance their learning. The effectiveness of each method was evaluated based on student performance on a vocabulary test administered by the researcher. Furthermore, receptive, and productive vocabulary knowledge was also investigated in each condition as an additional variable to assess the extent to which students were able to learn the new academic vocabulary words. Data on learners' perceptions of the flashcard methods was also gathered through quantitative data from a questionnaire. This research utilized a within subjects' design, to test four hypotheses formulated based on previous research and the principles and assumptions found in Mayer's CTML.

The present research focused on academic vocabulary, which was developed using students' history and English textbooks, reflecting vocabulary encountered in all subject courses (McKeown et al., 2018; O'Connor et al., 2019; William & Martinez, 2019). Research suggests that educators should select material from content-area textbooks when choosing to focus on academic vocabulary for secondary level education (Baker et al., 2014; Williams & Martinez, 2019). Limited exposure to new vocabulary and instructional methods that do not consider weaknesses of students with LDs, increases the likelihood of

low academic achievement and profound difficulties with comprehension. Therefore, increasing academic vocabulary knowledge allows students to progressively comprehend more complex text encountered in their coursework (Perfetti & Stafura, 2014).

The main hypothesis of the study expected participants to attain higher scores on the vocabulary assessment after studying the digital flashcards when compared to the traditional paper flashcards. The first hypothesis was confirmed, indicating the effectiveness of digital flashcards when compared to paper flashcards for academic vocabulary acquisition with secondary students with LDs (see Figure 1). Particularly, the chosen application for the present study, Quizlet, significantly increased participants' vocabulary acquisition, and thus their performance on the post-test. Students in secondary grades, encounter several complex academic vocabulary words in subject area texts daily which significantly provide meaning to the text (McKeown et al., 2018; Sanchez & O'Connor, 2021; Williams & Martinez, 2019). With the use of a technology-based educational program, learners can tackle unknown words and learn using its' multimodal nature. Students with LDs frequently face difficulties with interpreting and evaluating material from their courses when early reading skills have not been mastered (Beach et al., 2015).

This finding echoes the outcomes of previous research which also found greater improvements in vocabulary acquisition when comparing technology-based flashcards with paper flashcards (Basoglu & Akdemir, 2010; Byrd & Lansing, 2016; Yuksel et al., 2020). Additionally, technological activity-based methods which engage learners in interactive activities are generally found to be effective for teaching students with learning difficulties (Jitendra et al., 2004; Kuder, 2017). However, it is important to note that the

previous research stated did not include students with LDs when comparing the two flashcard methods. Although the context, type of vocabulary targeted, and group of learners, varied across studies, their findings revealed that DFs lead to significant gains in vocabulary acquisition.

Grillo and Dieker (2013) are the only other researchers that the author is aware that included secondary students with LDs when comparing the effectiveness of digital and paper flashcards for learning vocabulary. However, this research did not focus on academic vocabulary. Instead, they focused specifically on biology related vocabulary and data was also collected with post tests and course grades. The results of this study found that both interventions produced significant improvements in course grades and vocabulary acquisition, which do not align with the findings of this research. The effectiveness of both flashcard methods may be partly explained by the use of technical vocabulary selected from students' course materials. This in essence may motivate students to learn the material despite the method of instruction because participants were later assessed in their classes on content related to the vocabulary. Similarly, other studies have also found equal effects of paper flashcards and digital flashcards on vocabulary acquisition, contrasting the results of the present research (Dizon & Tang, 2017; Sage et al., 2019, 2020). When self-created and teacher-made flashcards studied with paper, computer and tablet means were compared, Sage and colleagues (2019), found that students learned the vocabulary equally from paper and tablet devices. Nevertheless, digital flashcards were shown to produce vocabulary knowledge gains despite the lack of difference in improvement when compared with paper flashcards.

Additionally, the effectiveness of a digital flashcard intervention supports principles and claims from the Cognitive Theory of Multimedia Learning (CTML) which stated that new knowledge can be acquired through materials presented in both pictures and words (Mayer, 2008; Mayer & Sims, 1994). The inclusion of multimedia technology offers educators an opportunity to create technology-based instructional materials for students with learning difficulties in such a way in which motivation and engagement is increased (Kennedy & Deshler, 2010; Kennedy et al., 2015; Li & Tong, 2018). In the digital flashcard condition in which participants learned academic vocabulary with Quizlet, they were not only exposed to the definition, but to an image illustrating the definition of the target word. The image added to each academic vocabulary definition, may have facilitated students in recalling the definition of each word. The 'multimedia principle' states that deeper learning can occur when instructional material is presented in both text and images (Mayer & Moreno, 1999; Mayer & Valdez, 2005). The addition of visual material is processed both independently, building a mental representation of the material, and in combination with the verbal stimuli, building referential connections. The use of verbal and visual stimulus is supported by the notion that the human mind possesses separate channels for processing auditory and visual information and each channel is limited in the amount of information which can be processed (Baddeley & Hitch, 1974; Chandler & Sweller, 1991; Paivio, 1974).

The type of vocabulary knowledge attained was additionally compared across conditions to further investigate the extent to which students learned the academic vocabulary in the digital flashcard condition when compared to their performance in the paper flashcard condition. Receptive or passive knowledge is defined as the ability to

understand and recognize a word when displayed in a text or through listening (Webb, 2005, 2008). In the present study, this was assessed through a matching activity whereby participants were required to match the academic vocabulary word to its definition. This task required students to only recall and recognize the definition they were exposed to during the intervention. Conversely, productive, or expressive knowledge refers to the ability to produce the word and express understanding by applying it in writing or speech. This type of knowledge was assessed in the present study through fill in the blank sentences, where participants were required to access the definition from their memory and apply it in a novel sentence correctly. When students' receptive and productive vocabulary knowledge was compared across the two conditions, the analysis revealed that the Quizlet intervention increased students' receptive vocabulary knowledge significantly more when compared to their scores in the paper flashcard condition. Likewise, when students' productive vocabulary knowledge was compared across the two conditions, the difference in mean scores was also significant, indicating a great advantage of a technology-based flashcard method (see Figure 1). This finding further contributes to the superiority of a technology-based flashcard method to learning academic vocabulary. However, previous research comparing the types of knowledge between groups did not find significant differences (Dizon & Tang, 2017). The results from Dizon and Tang (2017) may be explained using vocabulary learning strategies in the paper flashcard condition which were not included in the present research or relevant to the participant's characteristics which did not match to the sample of the present study.

The second hypothesis expected participants to perform better in the receptive sub sections of the vocabulary assessments when compared to the productive measures of the

assessment in both flashcard interventions. The results from the analysis suggested only a marginal significance between the two types of knowledge in the DF condition with a trend of receptive vocabulary knowledge scores being higher. Further, the analysis did not reveal a significant difference in receptive and productive knowledge in the PF condition. Due to the inconsistent results among the two conditions in relation to type of vocabulary knowledge acquired, the author decided to further investigate the interaction between intervention type and type of knowledge. The findings suggested that the type of vocabulary knowledge acquired by the students did not differ when comparing the two conditions. Thus, the second hypothesis cannot be confirmed with confidence due to the marginal significance of receptive vocabulary knowledge in the DF condition. A lack of statistically significant difference found between type of knowledge gained in the PF condition further contributed to the rejection of the second hypothesis. The results contradict the claims of previous researchers (O'Connor et al., 2019; McKeown et al., 2018) which found small effects of productive vocabulary knowledge measures and large effects of receptive vocabulary knowledge measures in students with and without learning difficulties. In these studies, students with and without learning difficulties had difficulty applying learned vocabulary to novel sentences and passages that required deeper word knowledge.

Several explanations can be made for the results found regarding the second hypothesis. Firstly, if the results from the first hypothesis are considered, participants did not perform as well on the assessments in the PF condition when compared to the DF condition. Thus, major differences between receptive and productive vocabulary knowledge would not be expected in this condition if participants generally performed

poorly on in the assessment. Additionally, since the measures of the DF condition provided evidence for its effectiveness; the receptive vocabulary knowledge gained in this condition was more likely to be higher than the productive vocabulary knowledge gained. A larger sample size could indicate more significant results for this difference. However, an alternative explanation for this finding may be that individuals with learning difficulties typically have limited academic vocabulary knowledge, which would increase the difficulty and complexity of acquiring deeper processing of word knowledge (Beach et al., 2015; Fore et al., 2007; Roberts et al., 2008). Although Quizlet provides learners with various activities to learn vocabulary words and fosters a self-reliant method to learning academic vocabulary, more explicit instruction may be required to access deeper learning of vocabulary words (Nitzkin et al., 2014)

The third hypothesis of the study was not confirmed, suggesting that participants did not prefer one type of flashcard method over the other. However, the analysis revealed a marginal significance with students favoring DFs over PFs. The results neither confirm nor contrast the findings of previous research which provided evidence for the preference of digital flashcards (Basoglu & Akdemir, 2010; Dizon & Tang, 2017). The participants in these studies displayed favorable attitudes toward the usefulness and facilitated use of digital flashcards. Although, students in the current study performed significantly better in the DF condition as opposed to the PF condition. Their preference marginally supported this finding. The inconsistency between the results of the analysis for preference of digital flashcards and test performance may result from two alternative explanations. First, due to students' age, they may not be aware of their preferences because test performance on the DF condition varied significantly with the PF condition. Another explanation for this

inconsistency may be due to the sample size. More participants could indicate a stronger statistical significance of preference since responses reported in the questionnaire indicated a trend in favor of digital flashcards.

The final hypothesis of the current study was not confirmed, indicating a weak relationship between flashcard method preference and test performance. More specifically, students' preference of the digital flashcards did not relate to their performance on the vocabulary assessment nor did their preference of the paper flashcards. This finding was expected based on the previous analysis which failed to identify a preference of one flashcard intervention over the other.

**Clinical Application/Implications for practice**

Taken together, the findings of this study, in addition to the consideration of previous research can be applied in both the educational and clinical setting for adolescent learners. Technology-based flashcard interventions can be applied to students in the general education program and in the learning support classrooms to enhance vocabulary learning. In the general education classrooms, digital flashcards can create a more inclusive environment which will incorporate different strategies to benefit all students. Quizlet can be opted and replaced with the traditional vocabulary teaching methods educators usually select. Instead of students simply searching for a definition and writing it in their notebooks, they can create their own flashcard sets using Quizlet. Educators can assist students in becoming more independent learners both inside and outside the classroom. The findings of this research suggest that based upon the repetitive and interactive nature of media based instructional materials, educators inside and outside school can be provided with a powerful tool to promote vocabulary development and support direct instruction for

students with and without learning difficulties. Educators and learning specialists should consider the outcome of this study and previous research incorporating technology-based activities when planning lessons for students with learning difficulties. Additionally, focusing particularly on support services offered to students with LD, digital flashcards can be applied in this setting when working on vocabulary development related to their academic coursework and as an independent intervention for strengthening their working memory.

**Limitations and Recommendations for Future Research**

As in any study, there are several aspects of this research that limit the generalizability of the findings. Firstly, a major limitation of this study was the small sample size of only six participants. Although the positive effects of the digital flashcard intervention were shown to be significant, the small sample size affected the ability to generalize the findings and may have affected the overall results. Furthermore, the assumption of normality in the statistical analysis was met, however, the results may or may not be representative of findings resulting from a larger sample size of secondary students with LDs.

Another limitation to this study relates directly to the materials and components of each intervention. The differences between the paper and digital flashcards in relation to the content included were large. Specifically, the paper flashcards of this research only included text, whereas the Quizlet flashcards included images in addition to the various features the application has to offer. The differences in effectiveness of the two interventions found may be partly due to the nature and content available in the paper flashcard method. As the Cognitive Theory of Multimedia Learning suggests, deeper

learning occurs when material is presented both visually and verbally (Mayer, 2005). The Quizlet application, provided participants with a visual, text and auditory functions to foster vocabulary learning. The paper flashcards on the other hand, provided participants with only text. A possible solution to this limitation could be to create a third condition which would include paper flashcards with images to investigate whether the differences between digital and paper flashcards can be explained through the addition of pictures or if technology and its multimodal nature make the difference.

Several results of this research were marginally significant, as noted previously, in which a larger sample would most likely clarify and alter the significance. Researchers should continue investigating digital flashcards and consider including a larger sample of participants with learning difficulties to generalize the findings of this research.

Furthermore, a limitation necessary to mention is that the sample of the present study was not homogeneous, meaning that the diagnoses and difficulties of students varied from one another. Although all participant's diagnoses impact their learning to a certain extent, the diversity of the sample may be considered a threat to the study's validity. Future research should consider conducting the same study but instead including a homogenous group of individuals in relation to the learning difficulty they present with.

Adding to the diversity of the sample, participants of the study were also bilingual with some being native in another language besides English. Second language learning contributes to vocabulary knowledge and acquisition which may be viewed as a confounding variable in the present research.

Due to time constraints, the present study could not investigate the maintenance of vocabulary learning, which would further analyze and indicate the effectiveness of a digital

flashcard intervention. A delayed posttest would have provided insight on how well technology-based flashcard methods such as Quizlet, affect long term retention of vocabulary when compared to paper flashcards. Students with learning difficulties present with working memory and central executive deficits which in turn affects their learning and retention of new material (Beach et al., 2015; Kuder, 2017). Quizlet, which provides a variety of activities and approaches for learning vocabulary, may facilitate and promote long term retention of vocabulary. Future research should also consider including a delayed posttest assessment to assess learners long term memory in learning the vocabulary.

Overall, research should continue investigating digital flashcards by evaluating the various features of Quizlet and other technologically based mediums individually on students' performance and motivation to learn. By including multiple conditions, main effects of each feature and interaction effects may be identified. Additionally, comparing digital flashcard programs amongst each other, will allow educators to choose from multiple platforms.

**Conclusion**

Overall, during a time when technology is highly immersed in educational practices, it is important to investigate how technology can be used with students with LDs to their advantage regarding vocabulary acquisition. More specifically, educators and researchers face difficulties with teaching academic vocabulary to secondary-level students with LDs (Beach et al., 2015; Jitendra et al., 2004). Current findings advance our understanding on how technology-based methods can be applied to benefit students with LD concerning their academic vocabulary development. In particular, the multimodal

nature of digital flashcards, allow learners to engage in interactive activities and receive

immediate feedback on their progress.

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Table 1

*Student Demographic Information*

| Student | Gender | Age | Grade | Ethnicity | Diagnosis |
|---|---|---|---|---|---|
| 1 | Male | 13/5 | 7 | Greek | Asperger's Syndrome |
| 2 | Male | 13/4 | 7 | Greek | Specific LD + ADHD |
| 3 | Female | 13/2 | 7 | Greek | ADD and Low IQ |
| 4 | Male | 12/11 | 7 | Greek | Specific LD |
| 5 | Female | 12/7 | 7 | Greek | Specific LD |
| 6 | Female | 12/4 | 7 | Greek | Specific LD + ADHD |

*Age in years and months

Table 2

*Frequencies of responses for background questionnaire*

| Question | Frequency (n) | Percentage (%) |
|---|---|---|
| How often do you use flashcards? | | |
| Rarely | 2 | 33.3 |
| Sometimes | 3 | 50 |
| Often | 1 | 16.7 |
| Do you think flashcards are helpful for learning new words? | | |
| Neither disagree nor agree | 2 | 33.3 |
| Agree | 4 | 66.7 |
| Do you prefer to use paper instead of online flashcards? | | |
| Sometimes | 3 | 50 |
| Often | 3 | 50 |
| Do you use a printed textbook instead of an online textbook? | | |
| Sometimes | 2 | 33.3 |
| Often | 4 | 66.7 |
| Do you prefer to use paper textbooks? | | |
| Disagree | 5 | 83.3 |
| Agree | 1 | 16.7 |
| Do you prefer to use paper over online materials for your classes? | | |
| Rarely | 2 | 33.3 |
| Sometimes | 2 | 33.3 |
| Often | 2 | 33.3 |
| Do you prefer your class materials to be in paper instead of online? | | |
| Disagree | 3 | 50 |
| Neither disagree nor agree | 3 | 50 |
| How often do you use tablets for any reason? | | |
| Rarely | 3 | 50 |
| Often | 3 | 50 |
| How often do you use desktop computers for any reason? | | |
| Never | 2 | 33.3 |
| Rarely | 3 | 50 |
| Sometimes | 1 | 16.7 |
| How often do you use laptops for any reason? | | |
| Often | 3 | 50 |
| Always | 3 | 50 |

Table 3

*Paired Samples t-test analysis for test performance across conditions*

| Outcome | DF | | PF | | n | df | t | p |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | | | | |
| Receptive | 15.0 | 0 | 6.33 | 1.51 | 6 | 5 | -14.10 | <.0001 |
| Productive | 10.83 | 2.71 | 4.0 | 1.79 | 6 | 5 | 4.39 | .007 |
| Total | 25.83 | 2.71 | 10.33 | 1.86 | 6 | 5 | 11.40 | <.001 |

Table 4

*Paired Samples t-test analysis for type of vocabulary knowledge acquired across conditions*

| Condition | Receptive | | Productive | | n | df | t | p |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | | | | |
| DF | 15.0 | 0 | 10.83 | 1.86 | 6 | 5 | 3.76 | <.05 |
| PF | 6.33 | 1.51 | 4.0 | 1.79 | 6 | 5 | 2.09 | >.05 |

Figure 1
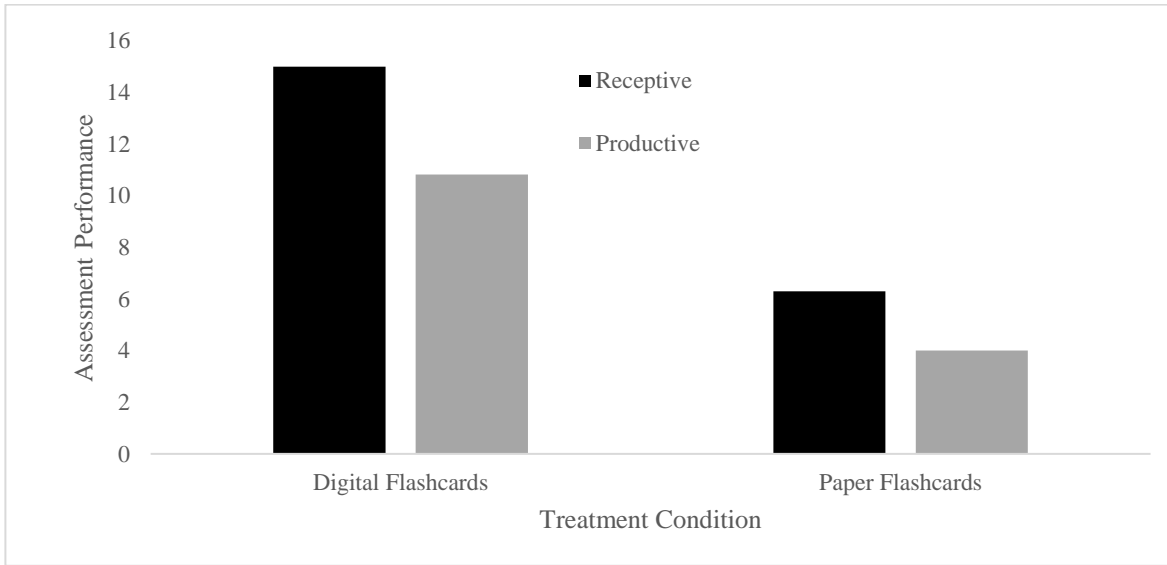
Appendix A

Informed Consent

Dear ISA,

I am Faye Sinou, a graduate student from the Applied Educational Psychology program at The American College of Greece. I kindly request permission for a group of students from the Learning Center to participate in a research study to be used for my dissertation. I am conducting a research study to compare the effectiveness of flashcards (digital and paper) as a method for teaching academic vocabulary to students with learning differences.

**Benefits:** The benefits of the students' participation include enhancing their academic vocabulary and introducing them to a platform which may increase their study skills in the future. Additionally, we hope to use what we learn from the study to apply new teaching methods for learning material.

**The study consists of the following activities:**

1.  If you allow the students to participate, they will be asked to study 2 sets of flashcards over the course of about 6 weeks. Each study session will only last for the first 10 minutes of the learning center lesson.
2.  They will be administered a vocabulary test after the 3 weeks of studying each flashcard set.
3.  They will also be asked to answer two brief questionnaires about their previous flashcard use and their opinions of the two methods after the intervention will be completed.

**Confidentiality:** Student's responses will be kept confidential. Their data and identity will be accessible only to the principal investigator and the co-investigators of the present study. When research results are reported, responses will be added together and described in summary.

**To Contact the Researcher:** If you have questions or concerns about this research at any time, please contact: Faye Sinou, Email: f.sinos@acg.edu.

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| This research study has been reviewed and approved by the Institutional Review Board of The American College of Greece. |
|---|

Name and signature of main investigator(s):_____

**I have read and understood the information provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.**

**Signature** _____          **Date** _____

Appendix A (Continued)

Informed Consent

Dear Parent or Guardian,

I am Faye Sinou, a graduate student from the Applied Educational Psychology program at The American College of Greece. I kindly ask for permission for your child to participate in a research study to be used for my dissertation. I am conducting a research study to compare the effectiveness of flashcards (digital and paper) as a method for teaching academic vocabulary to students with learning differences. Flashcards are small note cards used for learning and improving memory through practiced information. Flashcards are two-sided, with the vocabulary word on one side and the definition on the other side.

**Benefits:** The benefits of your child's participation include enhancing their academic vocabulary and introducing them to a platform which may increase their study skills in the future. Additionally, we hope to use what we learn from the study to apply new teaching methods for learning material.

**The study consists of the following activities:**
1. If you allow your child to participate, they will be asked to study 2 sets of flashcards over the course of about 6 weeks. Each study session will only last for the first 10 minutes of the learning center lesson.
2. They will be administered a vocabulary test after the 3 weeks of studying each flashcard set.
3. They will also be asked to answer two brief questionnaires about their previous flashcard use and their opinions of the two methods after the intervention will be completed.

**Confidentiality:** Your child's responses will be kept confidential. Their data and identity will be accessible only to the principal investigator and the co-investigators of the present study. When research results are reported, responses will be added together and described in summary.

**To Contact the Researcher:** If you have questions or concerns about this research at any time, please contact: Faye Sinou, Email: f.sinos@acg.edu.

This research study has been reviewed and approved by the Institutional Review Board of The American College of Greece.

Name and signature of main investigator(s):_____

**I have read and understood the information provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.**
**Your signature on this consent form is necessary to verify that you are fully informed about your child's participation as a volunteer**

**Signature** _____          **Date** _____

Appendix B

Assent Form

Dear Student,

This document provides you with important information about the research study you are being asked to take part in. Please read the following carefully! When you have finished reading this form you should know what the research study is about, what you will be asked to do and what the risks and benefits are. If you agree to participate, you will be asked to sign this form.

**PURPOSE OF STUDY:**
We are doing a research study involving flashcard methods for learning new vocabulary words. Flashcards are small note cards used for learning and improving your memory through practice.

**RESEARCH PROCEDURES:**

1. If you choose to participate, you will be asked to study sets of flashcards over a 6-week period. Each study session will only last for the first 10 minutes of the learning center lesson.
2. You will be given a short vocabulary assessment after 3 weeks of studying each flashcard set.
3. You will also be asked to answer two short asking for your opinions on the topic.

**RISKS AND BENEFITS:**
There are no known risks to participating in the study.
The benefits of your participation include improving your vocabulary and introducing you to a platform which you may use in the future with your other classes and in the learning center. We may also learn something that will help other students and teachers with teaching vocabulary.

When we are finished with this study, we will write a report about what was learned.  This report will not include your name or that you were in the study. All the information you provide will be kept private.

You do not have to be in this study if you do not want to be.  If you decide to stop after we begin, that's ok too. Your parents know about the study too.

If you decide you want to be in this study, please sign your name.

I, _____, want to be in this research study.


_____          _____
        (Sign your name here)                                    (Date)

Appendix C

Background Questionnaire

**Directions:** Please circle your responses based on what is being asked in each question provided below.

1. **How often do you use flashcards?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

2. **Do you think flashcards are helpful for learning new words?**

| 1 – totally disagree | 2 – disagree | 3- neither disagree or agree | 4 – agree | 5 – totally agree |
|---|---|---|---|---|

3. **Do you prefer to use paper instead of online flashcards?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

4. **Do you use a printed textbook instead of an online textbook?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

5. **Do you prefer to use paper textbooks?**

| 1 – totally disagree | 2 – disagree | 3- neither disagree or agree | 4 – agree | 5 – totally agree |
|---|---|---|---|---|

6. **Do you prefer to use paper over online materials for your classes?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

7. **Do you prefer your class materials to be in paper instead of online?**

| 1 – totally disagree | 2 – disagree | 3- neither disagree or agree | 4 – agree | 5 – totally agree |
|---|---|---|---|---|

8. **How often do you use tablets for any reason?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

9. **How often to you use desktop computers for any reason?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

10. **How often do you use laptops for any reason?**

| 1 – never | 2 – rarely | 3 – sometimes | 4 – often | 5 - always |
|---|---|---|---|---|

Appendix D

Academic Vocabulary Words

| | | |
|---|---|---|
| 1. Adequate | 18. Intensify | 35. Voluntary |
| 2. Advantage | 19. Investigate | 36. Aware |
| 3. Appoint | 20. Insinuate | 37. Agreement |
| 4. Boycott | 21. Limited | 38. Combine |
| 5. Coincide | 22. Mitigate | 39. Confident |
| 6. Comprehend | 23. Manifest | 40. Confirm |
| 7. Contemplate | 24. Manage | 41. Express |
| 8. Devoted | 25. Malevolent | 42. Introduce |
| 9. Develop | 26. Obtain | 43. Improve |
| 10. Employ | 27. Ordinary | 44. Identity |
| 11. Erratic | 28. Perspective | 45. Necessary |
| 12. Emphasize | 29. Reluctant | 46. Obvious |
| 13. Fluctuate | 30. Resolve | 47. Participate |
| 14. Fortunate | 31. Require | 48. Recommend |
| 15. Guarantee | 32. Recognize | 49. Receive |
| 16. Indulge | 33. Secular | 50. Understand |
| 17. Integral | 34. Sufficient | |

Appendix E

Vocabulary Assessment Productive

**Instructions:** Complete these sentences using the words on this list.

| Participate | Guaranteed | Adequate | Devoted | Aware |
|---|---|---|---|---|
| Emphasized | Fortunate | Mitigated | Advantages | Coincide |
| Intensified | Investigating | Comprehend | Requires | Obvious |
| Indulged | Resolved | | | |

1. They _____ their time and energy to helping others.

2. The _____ of my new job are better hours and better pay.

3. Do you _____ the instructions?

4. Is your paycheck _____ ? Is it enough to pay all your bills?

5. Our lunch breaks _____ , so we get to eat together.

6. I am _____ of the hole in my shirt.

7. His rude speech _____ the anger of the crowd.

8. The president _____ the importance of education.

9. You are _____ to receive such a good education.

10. She _____ her desire for chocolate.

11. The mother's apology _____ the pain and sadness her child felt.

12. The police are _____ the crime.

13. My teacher _____ that if I study three weeks for the test, I will get a good grade.

14. The brothers finally _____ their conflict.

15. The gym _____ everyone to sign up for at least 3 months to get a membership.

16. It was _____ that he liked her a lot.

17. The teachers hope that all the parents will _____ in this important school event.

Appendix E (continued)

**Instructions:** Complete these sentences using the words on this list.

| Participate | Guaranteed | Adequate | Devoted | Aware |
|---|---|---|---|---|
| Emphasized | Fortunate | Mitigated | Advantages | Coincide |
| Intensified | Investigating | Comprehend | Requires | Obvious |
| Indulged | Resolved | | | |

1. They _____ their time and energy to helping others.

2. The _____ of my new job are better hours and better pay.

3. Do you _____ the instructions?

4. Is your paycheck _____ ? Is it enough to pay all your bills?

5. Our lunch breaks _____ , so we get to eat together.

6. I am _____ of the hole in my shirt.

7. His rude speech _____ the anger of the crowd.

8. The president _____ the importance of education.

9. You are _____ to receive such a good education.

10. She _____ her desire for chocolate.

11. The mother's apology _____ the pain and sadness her child felt.

12. The police are _____ the crime.

13. My teacher _____ that if I study three weeks for the test, I will get a good grade.

14. The brothers finally _____ their conflict.

15. The gym _____ everyone to sign up for at least 3 months to get a membership.

16. It was _____ that he liked her a lot.

17. The teachers hope that all the parents will _____ in this important school event.

Appendix E (continued)

**Instructions:** Complete these sentences using the words in the list.

| Appointed | Agreement | Fluctuates | Received | Perspective | Insinuate |
|-----------|-----------|------------|----------|-------------|-----------|
| Limited | Resolved | Boycott | Necessary | Contemplated | Reluctant |
| voluntary | Expressed | Confirmed | Secular | Improved | |

1. My appetite _____; some days I'm hungry all the time and other days I don't feel like eating at all.

2. She didn't openly blame him, but she _____ that he'd been cheating during the test.

3. He _____ many cards while he was in the hospital.

4. Participation in planting new trees in the neighborhood is completely _____.

5. He gave up this job as a priest and returned to _____ life.

6. I was so angry that I could not see his _____ on the situation.

7. We _____ to them our thoughts/feelings/views on the subject.

8. It is _____ for you to sign all the forms.

9. She was _____ to do her math homework because this is a subject she does not like.

10. There is a _____ supply of fresh water in this desert area.

11. She _____ the problem until she finally solved it.

12. Her grades in school have _____ this year.

13. She _____ the story about the escaped tiger.

14. My friends and I made an _____ to drive to work together.

15. The mayor _____ a new police chief.

16. Plans were made to _____ American products.

Appendix F

Vocabulary Assessment Receptive

**Instructions:** Write the correct word for each definition provided.

| Adequate | Identity | Fortunate | Comprehend |
|----------|----------|-----------|------------|
| Aware | Boycott | Employ | Devoted |
| Develop | Improve | Coincide | Erratic |

1. _____
   - To cause (something) to grow or become more advanced

2. _____
   - Having good luck

3. _____
   - To refuse, to buy, use, or go to in order to make a protest or bring about a change.

4. _____
   - To understand (something, such as a difficult subject)

5. _____
   - Knowing that something (such as a situation, condition or problem) exists

6. _____
   - Who a person is

7. _____
   - To happen at the same time as something else.

8. _____
   - Having strong love or loyalty for something or someone

9. _____
   - Enough for some need or requirement/good enough

10. _____
    - To use (something) for a particular reason or to do something

11. _____
    - Acting, moving, or changing in way that are not expected or usual

12. _____
    - To make (something) better

Appendix F (continued)

**Instructions:** Write the correct word for each definition provided.

| Require | Emphasize | Obvious | Indulge |
|---------|-----------|---------|---------|
| Participate | Sufficient | Contemplate | Guarantee |
| Insinuate | Manifest | Advantage | Mitigate |

1. _____ 
   - To make (something) less harmful/painful

2. _____ 
   - Enough, as much as needed

3. _____ 
   - A promise that something is true or real; or will happen or be done

4. _____ 
   - To think about deeply or carefully about (something)

5. _____ 
   - To suggest (something, especially something bad or insulting) in an indirect way

6. _____ 
   - To make (something) necessary for someone

7. _____ 
   - To give special attention to something

8. _____ 
   - To allow (yourself) to have or do something as a special pleasure

9. _____ 
   - Easy for someone to see or understand

10. _____ 
    - To take part; to become involved

11. _____ 
    - Something that helps to make someone better or more likely to succeed than others

12. _____ 
    - To show something clearly

Appendix F (continued)

**Instructions:** Write the correct word for each definition provided.

| Confident | Integral | Introduce | Agreement | Resolve |
|---|---|---|---|---|
| Receive | Combine | Perspective | Confirm | Ordinary |
| Express | Malevolent | Limited | Necessary | |

1. _____
   - Something that is very important and necessary

2. _____
   - To cause (two or more things) to be together or to work together

3. _____
   - Not high or great in number, amount

4. _____
   - To find a solution or answer to something

5. _____
   - A situation where people share the same opinion/agree

6. _____
   - Having or showing a desire to cause harm to another person

7. _____
   - To get or accept

8. _____
   - Something that you must have or must do; needed

9. _____
   - To talk write or show about (something that you are thinking or feeling)

10. _____
   - The way things are seen from a particular point of view.

11. _____
   - To prove or show to be true

12. _____
   - Usual or normal

13. _____
   - To present one person to another person for the first time or to present a new thing

14. _____
   - Having a feeling or belief that you can do something well or succeed at something

Appendix F (continued)

**Instructions:** Write the correct word for each definition provided.

| Manage | Understand | Recommend | Recognize |
|--------|-----------|-----------|-----------|
| Fluctuate | Investigate | Secular | Voluntary |
| Obtain | Reluctant | Appoint | Intensify |

1. _____
   - To give (someone) a particular job

2. _____
   - to become stronger, or more extreme

3. _____
   - to look at closely so as to get information and learn the facts

4. _____
   - to know from earlier experience

5. _____
   - To change size, amount, quality often; from one extreme to the other

6. _____
   - to get or (gain) something usually by effort

7. _____
   - doing something because you want or choose to do it, not because you have to do it

8. _____
   - to suggest that someone does (something)

9. _____
   - to direct or control; to succeed in doing, even if you have problems.

10. _____
    - Feeling or showing doubt about doing something: not willing or eager to do something.

11. _____
    - Not religious; not relating to the spiritual world

12. _____
    - To know what something means.
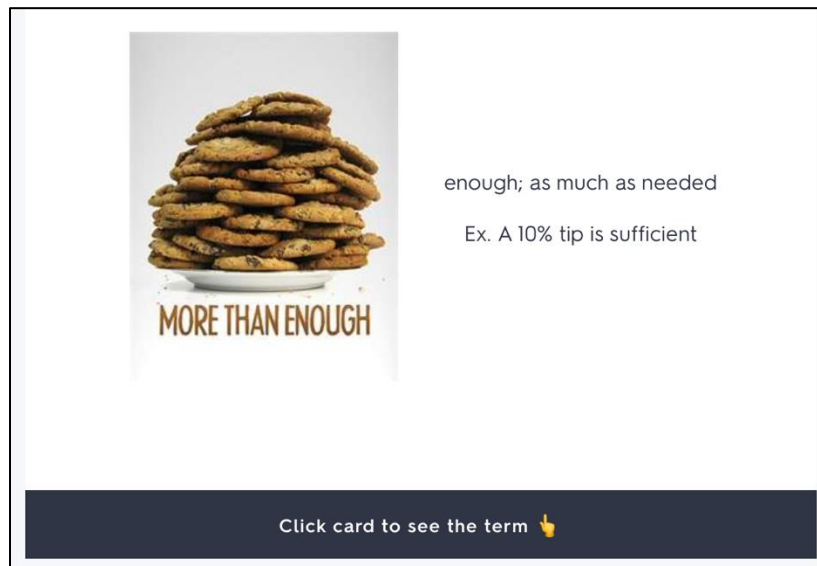
Appendix G

Paper Flashcard Sample

Appoint

To give someone
a particular job.

Ex. She was appointed
professor of history.

Appendix H

Screen Capture of Quizlet Flashcard

Appendix I

Perceptions of Flashcard Type

| 1<br>strongly disagree | 2<br>disagree | 3<br>neither agree or<br>disagree | 4<br>agree | 5<br>strongly agree |
|---|---|---|---|---|

1. \_\_\_\_\_ I was able to learn English vocabulary more quickly with paper flashcards

2. \_\_\_\_\_ Using paper flashcards improved my English vocabulary

3. \_\_\_\_\_ Using paper flashcards made it easier to learn English vocabulary

4. \_\_\_\_\_ I think paper flashcards were useful in my class

5. \_\_\_\_\_ It was easy for me to study English vocabulary with paper flashcards

6. \_\_\_\_\_ It was easy for me to become skillful at studying English with paper flashcards

7. \_\_\_\_\_ Learning how to study English vocabulary with paper flashcards was easy for me

8. \_\_\_\_\_ I prefer studying English vocabulary with paper flashcards to digital flashcards.

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1. \_\_\_\_\_ I was able to learn English vocabulary more quickly with Quizlet

2. \_\_\_\_\_ Using Quizlet improved my English vocabulary

3. \_\_\_\_\_ Using Quizlet made it easier to learn English vocabulary

4. \_\_\_\_\_ I think using Quizlet was useful in my class

5. \_\_\_\_\_ It was easy for me to study English vocabulary with Quizlet

6. \_\_\_\_\_ It was easy for me to become skillful at studying English with Quizlet

7. \_\_\_\_\_ Learning how to study English vocabulary with Quizlet was easy for me

8. \_\_\_\_\_ I prefer studying English vocabulary with Quizlet to paper flashcards.