Using Digital Flashcards to Enhance Thai EFL Primary School Students' Vocabulary Knowledge

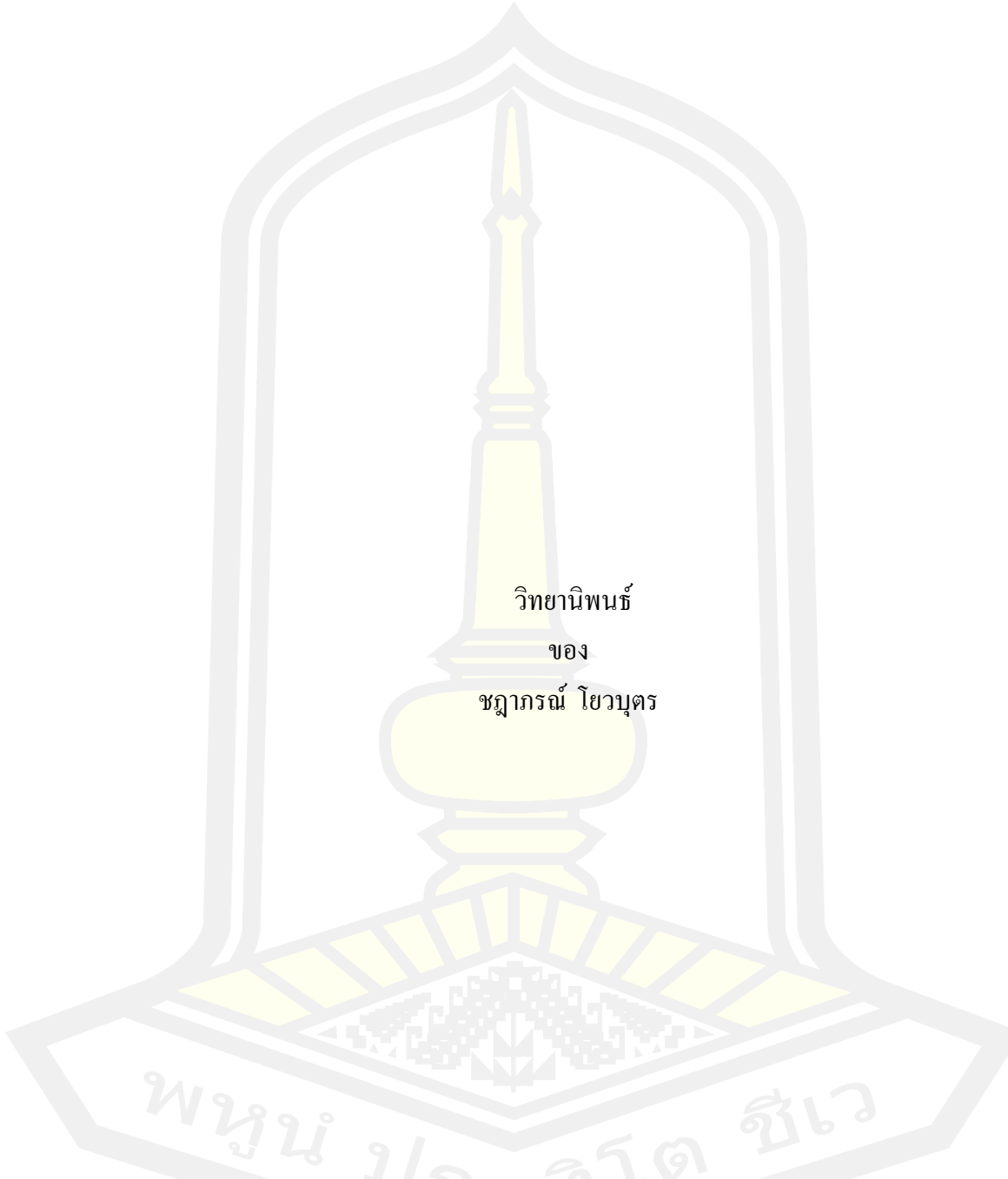
Chadaporn Yowaboot

A Thesis Submitted in Partial Fulfillment of Requirements for

degree of Master of Education in English Language Teaching

May 2022

การใช้บัตรคำศัพท์ดิจิทัลเพื่อพัฒนาความรู้ทางด้านคำศัพท์ของนักเรียนระดับชั้นประถมศึกษา



วิทยานิพนธ์

ของ

ชฎาภรณ์ โยวบุตร

เสนอต่อมหาวิทยาลัยมหาสารคาม เพื่อเป็นส่วนหนึ่งของการศึกษาตามหลักสูตร

ปริญญาการศึกษามหาบัณฑิต สาขาวิชาการสอนภาษาอังกฤษ

พฤษภาคม 2565

Using Digital Flashcards to Enhance Thai EFL Primary School Students' Vocabulary Knowledge

Chadaporn Yowaboot

A Thesis Submitted in Partial Fulfillment of Requirements

for Master of Education (English Language Teaching)

May 2022

The examining committee has unanimously approved this Thesis, submitted by Miss Chadaporn Yowaboot , as a partial fulfillment of the requirements for the Master of Education English Language Teaching at Mahasarakham University

Examining Committee

..... Chairman
(Nuchsara Choksuansup Thongsan , Ph.D.)

..... Advisor
(Asst. Prof. Apisak Sukying , Ph.D.)

..... Committee
(Pilanut Phusawisot , Ph.D.)

..... External Committee
(Asst. Prof. Chongrak Liangpanit , Ph.D.)

Mahasarakham University has granted approval to accept this Thesis as a partial fulfillment of the requirements for the Master of Education English Language Teaching

....

(Assoc. Prof. Nittaya Wannakit , Ph.D.) (Assoc. Prof. Krit Chaimoon , Ph.D.)
Dean of The Faculty of Humanities and Social Sciences Dean of Graduate School

TITLE Using Digital Flashcards to Enhance Thai EFL Primary School Students' Vocabulary Knowledge

AUTHOR Chadaporn Yowaboot

ADVISORS Assistant Professor Apisak Sukying , Ph.D.

DEGREE Master of Education **MAJOR** English Language Teaching

UNIVERSITY Mahasarakham University **YEAR** 2022

ABSTRACT

Growing L2 vocabulary research indicates that digital flashcards facilitate learners' vocabulary learning and development. It also suggests that deliberate vocabulary teaching is critical for successful language learning. Hence, the primary goal of this study was to investigate the effect of digital flashcards on the form-meaning link of English vocabulary knowledge among primary school children in the Thai EFL context. The study also aimed to explore Thai primary school students' attitudes towards using digital flashcards on vocabulary learning. The participants were 120 Thai primary school students who were divided into experimental and control groups. The experimental participants received vocabulary learning through digital flashcards, while the control peers received no unique treatments. Four measures of vocabulary knowledge were employed to capture participants' vocabulary learning. The five-point Likert scale questionnaire was also used to explore students' school students' regarding the use of digital flashcards. Descriptive and inferential statistics were used to analyze the quantitative data. The results showed that although both cohorts significantly improved their receptive and productive knowledge of L2 vocabulary, the experimental students significantly performed better than their control colleagues. These results indicated that digital flashcards were an effective mechanism to facilitate vocabulary learning among Thai primary school learners. The analysis of the questionnaires also suggested that learners had a very high level of positive attitudes towards the use of digital flashcards. These findings reaffirm the efficacy, visual and sound images, and entertainment value of digital flashcards on vocabulary learning. Other implications for practitioners and suggestions for further studies are addressed.

Keyword : Vocabulary knowledge, digital flashcard, intentional vocabulary learning

ACKNOWLEDGEMENTS

The completion of my study would not have been possible without the support and nurturing of these persons. First, I would like to express my deepest appreciation to my supervisor, Assistant Professor Dr. Apisak Sukying, for his unwavering support, insightful suggestion and patience that cannot be underestimated. Especially, his profound belief in my work, my abilities and constructive criticism helped me refine my work.

More importantly, I would also like to extend my sincere gratitude to my committee, Associate Professor Dr. Chongrak Liangpanit, Dr. Pilanut Phusawisot and Dr. Nuchsara Choksuansup Thongsan for providing with constructive feedbacks and invaluable in sight into my work.

Moreover, I would like to thank my classmates in Master of Education in English Language Teaching Program for a cherished time spent together in the university and social settings.

Finally, I am also grateful to my beloved family, parents, relatives and friends for their continuous emotional support and encouragement.

Chadaporn Yowaboot

TABLE OF CONTENTS

Page

List of Tables

Page

List of Figures

Page

CHAPTER I
INTRODUCTION

1.1 Background of the study

Vocabulary is one of the most crucial aspects in any language, especially English, of all four skills: listening, speaking, reading, and writing. As Wilkins (1972, p.111-112) stated that "without grammar, little can be conveyed; without vocabulary, nothing can be conveyed". In this regard, vocabulary is considered a mandatory aspect of language learning because it helps communicate. Vocabulary knowledge is an essential element of second or foreign language (L2) learners' English language proficiency (Nation, 2013, Schmidt, 2010). However, acquiring vocabulary and gaining sufficient vocabulary knowledge has often become an obstacle to learning for some students due to several discerning factors, including learning disability, lack of exposure to English, lack of self-confidence, and lack of knowledge about proper vocabulary learning strategies (Yunus *et al*. 2016). In order to improve the vocabulary knowledge of L2 learners, teachers apply many learning methods to teach vocabulary effectively, such as using a dictionary, using visual materials such as a picture or real object: The Picture Word Inductive Model (PWIM), using songs, using games, or using flashcards, to facilitate their vocabulary acquisition. In addition, such strategies allow teachers to create opportunities to help students consolidate their vocabulary learning (Magnussen & Sukying, 2021; Sung, Chang, & McLaughlin, 2016).

According to the Office of The Basic Education Commission (OBEC, 2014), the standard qualification of six-grade primary students should be able to communicate about 1,050-1,200 words as qualified learners. However, Thai primary students tend to have an inadequate vocabulary resulting from the average performance of 39.24% in the Ordinary National Education Test (ONET) of Grade Six learners' English test scores (The National Institute of Educational Testing Service (Public Organization), 2021).

Deliberate or intentional vocabulary learning is a traditional and common form of explicit vocabulary learning, which requires direct attention and contact with the context learned (Schmitt, 2000:120). Research shows that intentional vocabulary

teaching and learning techniques, such as notebooks, word lists, and word cards, are beneficial approaches for acquiring L2 vocabulary (Elgort, 2011; Elgort & Nation, 2010; Hung, 2017; Magnussen & Sukying, 2021). Moreover, Elgort (2011) adds that intentional vocabulary learning is more effective than incidental learning because the latter often requires long-term and extensive exposure to linguistic input. Deliberate learning (Elgort, 2010: p.2) yields an efficient and convenient way of memorizing vocabulary. Learning from word lists or cards can be exercised outside the classroom, and target words can be personalized to the interests learning goals of each L2 learner. Nation (1980) adds that bilingual word pairs can learn between 30 and 100 new words per hour. Besides, retention rates under deliberate learning are much higher than under incidental conditions on average (Hulstijn, 2003).

Moreover, Schmidt's (1990) noticing hypothesis is the underlying rationale for intentional vocabulary teaching, indicating that noticing is necessary for L2 vocabulary acquisition. Therefore, vocabulary is commonly taught explicitly and directly in foreign language classrooms to compensate for the limited exposure and resources that may otherwise be available. Indeed, Nation (2013, p. 536) argued that "directed deliberate vocabulary learning using word cards is very effective and much more efficient than teaching and vocabulary exercises." According to Nation (2013), the quality of vocabulary learning is conditional on the amount of learner involvement while processing individual words. He further explains three cognitive processes that lead to a word being learned. These comprise noticing through deliberate instruction, retrieval, and creative (generative) use.

Many different learning strategies are used in learning a second language depending on task type and context. While direct vocabulary teaching strategies of using word cards or flashcards have long been used in language classrooms, the recent rapid growth in educational technology has just stimulated the interest of vocabulary researchers. Word cards can also be described as a variation of word lists and are believed to offer more flexibility in creating interactive vocabulary activities for classroom teaching or self-testing. Building on the benefits of list learning, a few recent studies have extended the implementation of word lists to word cards that come in various delivery forms, such as paper-and web-based flashcards. For example,

Hung (2015) investigated how digital flashcards can be incorporated into a university course to promote intentional vocabulary learning. The study results emphasized the value of learning vocabulary with digital flashcards in learning tasks in classroom settings.

Flashcards are a set of double-sided cards designed for direct vocabulary learning that allows learners to practice recalling the form and meaning links in repeated retrieval of L2 words by flipping the front and back sides of the cards. Flashcards may vary in form, ranging from print to digital versions and digital flashcards (DFs) for the present study. The use of flashcards significantly helped the students' vocabulary growth. According to these empirical studies, flashcards appear to be more effective than other vocabulary learning techniques, regardless of their delivery form. Since flashcards can help students focus on form and meaning simultaneously for repeated retrieval of vocabulary items (Komachali & Khodareza, 2012). However, the effects of digital flashcards on L2 vocabulary acquisition and development and the pedagogical implications of using flashcards have yet to be comprehensively investigated, particularly in such a disruptive world (Elgort, 2011; Hustjinm 2003; Komachali & Khodareza, 2012; Mercanoglu & Yilmaz, 2020; Mousvi & Nemati, 2017; Nakato, 2008; Nation, 2013; Sanosi, 2018). Therefore, this study aims to investigate how digital flashcards can be integrated into intentional and direct learning tasks to enhance students' vocabulary learning outcomes and experiences through a classroom-based experiment. To respond to the current trends of technology that enhance vocabulary learning and development, the present study thus focused on using digital flashcards as an intentional vocabulary learning technique. Awareness of digital flashcards would shed light on the role of deliberate vocabulary learning and teaching and the nature of technological innovations in L2 vocabulary acquisition.

1.2 Purposes of the study

This research focused on vocabulary instruction using flashcards. Specifically, it aimed to investigate the effectiveness level of digital flashcards on the form-meaning link of English vocabulary knowledge among grade six primary school children in the Thai EFL context. It also aimed to explore Thai grade six primary school students'

attitudes toward using digital flashcards on vocabulary learning. There are two research questions in this study.

1. To what extent do digital flashcards enhance Thai primary school students in vocabulary knowledge?
2. What are Thai EFL grade six primary school students' attitudes towards using digital flashcards in enhancing vocabulary learning?

1.3 Scope of the study

This research focuses on measuring the effects of digital flashcards on the spelling and meaning of word grade six primary students in the Thai primary school and students' attitude in using digital flashcards in vocabulary knowledge. The researcher selected the words from the students' book version six (Say Hello by Mc Education) that matched with The New General Service List (NGSL). NGSL provides learners with the essential high-frequency words in English (Browne, 2013) and offers learners a valuable resource for English language learning learners (Bauer & Nation, 1993; Nation, 2006, 2013; Schmitt, 2010, Webb, 2008).

This research has limited the population to only grade six students of a Thai primary public school in the province of Mukdahan located in Northeastern Thailand since the researcher is an English teacher in grade six in the school, therefore; possible for the researcher to conduct this research and collect the data by using SPSS software to get the overall result.

Moreover, the research tools are a vocabulary checklist to find the most 80-unknown-word for these participants to make into target words for this research and a 40-word productive and receptive test. This research has a time limitation for one academic semester only.

1.4 Significance of the study

This quasi-experimental research design examined the effectiveness of deliberate vocabulary learning using digital flashcards. The current study also explored the participants' attitudes toward intentional vocabulary teaching using digital flashcards. The current study contributed significantly to L2 vocabulary teaching and learning. Moreover, the present results yield fruitful information for practitioners, including

teachers, students and course designers. The study also raised awareness of intentional vocabulary learning among practitioners and researchers. Finally, the present study would prove the efficacy of digital flashcards in deliberate vocabulary learning and teaching.

1.5 Definitions of key terms

A digital flashcard teaching approach refers to the teaching method and strategy with the aid of multi-media using a set of slides using LCD monitor designed for direct vocabulary learning.

A traditional method is a technique often implemented in today's regular classrooms. In the regular classroom, the teacher usually asks students to memorize a short list of words each day in English and give their native language equivalent. The teacher asks their students to pick vocabulary words they like from a textbook and then translate them into their mother tongue.

English as a Foreign Language or EFL refers to learning English in a non-English-speaking country. For example, students in Thailand who learn English are considered EFL students because English is not the country's official language. *Receptive word knowledge* refers to the ability to recognize or know a word, namely, the word's spelling or meaning, at least to some extent.

Productive word knowledge refers to the ability to recall and retrieve a word and be able to use it in context.

1.6 Outlines of the thesis

This study employed digital flashcards to enhance Thai EFL primary school students' vocabulary knowledge. Chapter I describes the problem of vocabulary knowledge of Thai students in studying a foreign language. There were various learning strategies for learning a second language, and deliberate learning using digital flashcards seems effective. This chapter also clarifies the scope, definition, and significance of the study to explore the extent of digital flashcards in promoting Thai primary school students in vocabulary knowledge.

Chapter II provides a literature review on vocabulary learning definitions, vocabulary learning strategies, direct learning methods, flashcard strategies, and the study's conceptual framework. Chapter III explains the methodology of the current study, including the research design, the participants and setting, the research instruments, and data collection and data analysis procedures. Chapter IV presents the study results and interpretation of those findings to answer research questions. Finally, Chapter V shows the conclusion and discussion of the study, implications of the current study, limitations and recommendations for future research are also presented.

CHAPTER II
LITERATURE REVIEW

2.1 Vocabulary Knowledge

Vocabulary knowledge had been given various definitions. Vocabulary knowledge has been defined as word knowledge (Laufer, 1998, 1992, 1997; Nation, 2013) or lexical knowledge (Laufer & Goldstein, 2004; Schmitt, 2014). Vocabulary knowledge can be the words of a language in either a single item, phrase, or chunks of several words that convey a particular meaning. Moreover, word knowledge also incorporates comprehension and use of words and requires an understanding of concrete and abstract meanings (Nation, 2013). Word knowledge can be multidimensional and complex learning. Knowing a word involves a multitude of linguistic knowledge, word's pronunciation, spelling, and morphology, to be aware of its syntactic relationships with other words, including synonym, antonym, hyponym, and collocation meanings (Laufer, 1998, 1992).

Richards (1976) proposed eight aspects of word knowledge (1) The spoken form of a word, (2) The written form of a word, (3) The grammatical behavior of the word, (4) The collocation behavior of the word, (5) The frequency of the word, (6) The stylistic register constraints of a word, (7) The conceptual meaning of a word, and (8) The associations a word has with other related words. In addition, Nation (1990) outlined a concept of word knowledge based on these aspects, including form, meaning, and use. The learners must possess this knowledge, both receptively and productively, to have complete command of the words. According to Nation (2013), there are nine aspects of vocabulary knowledge divided into three elements. First, knowing the *form* of a word involves knowing how it is spoken, spelled, written, and part of speech. Next, knowing the *meaning* of a word requires knowledge of word form and meaning, concept and references, and word associations. Finally, knowing the *use* of a word requires knowing grammatical functions, collocations, and the constraints of a word. In addition, the vocabulary bank is involved in the *form* and the sub-category *form and meaning* (Milton, 2009).

Knowledge of form indicates the learners' ability to notify the phonological and morphological elements of words in spoken and written modules. Moreover, meaning knowledge indicates the learners' ability to understand the concepts and lexical networks informing and interpreting those words. Finally, knowledge on use demonstrates the learners' ability to position when and where those words can be applied. Unfortunately, understanding words sometimes can take children 16 times for listening or reading. When encountering a new word, a learner must understand its meaning, including the context and morphology of the word. Morphemes refer to the form of a word, and word parts refer to morphological knowledge comprised of several morphemes. Word parts in English can be defined as affixes, prefixes and suffixes (Nation, 2013). Affixes attaching to a base form can contribute to the overall meaning of the word. Word parts are usually implicit to language learners but are seldom to be taught. Knowing what parts are recognizable in a word and what parts are needed to express a given meaning (Nation, 2001; Thornbury, 2002).

According to Nation (2001), they know the meaning of a word consist of connecting form and meaning, concept and referents, and word associations. Both word form and meaning can be learned together. It describes that when the learner reads and hears the word, its meaning will be retrieved. Richards (1976:81) claim that knowing a word involves knowing word association. It comes into people's minds. Some are alike or opposite, and associated words simply come to mind.

Nation (2001) identifies many factors such as register, frequency, and different cultures. It involves knowing the word grammatical functions, collocations and being aware of constraints on word use. The register is the stylistic constraint that 'makes each word appropriate for certain language situations and purposes' (Schmitt, 2000:31). The word frequency and High-frequency words are heard and seen and used more frequently than low-frequency words. In speaking, low-frequency words are used in communicating, while high-frequency words are more simply recognized and recalled when communicating with people. Knowing the usage of a word should be aware, and it should be appropriate for a specific situation and purposes (Schmitt, 2000:31).

Nation (2013) categorized the three elements of vocabulary knowledge into receptive and productive knowledge, as shown in Table 1

Table 1: Aspects of word knowledge (Nation, 2013)

Form	Spoken	R	What does the word sound like?
		P	How is the word pronounced?
	Written	R	What does the word look like?
		P	How is the word written and spelled?
	Word parts	R	What parts are recognizable in this word?
		P	What word parts are needed to express meaning?
Meaning	Form and meaning	R	What meaning does this word form signal?
		P	What word form can be used to express this meaning?
	Concepts and references	R	What is included in the concept?
		P	What items can the concept refer to?
	Associations	R	What other words does this word make us think of?
		P	What other words could we use instead of this one?
Use	Grammatical functions	R	In what patterns does the word occur?
		P	In what patterns must we use this word?
	Collocations	R	What words or types of word occur with this one?
		P	What words or types of words must we use with this one?
	Constraints on use	R	Where, when and how often would we meet this word?
		P	Where, when and how often can we use this word?

Note: R = receptive knowledge, P = productive knowledge

Nation (2013) distinguished the difference between receptive and productive vocabulary knowledge according to the skills involved. The former is about the comprehension of the input text, such as listening to a song or reading a book, while the latter is formulating words and sentences in speaking or in writing. Nation (2013) concluded that receptive vocabulary knowledge uses fewer cognitive attempts and found receptive knowledge is acquired easier and develops faster than productive knowledge. The cognition load to process input is less than productive language output. In addition, receptive vocabulary knowledge can be called passive vocabulary.

It can be easily developed when learners meet the words frequently. Therefore, listening and reading new words often will lead the learners to acquire the words receptively. According to Scott Thornbury (2002), vocabulary varies in the four language skills, listening, writing, reading, and speaking. Generally, learners will

perceive listening and speaking vocabulary easier and faster than reading and writing vocabulary. Scott Thornbury (2002) proposed that receptive vocabulary refers to the words learners know when they listen and read or the words they know when they receive from another. In contrast, Productive vocabulary knowledge requires recall of words and knowledge of how to use the words correctly to deliver meaningful messages in speaking or writing (Sukying, 2021). To enhance this productive vocabulary ability, the learners should practice more on speaking and writing (Thornbury, 2002). Productive vocabulary refers to the words that learners use when they speak or write, and it can be called active vocabulary (Thornbury, 2002). Productive knowledge or using a word is more challenging either in speech or writing. It requires recall of words and knowledge of how to use them correctly to convey meaningful messages. As a result, productive knowledge is more profound as it requires knowledge of the word's pronunciation, spelling, and pragmatics.

According to Nation (1992), for pleasurable reading to occur, learners need to be familiar with 97-98% of words in a text (i.e., 97-98% text coverage). For example, suppose independent comprehension needs 98% knowledge of the running words in a text, L2 learners need an 8000 to 9000 word-family vocabulary for comprehension of written text, such as newspapers and novels, and a vocabulary of 6000 to 7000 for spoken texts such as lectures and movies (Nation 2006).

It can be summarized that vocabulary knowledge is essential for language learners in order to comprehend with others. There are three aspects of vocabulary knowledge: recognition of the form, understanding of the meaning, and using the words in communications correctly and appropriately.

2.2 The goals of vocabulary learning

The goal of vocabulary learning is for L2 learners to communicate correctly and appropriately in English. Since vocabulary knowledge plays a principal role in Second Language Acquisition (SLA), L2 learners will not be able to communicate if they do not have vocabulary knowledge. Numerous studies have exhibited the relationship between vocabulary bank and L2 reading and listening skills (Anderson & Freebody, 1981; Koda, 1989; Laufer, 1991; Bernhardt & Kamil, 1995; Durgunoglu, 1997;

Nation, 2006) , therefore, without adequate numbers of vocabulary , L2 learners can't express their message clearly and meaningfully in speaking and in writing (Astika, 1993; Engber, 1995; Laufer & Nation, 1995; Olinghouse & Leaird, 2009; Wilkinson, 2017).

For L2 learners to have effective communication, they need to have adequate vocabulary knowledge. Montgomery (2007) mentions that listening vocabulary is the words that learners hear and understand their meaning, which needs about 50,000 listening words to understand and communicate. In addition, speaking vocabulary is the words that learners use in speaking, which needs about 5,000 to 10,000 speaking words to communicate. Lastly, writing vocabulary is the words that learners use in writing.

Moreover, vocabulary knowledge is classified into three tiers: tier 1 is basic words such as happy, tier 2 is high-frequency words such as sympathy, and tier 3 is low frequency and specific words in science or math such as a lathe. In addition, listening and reading vocabulary is categorized as receptive vocabulary while speaking, and writing vocabulary is categorized as productive vocabulary.

Having receptive vocabulary knowledge means learners can understand the words they hear and the words they read. Receptive vocabulary knowledge is how learners retrieve and understand the words when exposed to oral or written input (Nation, 2001). On the other hand, having productive vocabulary knowledge means learners can use correct and appropriate words in speaking or in writing. Productive vocabulary knowledge is the ability to retrieve words from memory and produce them as proper output. It involves knowing how to pronounce the word, spell the word, and use it correctly (Fan, 2000; Nation, 2001).

How many words L2 learners need to know to use foreign language appropriately is always an interesting question for teachers and scholars. The English language has about 450,000 to 750,000 words (Stahl, 1999; Tompkins, 2005). Although various scholars demonstrate their studies, Schonell, Meddleton, and Shaw (1956) mention that learners should understand 4,539 headwords, 12,611 word types, and 512,647 tokens to communicate in a foreign language, while West (1960) argued that 1,200

headwords are enough for speaking English and 2,000 words in the General Service List can be a goal for L2 learners to have vocabulary knowledge (West, 1953).

In addition, Nation (1990) indicates that the suitable vocabulary size for reading comprehensive skills ranges from 300 to 2,600 words in various simplified reading levels. He mentions that there are six levels of reading skills derived from The Newbury House Writers' Guide. It implies that low vocabulary bank learners can read the text which contains fewer words, and having 3,000 headwords knowledge is more than enough to read and comprehend difficult texts.

According to the Office of The Basic Education Commission, Ministry of Education, Thailand (Guideline in English Teaching, 2014) provides a guideline in English knowledge of learners , the standard qualification of six grade primary students should be able to communicate about 1,050-1,200 words as qualified learners. Unfortunately,Thai primary learners do not possess that level of vocabulary, and inadequate vocabulary knowledge remains the most significant problem for Thai L2 learners, causing many reasons such as inadequate English language exposure (Tassana-ngam, 1994) to learn the only single language meaning of words (Wimolkasem, 1992). Ordinary National Education Test: ONET English score of Grade Six learners declares the average latest score in English subject for grade six learners is 39.24 from 100, this shows the low ability in using English of Thai grade six learners in average (The National Institute of Educational Testing Service (Public Organization), 2021).

To sum up, vocabulary learning aims to study four skills vocabulary to be used in communication in both receptive and productive ways appropriately. L2 learners should have 3,000 headwords knowledge to read, retrieve, understand, speak and write inappropriate English communication (Nation 1990; 2001). However, this research focuses on grade six primary learners of public schools in Thailand. The researcher concludes that vocabulary knowledge for this study should aim at a CEFR – A1 level of 1,050 English words.

2.3 Vocabulary teaching and learning

The process of acquiring a word consists of many steps. Firstly, learners see or hear the word. Then, they can recognize the spelling or the sound of that word. This is receptive vocabulary knowledge. Further, they can advance their speaking skills or writing skills, and when they can pronounce the word or write a sentence, they acquire productive vocabulary knowledge. Vocabulary learning needs serious attention from both learners and teachers. It becomes a great challenge for the teachers to teach vocabulary, what kind of methods they use, what kind of vocabulary they teach, or how many words they should teach. The first step when teaching vocabulary is to decide whether the word is worth spending time on or not. If the word is a low-frequency, useless technical, and impractical word for the learners, it should be taught quickly. The teacher should spend time on high-frequency and practical words with learners to build their word bank for further use. Yale stated several explicit strategies that teachers can employ with learners. First, pre-teaching vocabulary. Second, repeated exposure to words. Third, word map. Fourth, Root analysis. They are, lastly, restructuring reading materials (Thornbury 2002).

To sum up, the role of vocabulary knowledge is crucial for successful second language learning; therefore, researchers investigated ways to foster vocabulary expansion and found two ways of fruitful vocabulary learning: incidental vocabulary learning and deliberate vocabulary learning.

2.3.1 Incidental vocabulary learning

Incidental learning is the learning of one stimulus context while concentrating on another stimulus context. It can be observations, communications with colleagues about tasks or projects, experiencing mistakes, or reading things. Moreover, it is common for learners to acquire vocabulary stock (Laufer & Hulstijn, 2001). Hulstijn and Laufer (2001) mention that the wordlist that the readers meet in incidental vocabulary learning would be retained in the long-term memory and used more confidently in different situations; however, only incidental learning works well on advanced level learners. Although incidental vocabulary learning seems to be effective for L2 learners, there are some limitations due to time-consuming because incidental learning is slow (Schmitt, 2000:120), learners who have academic goals

may not be suitable for this form of vocabulary learning (Coady, 1997:273); therefore, to compensate for these limitations, intentional vocabulary learning is required. Nation (2001) adds that incidental learning is a principal strategy in vocabulary learning. It occurs without a specific intention to focus on vocabulary. Nation (2001) concludes that incidental vocabulary learning is one form of learning from listening, speaking, reading or writing while focusing on information of the text, not the vocabulary itself.

To sum up, incidental learning is the learning form in that learners concentrate on the context, not the vocabulary itself. The readers may meet the words in listening, reading, listening or writing would be retained in the long-term memory. However, incidental learning has the limitation that it works well on advanced learners; therefore, it may not be practical to use incidental learning for primary students.

2.3.2 Intentional vocabulary learning

Deliberate or intentional vocabulary learning is a traditional and common form of teaching vocabulary (Ellis, 2001: 1-46). Schmitt (2000:120) defines it as explicit vocabulary learning, which requires direct attention and contact to the context learned. Deliberate learning is paying intention to learn lexical items. Learners must apply retention strategies to recall these words later (Schmidt, 1984; Hulstijn, 2003; Nation, 2013). Intentional learning is fast; thus, it is preferred by L2 learners; nevertheless, the problem arises when learners come across low-frequency words and cannot comprehend them correctly. Although Nation (2001: 232) claims that vocabulary is learned incidentally, he insists that intentional learning is required for vocabulary learning too, and Schmitt (2000: 121) supports this claim that both explicit and incidental learning is necessary and should be taught. Eventually, intentional learning can be defined as the form of learning vocabulary by using some media or tools to draw learners' attention into direct contact with the form and meaning of the words; those tools can be a dictionary or vocabulary lists.

According to Nation (2013), the quality of vocabulary learning is conditional on the amount of learner involvement while processing individual words. He further explains

three cognitive processes that lead to a word being learned. These comprise noticing through deliberate instruction, retrieval and creative (generative) use.

Table 2: Types of repetition of word meaning (Nation, 2013: p.457)

Type of processing	Type of repetition
Noticing	Seeing the same word from and simultaneously presented meaning again
Retrieval	Recalling the meaning in different contexts requiring
Creative use	Recalling the meaning in different contexts requiring a different instantiation of the meaning

The noticing process involves a learner's attention to a given word and marks it as an unknown. This means that the learner needs to notice the word and be aware of it as a valuable lexical item. However, the learner realizes that the word is met before, but it is used differently. Besides, the learner will tend to decontextualize the word the moment they notice it, which, in turn, will provide the foundation for a better understanding of the word. The process of de-contextualization occurs either consciously or subconsciously in a variety of ways. For example, it occurs while listening or reading activities, when the teacher highlights a particular word while negotiating meaning in speaking activities, or when the teacher explains the word, be it translation, giving a synonym, or target language definition.

While the noticing process directs the learner toward learning the word, the retrieval reinforces the meaning of the word in the learner's mind. Nation (2012) suggested that the more frequent the retrieval of a particular lexical item in a learning process, the greater the chance that the item will strike more profound in the learner's memory. Therefore, repetition and retrieval of the word extend its meaning, or definition and repetitive exposure to and use of it will lead the learner to better understand each meaning of the word they encounter. However, the span of time between encounters cannot last that long. The greatest increase in learning occurs in two or three repetitions for reading, while the most significant growth occurs between five and six repetitions for listening (Vidal, 2011). Brown, Waring and Donkaewbua (2008) show that the word met more often had a greater chance of being learned. Webb (2007) argues that gains over several aspects of word knowledge resulted from repetitions.

Still, at least ten repetitions would be needed to develop a rich knowledge of several aspects of a word.

Finally, the process of creative use occurs when "previously met words are subsequently met or used in ways that differ from the previous meeting with the word" (Nation, 2013, p. 110). These new encounters push learners toward a reconceptualization of their knowledge of such words. For example, if a learner has met the word book used as a noun as in "We bought a book yesterday," and then meets "We booked tickets for a football match, the learner will need to reconsider the meaning and uses of 'book'. This phenomenon will help the learner establish the memory of this word. However, creative use is not restricted to the metaphorical addition of word meaning. It can apply to a range of variations from inflections and derivations through collocation and grammatical context to reference and meaning (Nation, 2013)

Deliberate vocabulary learning significantly outperformed the incidental group on vocabulary tests (Tabrizi & Feiz, 2016). Nation (2013) illustrates in his book that repetition is crucial for vocabulary learning. In learning a second or another language, learners must frequently be exposed to the words or have spaced repetition with the words. Moreover, Elgort (2011) argued that deliberate vocabulary learning is more effective than incidental learning because the latter often requires long-term and extensive exposure to linguistic input. Besides, naturalistic language learning conditions are uncommon in English as a foreign language (EFL) or other foreign language learning contexts. By contrast, deliberate learning of vocabulary enhances learners' process of vocabulary development. This is due to the focused repetition or memorization strategies, which can be completed individually in a short period of time. Arguably, deliberate vocabulary learning retention rates are generally higher than those obtained with incidental learning (Hustijn, 2003), showing that deliberate attempts to learn vocabulary are effective and worth the effort. The research concludes that the direct and intentional learning method is a more effective way to learn and retain new words for L2 learners (Nation & Meara, 2010).

To sum up, deliberate learning is a direct learning method in which the learners must pay attention to learning the words. Repetition is the primary strategy that makes this learning effective: noticing the words, retrieving or recalling the words regularly, and using them in different contexts regularly.

2.3.3 Criticisms of Deliberate Vocabulary Learning

Deliberate learning (Elgort, 2010: p.2) yields an efficient and convenient way of memorizing vocabulary. Learning from word lists or cards can be exercised outside the classroom, and target words can be personalized to the interests learning goals of each L2 learner. Nation (1980) reveals that bilingual word pairs can learn between 30 and 100 new words per hour. Besides, retention rates under deliberate learning are much higher than under incidental conditions on average (Hulstijn, 2003). However, there are some drawbacks to deliberate learning; it cannot be automatically claimed that the quality of word learning gained through intentional decontextualized learning is at the level that is required for practical language use.

To sum up, the shortfalls of deliberate vocabulary learning are that the quality of the words recalled depends on the frequency of use.

2.3.4 Direct vocabulary teaching

Many different learning strategies are used in learning a second language depending on factors such as task type and context. Direct vocabulary teaching strategies are inferring meaning from context, using word parts to learn and remember words, using vocabulary cards, and using dictionaries to look up words (Nation, 2001). The direct method or natural method is an antithesis to the popular grammar-translation method. Direct method teaching is more effective than the former grammar-translation method in second language communication because the direct method focuses on full immersion in the classroom environment rather than on grammar. Still, it focuses on learning through listening and speaking. Explicit vocabulary teaching has various strategies such as using the dictionary, and using flashcards.

Using dictionaries

The dictionary is a significant part of vocabulary learning strategies. Dictionaries help L2 learners to understand the text and learn the vocabulary (Nation, 2001).

Dictionaries provide the meaning of a particular word and its pronunciation, part of speech, and syntactic behaviour. Moreover, sometimes a good dictionary provides its possible alternative spellings (for example, behaviour and behaviour are correct alternative spellings) and possible sentence examples, which help learners understand how to use that word in different settings. All this is potentially valuable for learning new words.

Furthermore, Landau (1984) exhibits that dictionaries designed for L2 learners often have the features of second language learning, such as pronunciation information, verb patterns, and collocations. In addition, it also often has detailed grammatical information. The studies of dictionary use have been conducted lately (Cote González & Tejedor Martínez, 2011). Nation (2001) gives an overview of several studies into dictionary use by L2 learners. Some studies focus on the use of dictionaries while reading, with many concluding that the use of a second language dictionary while reading helps in vocabulary learning (Gu & Johnson, 1996; 17 Hulstijn, Hollander & Greidanus, 1996; Knight, 1994; Luppescu & Day, 1993) and reading comprehension (Hulstijn, 1993; Hulstijn et al., 1996; Knight, 1994). Knight (1994) concludes that learners who use dictionaries while reading two reading texts can remember more word meanings than those who do not. However, studies have not unequivocally found that dictionaries are effective for reading comprehension (Bensoussan & Sim, & Weiss, 1983). On the contrary, Miller (2006) concludes that her learners improve her writing skills in her studies. From the mentioned information, dictionary use exhibits the improvement of English learning in finding meaning.

The Picture Word Inductive Model (PWIM)

Second Language teachers in primary grade use different types of teaching materials to explain the meaning of new words. The use of visual materials such as a picture or real object is helpful because a picture or real object makes the learning process more accessible, more enjoyable and eventually more memorable. The Picture Word Inductive Model (PWIM) is based on early literacy and was designed by Calhoun (1999). PWIM is “an inquiry-oriented language arts strategy that uses pictures containing familiar objects and actions to elicit words from children's listening and speaking vocabularies” (Calhoun, 1999, p. 21) designed for small groups and

individuals from kindergarten through sixth grade. Implementing PWIM aims to enhance young L2 learners to think and generalize the words and develop learners' vocabulary concepts, paragraphs, and sentence structures in general content subject matters, including mathematics, reading, science, and social science. The ultimate goal of this strategy is to enable second language beginners to become effective second language learners (Calhoun, 1999). Moreover, PWIM embraces the development of visual perception, which is vital to children's literacy acquisition (Astorga, 1999; Clay, 2001; Joyce, Calhoun, & Hopkins, 2002). During instruction with the PWIM, learners are shown a picture and are asked to identify items in the picture or "shake out" the words of the picture. The picture as a visual image has a significant role in PWIM to develop children's literacy

Children can learn by reading and communicating using the picture and deconstructing and interpreting the image (Calhoun, 1999; Wong, 2009). Hence, PWIM is a suitable method for a young learner to acquire second language vocabulary.

Using Song

The song is often used in second language beginners' classrooms to provide acquaintance to the language, and it is fun for learners to learn from songs. Listening to a song can improve listening skills and pronunciation; it becomes a valuable pedagogical tool for young learners. (Murphey, 1992). Moreover, songs can also be useful tools in learning vocabulary, sentence structures, and sentence patterns. It can be concluded that using songs is one of the educational tools in teaching vocabulary to L2 learners (Murphey, 1992).

Using Games

A game is a form of play that contains rules, so many teachers use games to help and encourage young learners to use full effort to answer and play the game. In his book "Teaching Oral English" (1976:100), Byrne emphasizes that games can be used to improve the learners' command of particular patterns: sound, vocabulary, spelling, grammatical items, or function. Therefore, it can be concluded that games are forms

of play that contain rules that we have to obey. Therefore, games can be helpful for the children to learn English, such as a puzzle or Hang Man.

Using flashcards or word cards

One strategy for learning vocabulary is the use of flashcards. Based on Oxford Advanced Learner's Dictionary (1995: 94) flashcard is a card with a word or words and sometimes a picture down it. The letters on flashcards must be visible and large enough for all learners in the classroom. Both sides of the flashcard should be used in teaching vocabulary. On one side, the new word is written in a second language and perhaps with a picture beside it and on the other side is the translation. Both teachers and learners can make these flashcards. Various kinds of flashcards are on the market. Flashcards are helpful for drilling new letters, syllables, words, and other information. They are typically used in a classroom but can also be used more informally. Flashcards are widely used as a learning drill to aid memorization by way of spaced repetition. Nation (2001) describes a strategy in Learning Vocabulary in Another Language: a learner writes the foreign word on one side of a small card and its translation of the first language on the other. The key to using flashcards is to look at the word or picture on one side and see if learners can remember the answer written on the other. In addition to teaching vocabulary, flashcards can be used to improve comprehensive reading skills (Tan & Nicholson, 1997).

To sum up, there are various strategies for deliberate vocabulary learning. After reviewing each strategy, this study focuses on the use of digital flashcards because it is easier and more convenient for learners to recall and practice the use of vocabulary.

2.4 Deliberate vocabulary learning from word cards (flashcards)

Learning a second language involves studying thousands of words, so L2 learners and teachers look for the most effective way to learn new words.

Schmidt's (1990) noticing hypothesis is the underlying rationale for deliberate vocabulary teaching, indicating that noticing is necessary for L2 vocabulary acquisition. As such, vocabulary learners consciously notice L2 features in the input and pay careful attention to the form-meaning link of vocabulary items to optimize L2 vocabulary learning. Therefore, vocabulary is commonly taught explicitly and directly

in foreign language classrooms to compensate for the limited exposure and resources that may otherwise be available. Research showed that deliberate vocabulary teaching and learning techniques, such as notebooks, word lists, and word cards, are beneficial approaches for acquiring L2 vocabulary (Elgort, 2011; Elgort & Nation, 2010; Hung, 2017; Magnussen & Sukying, 2021). In addition, Nation (2013, p. 536) adds that directed deliberate vocabulary learning using word cards is very effective and much more efficient than teaching and vocabulary exercises. He also states that among various vocabulary learning techniques, teachers should guide their learners to make use of word cards in learner-centered ways.

However, Oxford and Crookall (1990: p.9-10) denied learning from word cards because using flashcards is the decontextualizing technique that focuses only on a word and is not useful in a communicative context. They mention that deliberate learning provides only explicit knowledge, which is not for fluent use of language and intentional learning is effective only for a small number of words which is inadequate for communication.

Judd (1978; 73) argues that word cards learning is isolated; therefore, words are not remembered because learning in sentence context helps associate words – form and meaning. On the other hand, many scholars support flashcards learning that learners can remember the words even after 6 to 42 days (Thorndike, 1908; Webb 1962; Anderson & Jordan, 1928; De Groot, 2006). However, Nation (2013: p.441-442) does mention the drawbacks or the scope of word knowledge that is not covered by flashcard learning as in Table 3.

Table 3: Aspects of word knowledge dealt with by learning from word cards (Nation, 2013: p. 442)

Form	Spoken	R P	✓
	Written	R P	✓✓ ✓✓
	Word parts	R P	
Meaning	Form and meaning	R P	✓✓ ✓✓
	Concept and referents	R P	✓
	Associations	R P	
Use	grammatical functions	R P	✓ ✓
	Collocations	R P	✓ ✓
	Constraints on use (register, frequency)	R P	

Notes: R = Receptive knowledge, P = productive knowledge

In Column 4 -✓✓ = well dealt with, ✓= partly dealt with

From Table 2.3, Nation (2013: p. 442-443) declares flashcards learning is effective for both receptive and productive knowledge in written form, form and meaning. In addition, flashcards learning is less effective in receptive spoken form, receptive concept and referents, and the use of grammatical function and collocations. However, flashcard learning is ineffective in productive spoken form, word parts form, association meaning and constraints on use.

To sum up, a flashcard is effective as a deliberate vocabulary learning tool, and it is effective for both receptive and productive learning.

2.4.1 The flashcard strategy

Flashcards are a set of double-sided cards designed for direct vocabulary learning that allows learners to practice recalling the form and meaning links in repeated retrieval of L2 words by flipping the front and back sides of the cards. Flashcards learning is a fast way to increase vocabulary size by deliberate learning. Nation (2000) defined flashcard as a small card with a foreign word and its meaning on front and back sides. On the card, the word meaning can be added in first language translation or a picture in order for learners to learn the meaning of new words. Flashcards are recognized to have a positive motivational effect on language learners (Ashcroft and Imrie, 2014)

and have been used in EFL teaching for years as a strategy for learning vocabulary. There are two main types of flashcards: the traditional card type and electronic or digital type.

A traditional flashcard is made from paper or card containing an image on one side and vocabulary relating to the image on the other side. (Aslan, 2011). In a foreign language classroom, the teacher may add translations to the back of the card with student's first language and encourage the students to recall vocabulary and meanings (McLean, Hogg and Rush, 2013). The size of the words or pictures on a flashcard should be big enough for every learner to see in the classroom. This type of card is convenient and easy to use for studying any time.

Computer-based flashcard is another type of flashcard that can be even more effective than paper (Nakata, 2008; Başoğlu and Akdemir, 2010; Azabdaftari and Mozaheb, 2012; Nikoopoura and Kazemi, 2014). These flashcards are computer-based systems, or digital flashcards, designed for electronic devices and projectors. This type of flashcard can be created using Microsoft PowerPoint or any programs and applications. With the current situation and emerging of new technology, digital flashcards interest the researcher to explore its benefits and motivational tool for young students to study vocabulary.

The building and using of flashcards have three major steps: choosing the words to learn, making word cards, and using the cards. Each step is made from a research-based principle (Nation, 2013: p. 446)

Table 4: Principles and steps in the word and strategy (Nation, 2013, p. 446)

1. Choosing words to learn	- Learn useful words. - Avoid interference.
2. Making word cards	- Put the word or phrase on one side and the meaning on the other to encourage retrieval.
3. Using the word cards	- Use retrieval. - Space the repetitions, particularly the first one. - Learn receptively, then productively. - Start with small packs (or blocks) of words and increase the size as learning becomes easier. - Keep changing the order of words in the packs. - Say the words aloud or to yourself. - Put the word or phrase in a sentence or with some collocations. - Process the word deeply and thoughtfully using the mnemonic techniques of word parts or the keyword technique where feasible and necessary.

Choosing words to learn is the first step in the flashcard strategy. Teachers must select appropriate words for learners; teachers mostly select from high-frequency words. Then teachers must avoid interference by separating similar words, same lexical set, synonyms, so learners are not confused with those similarities (Erten & Tekin, 2008; Higa, 1963; Papathanasiou, 2009; Tinkham, 1993; Waring 1997b)

Next, making word cards is the second step. The popular size of flashcards is 5 x 4 cm because they are small and easy to carry around. Both sides of the cards must be printable, one side is the word in the second language, and the other side is the meaning in the first language. The learning word can be written or printed solely or in a sentence context (Nation, 2013:443). Research shows that learning is more effective if the meaning is translated into the first language (Lado et al., 1967; Laufer & Shmueli, 1997; Mishima, 1967)

Lastly, using the word cards is the final step of the flashcard strategy. This is a pretty crucial step because the efficiency of learning from flashcards depends on how they are used in learning. Flashcards are used for retrieval by allowing learners to retrieve the meaning of the word from their memory when seeing the second language word on one side of flashcards; each correct retrieval is the test (Karpicke & Roediger, 2007). Flashcards must be used repetitively in space-time because one meeting is not adequate for L2 learners to gain vocabulary knowledge of that word (Nation, 2013).

There are some guidelines in using word cards: (1) retrieve rather than recognize, (2) use suitable size of cards, about 15 or 20 words, (3) space the repetitions, (4) repeat the words aloud to absorb into long-term memory, (5) use depth processing technique in making words, (6) avoid interference, (7) keep changing the order of the words in the pack, and (8) use context and collocating words (Tabrizi & Feiz, 2016).

To sum up, there are three steps in using flashcards, (1) choosing words to learn by selecting useful words for learners and avoiding the interference; (2) making word cards by putting the word on one side and the meaning in Thai on the other side for better retrieval; (3) using the word cards by practicing the word regularly in class and after class.

2.4.2 The benefits of learning from flashcards

Flashcards are effective learning tools and can provide vocabulary knowledge to learners through retrieval on spacing repetitions (Nation, 2013), even though there are some arguments that flashcards learning is decontextualizing. It is not suitable for practical communication use (Judd, 1978). 35% of word knowledge from flashcard learning remains in the memory after ten years (Bahrick & Phelps, 1987), and 65% word accuracy is retrieved after vocabulary list learning, which is good evidence for the long-time word knowledge of flashcards learning.

Nation (2013:p.444) mentions that flashcards quickly increase vocabulary knowledge for L2 learners because words on flashcards are high-frequency words; therefore, they are more useful in communication than low-frequency words. In addition, they create high awareness of particular words in reading or listening. Therefore, direct learning like the flashcard method is worthy compared to context learning.

Nation (2013: p.444) further elaborates that direct learning such as flashcards has four benefits: (1) it is effective in terms of return for time and effort, (2) learners have a better focus on word knowledge than from context or dictionary use, (3) learners can do spacing repetition to gain secured word knowledge, and (4) it provides implicit knowledge for fluent language use.

In addition, the studies revealed that using electronic flashcards can improve vocabulary knowledge better than paper or traditional flashcards (Kerdmuenwai, 2018) due to more colorful and higher technology. The technology of digital flashcards draws stronger attention of learners than paper ones. According to the repetition strategy, the more repetition the learners do, the better word recognition affects. Dizon and Tang (2017) also compared the efficacy of paper flashcards and digital flashcards and found that incorporating computer-assisted language learning (CALL) is more effective in L2 vocabulary learning. Looking into learners' perception of digital flashcards, they prefer to use digital flashcards over paper flashcards (Basoglu & Akdemir, 2010; Yuksel *et at*., 2020) due to their efficacy, ubiquity, and entertainment value. In addition, Asabdaftari and Moazaheb (2012) discover three main advantages of digital flashcards: ubiquity, convenience, and entertainment to teach new words. Ashcroft and Imrie (2013) confirmed that digital flashcards medias such as Quizlet program offers the opportunity to redefine the word learning experience in which the students can share and interact with their classmates during the practice, thus making it more fun for young students to learn the words; therefore, at the end of the semester, students who use Quizlet have better learning outcomes; they have higher word knowledge than students who use paper flashcards. The challenges of using digital flashcards in the classroom depend on L2 ages and graphics' quality (Alnajjar & Brick, 2017). It yields better when using a paired-associate learning program (Mc Lean *et al.,* 2013).

It can be concluded that learners have a positive view of digital flashcard learning, which leads to higher and faster vocabulary knowledge when using a digital flashcard than a paper one.

2.5 Research and related studies on vocabulary learning and teaching

2.5.1 Domestic Research

In the Thai context, Sukying (2020) notes that deliberate learning through morphological learning leads students to better vocabulary proficiency because they know the word form; thus, it is easier for them to memorize the words. Moreover, learning a word family helps students with vocabulary, especially affix knowledge (Sukying, 2018). Another study found that Thai kindergarten learners significantly

improved their vocabulary knowledge through total physical response (TPR) and songs (Magnussen & Sukying, 2021). These studies indicate that deliberate vocabulary learning through different activities can facilitate vocabulary learning and prove effective in advancing word learnability in young learners (Magnussen & Sukying, 2021).

Kerdmuenwai (2018) studied the using electronic flashcards to improve vocabulary learning of mathayomsuksa 2 students found that electronic flashcards had positive effects in improvement of students' vocabulary knowledge especially in word recognition, word meaning and using words appropriately.

2.5.2 Foreign Research

L2 vocabulary research has shown that flashcards appear to be more effective than other vocabulary learning techniques, regardless of their delivery form (Dizon & Tang, 2017; Yuksel et al., 2020; Wilkinson, 2017). These studies indicate that flashcards help learners focus on form and meaning simultaneously for repeated retrieval of vocabulary items. Dizon and Tang (2017) also compared the efficacy of paper flashcards and digital flashcards and found that incorporating computer-assisted language learning (CALL) is more effective in L2 vocabulary learning.

Regarding learners' perception of digital flashcards, they prefer to use digital flashcards to paper flashcards (Basoglu & Akdemir, 2010; Yuksel *et at*., 2020) due to their efficacy, ubiquity, and entertainment value. In addition, Asabdaftari and Moazaheb (2012) discover three main advantages of digital flashcards: ubiquity, convenience, and entertainment to teach new words. However, the effective use of digital flashcards in the classroom depends on L2 ages and graphics' quality (Alnajjar & Brick, 2017). It yields better when using a paired-associate learning program (Mc Lean *et al.*, 2013). Scholars conclude that learners positively view word card learning (Wilkinson, 2017; Yuksel *et al.*, 2020). Hsui-Ting Hung (2015) mentions in the study that students' vocabulary knowledge is advanced with the use of intentional vocabulary learning with the use of digital flashcards.

Along the same line of promoting deliberate learning techniques, some vocabulary researchers have compared learning effects with word lists and cards among EFL

learners. For example, Nakata (2008) reached Japanese high school learners' English vocabulary learning with word lists, word cards and computer drills, indicating the computer group achieved the highest retention rates, followed by the paper-based word card group and then the word list group.

From the review, many scholars agree that deliberate learning with spaced repetition using digital flashcards seems to be an effective and interesting way of learning the language. Spaced repetition words learning involves three processes, (1) noticing which is seeing the same word form and continuously presented meaning, (2) retrieval, which is recalling the exact meaning of words many times; and (3) generation, which is recalling the meaning in different contexts of the words. Nation (2013) mentions that it takes learners 16 meetings to recognize the new word. Retrieval is an important tactic when using flashcards. Generation of words can be done when learners use a new sentence with the same words they retrieve from flashcards.

Komachali (2012) studies the effect of using vocabulary flashcards on Iranian pre-university students' vocabulary knowledge. There are 50 students and are divided into two groups: the control and experimental group. The control group uses the traditional teaching method, and the experimental group uses vocabulary flashcard teaching. Komachali uses pretest and posttest as research tools and concludes that students in the experimental groups have a higher level of vocabulary knowledge than the control group. That means vocabulary flashcard improves students' vocabulary knowledge.

Ashcroft and Imrie (2013) study the learning vocabulary with digital flashcards, Quizlet program, and conclude that Quizlet offers the opportunity to redefine word learning experience. They can share and interact with their classmates during the practice, thus makes it more fun for students to learn the words. Students who use Quizlet have better learning outcomes; they have higher word knowledge than students who use paper flashcards. Sholikhah (2013) studies the improving students' vocabulary by using flashcards at the fifth-grade students of SDN Singajaya II. Sholikhah uses tests, observation, questionnaires to collect the data and conclude that

students have a higher mean score. For example, the mean score of the pre-test is 58.8 and the mean score posttest 1 is 66, and the mean score of posttest 2 is 78.3.

2.6 Summary of the current study

Vocabulary is one of the most crucial aspects in any language, especially English, of all four skills: listening, speaking, reading, and writing. Vocabulary knowledge consists of three main areas: form, meaning and use, in two methods: receptive and productive. This research focuses on grade six primary learners of public schools in Thailand, and vocabulary knowledge should aim at CEFR – A1 level of 1,050 English words. To achieve this level of work knowledge, deliberate vocabulary learning is used in this study because deliberate vocabulary learning significantly outperforms the incidental group on vocabulary tests (Tabrizi & Feiz, 2016) in more frequent exposure to the language Nation (2013) and more effective way to learn and retain new words for L2 learners (Nation & Meara, 2010). Nation (2013, p. 536) adds that directed deliberate vocabulary learning using word cards is very effective and much more efficient than teaching and vocabulary exercises. He also states that among various vocabulary learning techniques, teachers should guide their learners to make use of word cards in learner-centered ways.

Flashcards are a set of double-sided cards designed for direct vocabulary learning that allows learners to practice recalling the form and meaning links in repeated retrieval of L2 words by flipping the front and back sides of the cards. Flashcards learning is a fast way to increase vocabulary size by deliberate learning. There are three steps in building flashcards – choose high-frequency words, make the cards (one side is the word, the other side is the meaning), and use the card frequently, repetitively.

The research gap from reviewing related research was whether the digital flashcard could have better motivation on students; whether using digital flashcards is better for primary students than using the traditional method; and how to design digital flashcards to attract and enhance the vocabulary learning ability of students.

CHAPTER III
RESEARCH METHODS

This chapter describes the research methodology used, including the participants and setting, research instruments, data collection, and data analysis. The research design of this study followed previous research using flashcards in vocabulary learning for second language learners (Thornbury, 2002; Nation, 2013; Dizon & Tang, 2017; Kose & Mede, 2018; Feng, 2020; Sukying, 2021).

3.1 Participants and setting

The participants were 120 grade six students of a public school in Mukdahan province, Thailand. The researcher worked as an English teacher for grade six in this school. The participants were divided into the control group (n = 60) and the experimental group (n = 60). The control group were taught with the conventional teaching method – Grammar –translation method, whereas the experimental group were taught with digital flashcards materials. All students were Thai English learners who had been learning English for nine years. Both groups were taught in the same A1 level CEFR vocabulary lesson with different teaching methods.

3.2 Research design

This quasi-experimental research examines how grade six students improved their vocabulary knowledge by using digital flashcards as a direct teaching method. Specifically, the control group was taught using the traditional teaching method, while the experimental group was taught with the digital flashcards method. Both groups used the same English textbook, “Say Hello grade six.” The traditional teaching method for the control group involved a conventional method that used classroom tools such as English textbooks, notebooks, and printed materials. This method relies on teachers using direct teaching, and it is teacher-centred most of the time. For example, the teacher wrote on the board, spoke the words, translated them into Thai, and instructed them to write them in their notebooks. Students in the control group copied the words, pronounced them after the teacher, and learned the meaning of the words in Thai. The teacher also gave the students worksheets to write the meaning of the words and sometimes to write the spelling of the words dictated by the teacher.

Students could practice, review the words by looking in their notebooks and review their textbook at home. The teacher also conducted class activities such as a worksheet, written, paper, and oral recitation to better understand the level of the students. There were eight 50-minute classes in this treatment period. During the first week, students completed the vocabulary checklist, weeks 2-9 were the teaching period, and in week 10 students completed the vocabulary post-test.

In contrast to the control group, the experimental group were taught using the digital flashcards method. Flashcards are effective learning tools and can provide vocabulary knowledge to learners through retrieval on spacing repetitions (Nation, 2013; Dizon & Tang, 2017). Flashcards were prepared using Microsoft PowerPoint and t he teacher prepared a computer, monitor, LCD projector, speakers, and student electronic tools such as smartphones or tablets inside the classroom. The teacher showed the words in English on the computer screen, broadcasted proper pronunciation of the word by turning on digital sound, and gave the meaning of the word in the Thai and English language. Students in the experimental group had to read the given words, and spell them correctly. The teacher reviewed the students by reading the word on the digital screen for them to recall and retrieve the past lessons conducted. The teacher also conducted class activities such as an online worksheet, online quiz, and oral recitation to better understand the students. As for the control group, there were eight 50-minute classes in this treatment period. During the first week, students completed the vocabulary checklist, weeks 2-9 were the teaching period, and in week 10 students completed the vocabulary post-test.

The lesson plans used in this study was adapted from Gains and Redman (2007). Each unit consisted of ten target words, with the goal of the student studying an average of eight to twelve words in fifty minutes. Samples of a lesson plan based on the traditional teaching method and the digital flashcards method are shown in Tables 5 and 6, respectively.

Table 5: Sample of a Traditional Teaching Lesson

Stage	Activities	Materials
Warm-up	1. The teacher present the title of the subject that the students will learn. 2. The teacher encourages students to think about the meaning of the title and the vocabulary that is related to the title	
Presentation	1. Teacher provides the target wordlists with the Thai meaning and asks students to memorize the words. Then, the teacher asks students to explain the meaning of each word in Thai, and students have to read the word after the teacher.	Book
Practice	1. The target words are presented on the blackboard and students repeat the word aloud twice. The words should also be written in their notebook. 2. The teacher will provide students with an assignment on the workbook. The teacher writes down the words on the blackboard then asks the students to spell	Notebook Book
Production	1. Students practice the words individually in their notebooks by matching the words with the meaning in Thai.	Notebook
Wrap-up	The teacher reviews the meaning and form of the words.	

Table 6: Sample of Digital Flashcards Teaching Lesson

Stage	Activities	Materials
Warm-up	1. The teacher present the title of the subject that the students will learn. 2. Teacher encourages students to think about the meaning of the title and the vocabulary that is related to the title	
Presentation	1. Teacher explains the objectives of the lesson and assigns the student work using digital flashcards. Then, students complete the activity online. 2. The teacher presents new vocabulary using digital flashcards, shows how to pronounce the vocabulary, and tells students to repeat.	Digital flashcards Computer/smartphone
Practice	1. Teacher presents "Use Recall" activity to students. To explain that the word and the definition are written on different slides, students have to recall the word form. 2. Teacher presents "Learn Receptively and productively." 3. For receptive learning, the teacher shows the word and provides its meaning. For productive learning, the teacher will encourage the students to recall and retrieve the word, as well as the meaning of each word by matching the word to the proper meaning. 4. The teacher presents the "Changing the orders of cards" activity to students 5. The teacher presents the "Put the difficult words near the beginning" activity. 6. The teacher presents the "Say the word aloud" activity to students. Students are shown the word meaning and have to say the associated word aloud.	Digital flashcards Computer/smartphone Digital flashcards Computer/smartphone
Production	Students complete the online worksheet.	Digital flashcards Computer/smartphone
Warp up	The teacher assigns students to write at least five words they have learned from digital flashcards	Computer/smartphone

3.2.1 Selecting the target words for the study

One hundred forty-six target words from the "Say Hello" number 6 for six grades were selected and checked against the New General Service List (NGSL) to ensure that the words are suitable for the participants' English proficiency levels. This English vocabulary checklist test was piloted with the control and experimental group participants to select the known and unknown words. The participants were given 50 minutes to finish the test. Table 3.3 shows an example of a checklist test. Finally, the top 80 unknown vocabulary words items from the checklist test were used as the target words during the treatment.

Table 7: Examples of an English Vocabulary Checklist Test

Word	Know word	Unknown word	Meaning
beautiful			
capital			
dozen			
engineer			
forest			

3.3 Research instruments

Four research instruments were used, including two aspects of a word form (written) and meaning (form-meaning) to measure receptive and productive dimensions, as well as a questionnaire. The research instruments used in the present study are illustrated in Table 8.

Table 8: Research Instruments

Research Questions	Research Instruments	Time of Distribution
1. To what extent do digital flashcards enhance Thai primary school students ' vocabulary learning?	Two receptive and two productive vocabulary tests	Before/after using the teaching period.
2. What are Thai EFL grade six primary school students' attitudes towards using digital flashcards in enhancing vocabulary learning?	Questionnaire	After using the digital flashcards approach, experimental group only.

Four tests were used to measure the participants' vocabulary knowledge before and after the treatment for both the control and experimental groups (Sukying, 2017). The test had the same content and was administered by the researcher. The first test was the receptive test of word meaning, the second was the productive test of word meaning, the third was the receptive word spelling test, and the fourth was the productive test of word spelling. designed and developed the receptive and productive

vocabulary knowledge tests. The receptive vocabulary knowledge test was presented in a choosing the word format to measure participants' vocabulary knowledge, whereas the productive vocabulary knowledge test was presented in a gap-filling format to measure participants' depth of vocabulary knowledge (Sukying, 2017). The productive vocabulary knowledge was administered first to avoid the possibility that participants might draw a connection between words on the receptive vocabulary knowledge test and spelling on the productive vocabulary knowledge test.

3.3.1 The receptive word meaning (L2 Translation Test)

The receptive word meaning test was designed and developed based on Nation and Belgar (2007; 1983; 1990) to measure receptive knowledge of the form-meaning aspect. Specifically, this test assessed the participants' ability to provide word meaning. This test was designed in the form of fill in the blank. There were 20 questions, and one point was awarded for each correct answer and no points were awarded for a blank or incorrect answer. An example from the receptive word meaning test is shown below:

Instructions: Look at the following description and choose the words with the correct meaning.	**Point**
Example: An area of knowledge that you study at a school subject	1

3.3.2 The productive word meaning (L1 Translation Test)

The productive test of meaning was adapted from Laufer and Goldstien (2004) to measure recall and knowledge of the form-meaning aspect by writing the correct definition of the word in the Thai language. The test required participants to read the meaning of a word in Thai and rearrange the English letters to provide the associated English word. The test included 20 questions. One point was awarded for each correct word definition and no points were awarded for a blank or incorrect word definition. Below is an example from the productive test of word meaning:

Instructions: Read the meaning of the following words in Thai and arrange the letters to form the correct words			**Point**
Word	Correct	Meaning	Percent of correct spelling* 100% =1 99%-75% = 0.75 74%-50%=0.5 49%-25%=0.25 0-24% = 0
p o o r a h p h e r g t	photographer	ช่างถ่ายภาพ	

* Based on Mann, Bushell Jr., & Morris (2010)

3.3.3 The receptive word form (vocabulary knowledge of spelling)

The receptive spelling test was adapted from Webb (2009) to assess the students' ability to form or spell the words. This test was taken during the tenth week of treatment. It was designed in the form of matching test formats, which required learners to match the words with the picture, and complete the spelling for each picture to measure students' recognition of accurate spelling. There were 20 questions, and one point was awarded for each correct answer and no points were given for a blank or incorrect answer. Below is an example from the receptive word spelling test:

Instructions: Match the word with the picture, and complete the spelling (จงจับคู่คำศัพท์กับรูปภาพและเขียนเติมตัวสะกดให้ถูกต้องลงในช่องว่างที่กำหนดให้)	**Point**
1.  windy	1

3.3.4 The productive word form (spelling L2 cloze test)

The productive vocabulary spelling test was adapted from Webb (2009) and was designed in the form of a fill-in-the-blank test, which required learners to write target words. The test measured the extent to which students could write the correct spelling of the target word. There were 20 questions. One point was awarded for each correct spelling and no points were awarded for incorrect spelling. Minor spelling mistakes that did not change the meaning of the word were ignored. Below is an example from the productive test of word spelling:

Instructions: Complete each sentence and correctly write the word in the spaces provided (จงเติมคำศัพท์ลงในช่องว่างให้ถูกต้อง)	**Point**
1. I send a mes _ _ _ _ from my mobile phone. Students must fill message to get one point.	1

* Based on Mann, Bushell Jr., & Morris (2010)

3.3.5 Students' attitudes questionnaire

The questionnaire was used to explore the students' attitudes toward the use of digital flashcards (DFs) to enhance vocabulary knowledge, including the advantages and disadvantages of this method (Fredericks, Blumenfeld, & Paris, 2004). The questionnaires were written both in Thai and English to avoid misunderstanding or confusion. All of the questions were closed-end to ensure a quantitative perception for each participant. Questionnaires were given to the experimental group only and were administered after the completion of the immediate vocabulary post-test. The questionnaire consisted of two parts. The first part included questions related to the students' background information. The second part included questions on the students' attitudes towards the use of digital flashcards. There were 15 items and students had 30 minutes to complete the questionnaire. Students were asked to rate their views towards the study methods according to a 5-point Likert-scale: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

Strongly agree	5	points
Agree	4	points
Neutral	3	points
Disagree	2	points
Strongly disagree	1	point

The result of questionnaire were interpreted with the following range

4.50 – 5.00	=	Very high
3.50 – 4.49	=	High
2.50 – 3.49	=	Moderate
1.50 – 2.49	=	Low
1.00 – 1.49	=	Very Low

3.4 Establishing the test reliability and validity

The reliability and validity of these research instruments was assessed via the Index of Item-Objective Congruence (IOC) method. Three Thai experts who had taught English at the university for more than five years were asked to rate the congruence between objectives and items in the test. These ratings were then used to calculate the IOC, as follows:

+1 means	a test item is considered congruent with the objectives
0 means	a test item is considered neutral in terms of whether it is congruent with the object
-1 means	a test item is considered not congruent with the objective

The IOC (Index of Item-Objective Congruence) is then used to measure the consistency of each item.

$$IOC = \frac{\sum R}{N}$$

IOC	means	the index of congruence
R	means	the total score from the score the opinion of the experts
N	means	a number of experts

The instruments with an IOC value equal to or higher than 0.5 were retained, and items with a score lower than 0.5 was removed. This yielded the following IOC scores for each test: 0.75 for the L2 Translation Test (L2TT), 0.75 for the L1 Translation Test (L1TT), 0.50 for the vocabulary knowledge of spelling, 0.50 for the vocabulary knowledge of spelling L2 cloze test, and 0.75 for the students' attitudes questionnaire.

The reliability of these research instruments was also assessed via a pilot study with 60 grade six students from another government primary school. The students in the pilot study had similar characteristics, in terms of educational background, as the participants in the main study. The students in the pilot study completed the four tests (L2TT, L1TT, Vocabulary knowledge of spelling, Vocabulary knowledge of spelling L2 cloze test). The results from these tests were then analyzed using coefficient Cronbach alpha, Cronbach's alpha is a measure of internal consistency or reliability,

that is, how closely related a set of items are as a group. The results of Cronbach alpha coefficient were as follows: 0.81 for the L2TT, 0.84 for the L1TT, 0.72 for the vocabulary knowledge of spelling, and 0.74 for the vocabulary knowledge of spelling L2 cloze. Therefore, the four tests were reliable to be used as research instruments in the current study.

3.5 Data collection procedure

The data collection procedure was completed over twelve teaching periods. In the first week, a vocabulary checklist test was given to both experimental and control groups. This test included 146 words based on the school textbook, Say Hello Grade Six. Participants had 60 minutes to mark their unknown words. To answer the checklist test, the student had to check (✓) if they knew the word and write its meaning. The participants were asked to mark a cross (×) if the given word was unknown. Based on the vocabulary checklist test results, 80 words that were the most unknown to the students were identified as the vocabulary to be taught during the experimental period.

Regarding the test administration, the productive tests of vocabulary knowledge were administered first, followed by the receptive tests of vocabulary knowledge. The productive measures of vocabulary knowledge were given first to avoid the possibility that they might draw a connection between familiar words on the receptive vocabulary knowledge and their spellings and meanings on the productive vocabulary knowledge tasks. A 15-minute break was provided between the productive and receptive tests to reduce participants' fatigue. Before the tests were administered, the instructions and a few examples of the tests were provided to all participants in their native Thai language. The same tests were administered again in the same order after the experiment had been completed. The survey questionnaires were also administered to the participants in the experimental group at the end of the teaching period to assess their attitudes towards the deliberate vocabulary teaching approach using the digital flashcards. Figure 1 illustrates the research procedure of the present study:

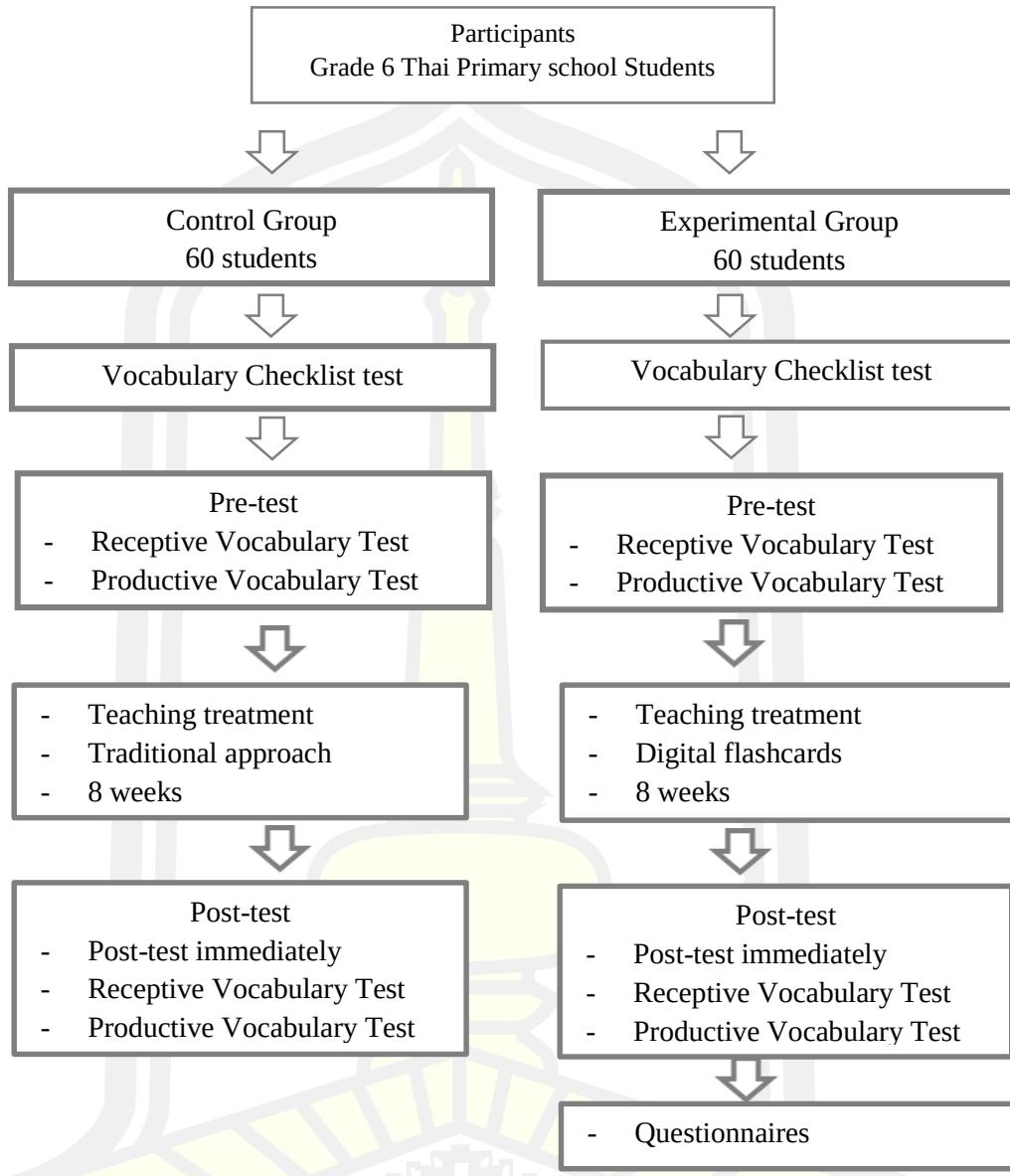


Figure 1: Research Procedure

3.6 Procedures and principles in learning from digital flashcards

Table 9 outlines the procedures and principles that are used to select the words to learn, and to make and use the digital flashcards. Each of these procedures is based on the application of research-based principles.

Table 9: Principles and procedures in the word card strategies (Nation, 2013, p.446)

1. Choosing words to learn	- Learn useful words. - Avoid interference.
2. Making word cards	- Put the word or phrase on one side and the meaning on the other to encourage retrieval.
3. Using the word cards	- Use retrieval. - Space the repetitions, particularly the first one. - Learn receptively, then productively. - Start with small packs (or blocks) of words and increase the size as learning becomes easier. - Keep changing the order of words in the packs. - Say the words aloud or to yourself. - Put the word or phrase in a sentence or with some collocations. - Process the word deeply and thoughtfully using the mnemonic techniques of word parts or the keyword technique where feasible and necessary.

Note: Slightly adapted from Nation's (2013, p. 446) framework

Choosing a word to learn

Choosing words to learn was the first step in the flashcard strategy. Learning useful words was the priority when making the digital flashcards. As such, the words should be high-frequency words and words that fulfil language use needs. Teachers should avoid interference by separating similar words, same lexical sets, and synonyms, to ensure that learners were not confused with those similarities (Erten & Tekin, 2008; Higa, 1963; Papathanasiou, 2009; Tinkham, 1993; Waring 1997b)

Making digital flashcards

Microsoft PowerPoint was used to create the digital flashcards and to present each word. Each word had two slides. The first slide was a word and picture, if possible. Webber (1978) found that images improve learning and others have also reported that L1 learning was faster in young learners in pictures were used (Chen, 1990; Lotto and De Groot, 1998; Tonzar et al., 2009). The second slide included English words and the meaning of the words in Thai on the other side. Previous research has shownn that learning is more effective if the meaning is translated into the first language (Lado et al., 1967; Laufer & Shmueli, 1997; Mishima, 1967). The flashcards were kept simple yet interesting by using animation and sound effects. The words were arranged from difficult to easy to ensure the learners pay attention (Baddeley, 1990: 52).

Using digital flashcards

Using the digital flashcard was the final step of the flashcard strategy. Digital flashcards were used for retrieval by allowing learners to retrieve the meaning of the word from their memory when the second language word was presented on one side of flashcards (Karpicke & Roediger, 2007). Flashcards had to be used repetitively because one exposure is not sufficient for L2 learners to gain vocabulary knowledge of that word (Nation, 2013). Students were provided with the following guidelines for using the flashcards: (1) retrieve rather than recognize, (2) use suitable size of cards, about 15 or 20 words, (3) space the repetitions, (4) repeat the words aloud to absorb into long-term memory, (5) use depth processing technique in making words, (6) avoid interference, (7) keep changing the order of the words in the pack, and (8) use context and collocating words (Tabrizi & Feiz, 2016). Putting known words aside and concentrating on the difficult words can also help to learn and retain the meaning of the difficult or unknown word (Arktison, 1972).

By contrast, the treatment used for the control group was the traditional teaching method. The teacher used books, papers, and printed materials during the treatment. Both the experimental and control groups were taught the same topic during the eight week teaching period. The lesson topics are shown in Table 10.

Table 10: Lesson topics for each week of the teaching period

Topic 1	My hobby
Topic 2	Shopping
Topic 3	Food and Drink
Topic 4	Place and Travel
Topic 5	Culture and Festival
Topic 6	Weather and Season
Topic 7	School subjects
Topic 8	Jobs

After eight weeks of teaching, a vocabulary post-test was given to all participants. The test content was the same as in the pre-test. This test aimed to investigate whether direct vocabulary instruction using digital flashcards had any significant impact on the overall vocabulary achievement of the participants. This test was administered after the eight weeks treatment had finished. The participants in both groups were given 50 minutes to complete the test. Every correct answer was awarded one point and no points were awarded for incorrect responses. The total possible score was 80.

3.7 Data Analysis

The descriptive statistics including mean ($\bar{X}$), standard deviation (S.D.) in the Statistical Package for the Social Science (SPSS) program were employed in the analysis of quantifying the questionnaire data with significant level of 0.05.

For the four test, the scores for each test were analyzed by descriptive statistics including mean ($\bar{X}$), standard deviation (S.D.), and percentile in the Statistical Package for the Social Science (SPSS) program. After that, inferential statistic , t-test analysis, was used to analyzed whether test scores were statistically significant.

3.8 Summary

This research used a quantitative approach to assess the effects of digital flashcards on vocabulary learning in Grade Six Thai primary public school students. There were 120 students in this research. Students were divided into two groups: the control and experimental group, each group consisted of 60 students. Eighty English words that were unknown to the students were selected as target words for this treatment. The treatment period was eight weeks. During the treatment period, both groups were given a pre-test, that assessed both receptive and productive vocabulary knowledge. Then, the control group was taught using the Grammar – translation, traditional teaching method, while the experimental group was taught the digital flashcards teaching method. After the treatment period, both groups were given the same immediate post-test. The student's attitudes questionnaire was given to the experimental group only, and data were analyzed using mean, S.D, and t-test correlation.

CHAPTER IV
RESULTS

This chapter describes the research results, and statistical analyses used to address the research questions. The first section presented the analyses related to receptive vocabulary knowledge, summarizing the participants' performance on the L2 translation test (L2TT) and the spelling test. The second section presented the analyses on productive vocabulary knowledge. Finally, the results related to the students' perceptions of pedagogical implementation using flashcards are described.

4.1 Receptive vocabulary knowledge results

4.1.1 Receptive word meaning (L2 Translation Test)

The L2 translation test measured primary school participants' receptive knowledge of the form-meaning aspect. Specifically, this test assessed the participants' ability to provide an L2 meaning of the target word. Table 11 shows the summary of Thai primary school students' performance on the L2 translation test. The results indicated an increase in L2 translation test performance in both experimental and control groups. Overall, the analysis also showed that the experimental group students performed higher than the control group counterparts. Specifically, the experimental group students achieved an average performance of 47.50% (SD = 0.68) on the pretest and 66.25% (SD = 0.78) on the posttest. By contrast, the control group participants scored an average of 47.50 (SD = 0.71) on the pretest and 55.00% (SD = 0.63) on the posttest. A dependent-samples *t*-test was also conducted to detect differences between pre-and posttest scores within each group. Post-test scores were significantly higher than pretest scores in both the experimental groups (*t*-value = 11.33, *p*-value < 0.000) and the control group (*t*-value = 5.61, *p*-value < 0.001). In addition, the independent samples *t*-test was also conducted to determine whether there was any significant difference between groups. It was worth noting that there was no significant difference in the pretest performance between the two groups (*t*-test = 0.00, *p*-value = 1.000). However, the analysis revealed a significant difference in the posttest performance between the control and the experimental groups (*t*-test = 17.38, *p*-value = 0.000). These findings indicated a significant increase in the knowledge of form-meaning connections over time.

Table 11: Thai primary school students' performance on the L2 Translation Test (L2TT)

		Pretest			Post-test				
Group	**N**	**Mean**	**%**	**S.D.**	**Mean**	**%**	**S.D.**	***t*-test**	***p*-value**
Experimental	60	9.5	47.50%	0.68	13.25	66.25%	0.78	11.33	0.000*
Control	60	9.5	47.50%	0.71	11.00	55.00%	0.63	5.61	0.001*
***t*-test**		0.00			17.38				
p-value		1.000			0.000*				

*=p value < 0.05

Figure 2 shows grade six primary school students' performance on form-meaning aspects. The graph revealed that both groups did not differ in their pre-test performance ($\bar{x}$=9.50). In contrast, there was a significant difference in the posttest performance between the experimental ($\bar{x}$=13.25) and control groups ($\bar{x}$=11.00). Both groups improved their receptive form-meaning skill at a significant level; the experimental group outperformed the control group significantly. It can be concluded that the current study provided evidence that digital flashcards improved vocabulary learning and development among Thai primary school students in receptive form-meaning knowledge.

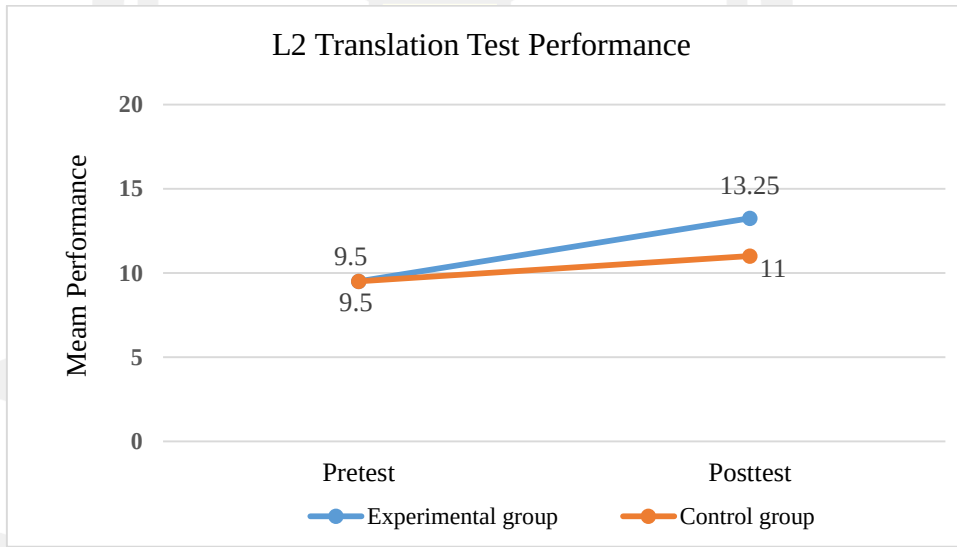


Figure 2: Students' performance on the L2 Translation Test (L2TT)

4.1.2 Receptive word form (vocabulary knowledge of spelling)

The vocabulary knowledge spelling test measured primary school participants' receptive knowledge of the form-spelling aspect. This test assessed the participants'

ability to form or spell the target word. Table 12 summarizes Thai primary school students' performance on vocabulary knowledge tests.

Statistical analyses revealed that, overall, the experimental group students performed better than the control group counterparts. Specifically, the experimental group students achieved an average performance of 48.75% (SD = 0.74) on the pretest and 61.25% (SD = 0.98) on the posttest. Control group participants scored an average of 47.50% (SD = 0.66) on the pretest and 51.25% (SD = 0.72) on the posttest. A dependent-samples *t*-test indicated that both the experimental (*t*- value = 7.88, *p*-value < 0.00) and control group (*t*-value = 6.34, *p*-value < 0.01) performed better on the posttest than on the pretest. In addition, the independent samples *t*-test was also conducted to determine whether there was any significant difference between groups. It was worth noting that there was no significant difference in the pretest performance between the two groups (*t*-test = 1.95, *p*-value = 0.053). However, the analysis revealed a significant difference in the posttest performance between the control and the experimental groups (*t*-test = 12.74, *p*-value = 0.000). These findings indicated a significant increase in the knowledge of form-spelling connections over time.

Table 12: Students' overall performance on vocabulary knowledge of spelling

		Pretest			Post-test				
Group	**N**	**Mean**	**%**	**S.D.**	**Mean**	**%**	**S.D.**	***t*-test**	***p*-value**
Experimental	60	9.75	48.75%	0.74	12.25	61.25%	0.98	7.88	0.000*
Control	60	9.5	47.50%	0.66	10.25	51.25%	0.72	6.34	0.01*
***t*-test**		1.95			12.74				
***p*-value**		0.053			0.000*				

*=p value < 0.05

Figure 3 shows grade six primary school students' performance on the form-spelling aspect. The graph revealed that there was a slight difference between the groups in their pre-test performance (*Experimental group, $\bar{x}$=9.75; Control group, $\bar{x}$=9.5),* whereas there was a significant difference in the posttest performance between the experimental ($\bar{x}$= *12.25*) and control groups ($\bar{x}$=*10.25*). This further supports the positive effect of digital flashcards on vocabulary learning and development among Thai primary school students on receptive form-spelling knowledge.

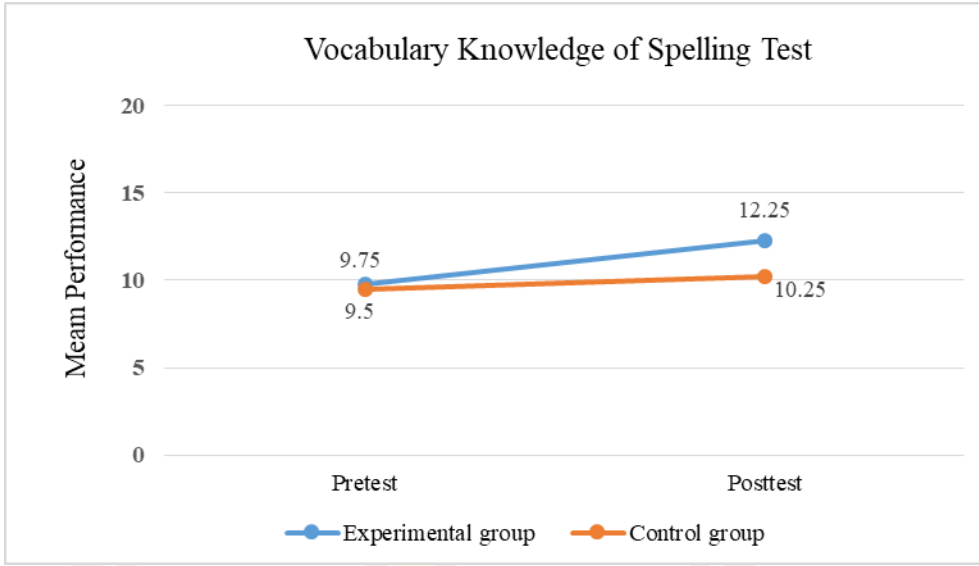


Figure 3: Students' overall performance on vocabulary knowledge of spelling

4.2 Productive vocabulary knowledge results

4.2.1 Productive word meaning (The L1 Translation Test)

The L1 Translation Test (L1TT) measured primary school participants' productive knowledge of the form-meaning aspect. Specifically, this test assessed the participants' ability to provide an L1 meaning of the target word. Table 13 summarises Thai primary school students' performance on the L1 translation test. The results showed that the experimental group achieved higher scores than the control group. Specifically, the experimental group students achieved an average performance of 43.75% (SD = 0.74) on the pretest and 60.25% (SD = 0.71) on the posttest, whereas the control group participants scored an average of 42.50% (SD = 0.66) on the pretest and 53.75% (SD = 0.65) on the posttest. A dependent-samples t-test indicated that posttest scores were significantly higher than pretest scores for participants in the experimental group (t-value = 7.88, p-value < 0.000) and the control group (t-value = 6.34, p-value < 0.05). In addition, the independent samples t-test was also conducted to determine whether there was any significant difference between groups. It was worth noting that there was no significant difference in the pretest performance between the two groups (t-test = 1.95, p-value = 0.053). However, the analysis revealed a significant difference in the posttest performance between the control and the experimental groups (t-test = 15.93, p-value = 0.000).

These findings indicated a significant increase in the knowledge of productive form-meaning connections over time.

Table 13: Students' overall performance on the L1 Translation Test (L1TT)

		Pre-test			Post-test				
Group	**N**	**Mean**	**%**	**S.D.**	**Mean**	**%**	**S.D.**	***t*-test**	***p*-value**
Experimental	60	8.75	43.75%	0.74	13.25	60.25%	0.71	7.88	0.001*
Control	60	8.50	42.50%	0.66	11.00	53.75%	0.66	6.34	0.049*
***t*-test**		1.95			15.93				
***p*-value**		0.053			0.000*				

*=p value < 0.05

Figure 4 shows the students' performance on the productive form-meaning aspect. Both groups revealed a slight difference in the pre-test performance between groups (*Experimental group =$\bar{x}$=8.75; Control group=$\bar{x}$=8.50.*) However, there was a significant difference in the posttest performance between the experimental (*$\bar{x}$=13.25*) and control groups (*$\bar{x}$=11.00*). This further supports the positive effect of digital flashcards on vocabulary learning and development among Thai primary school students on productive form-meaning knowledge.

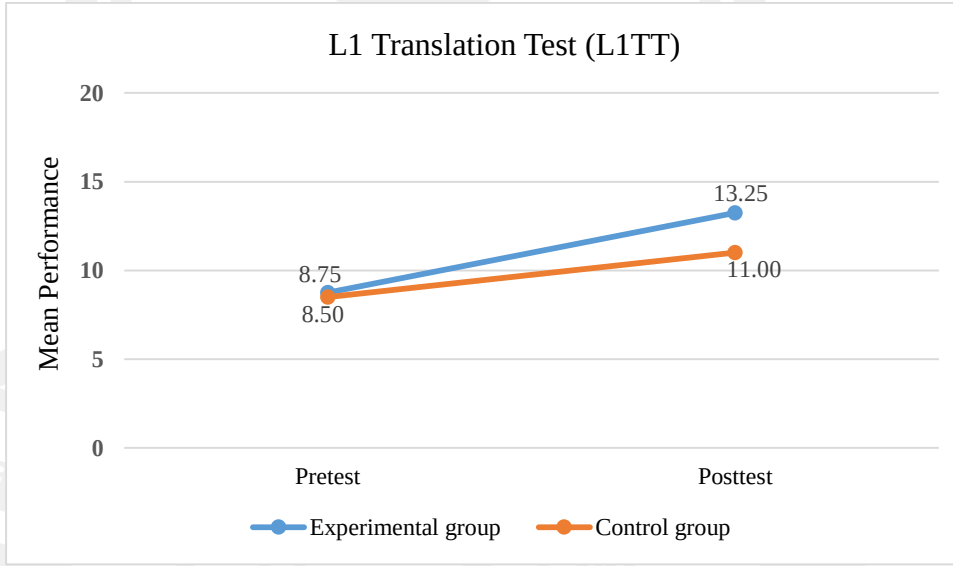


Figure 4: Students' overall performance on the L1 Translation Test (L1TT)

4.2.2 Productive word form (spelling L2 cloze test)

The vocabulary knowledge of the spelling test was used to measure participants' productive knowledge of the form-spelling aspect. This test assessed the participants' ability to form the target word. Table 14 summarises Thai primary school students'

performance on this test. Overall, the analysis showed that the experimental group students performed higher than the control group counterparts. Specifically, the experimental group students achieved an average performance of 45.00% (SD = 0.91) on the pretest and 58.75% (SD = 0.98) on the posttest. Control group participants scored an average of 43.75% (SD = 0.72) on the pretest and 51.25% (SD = 0.72) on the posttest. A dependent-samples t-test indicated that posttest performance was higher than pretest performance for both experimental (*t*-value = 10.55, *p*-value < 0.001) and control groups (*t*-value = 7.35, *p*-value < 0.05). In addition, the independent samples *t*-test was also conducted to determine whether there was any significant difference between groups. It was worth noting that there was no significant difference in the pretest performance between the two groups (*t*-test = 1.67, *p*-value = 0.098). However, the analysis revealed a significant difference in the posttest performance between the control and the experimental groups (*t*-test = 9.25, *p*-value = 0.000). These findings indicate a significant increase in the knowledge of productive form-spelling connections over time.

Table 14: Students' overall performance on vocabulary knowledge of spelling

		Pretest			Post-test				
Group	**N**	**Mean**	**%**	**S.D.**	**Mean**	**%**	**S.D.**	***t*-test**	***p*-value**
Experimental	60	9.00	45.00%	0.91	11.75	58.75%	0.98	10.55	0.001*
Control	60	8.75	43.75%	0.72	10.25	51.25%	0.72	7.35	0.049*
***t*-test**		1.67			9.25				
***p*-value**		0.098			0.000*				

*=p value < 0.05

Figure 5 shows the students' performance on the productive form-spelling aspect. Both groups revealed that there was a slight difference in the pre-test performance (*Experimental group, $\bar{x}$=9.00; Control group, $\bar{x}$=8.75*); however, the experimental group highly outperformed the control group in the posttest performance (*Experimental group, $\bar{x}$=11.75; Control group, $\bar{x}$=10.25*). This further supports the positive effect of digital flashcards on vocabulary learning and development among Thai primary school students on productive form-spelling knowledge.

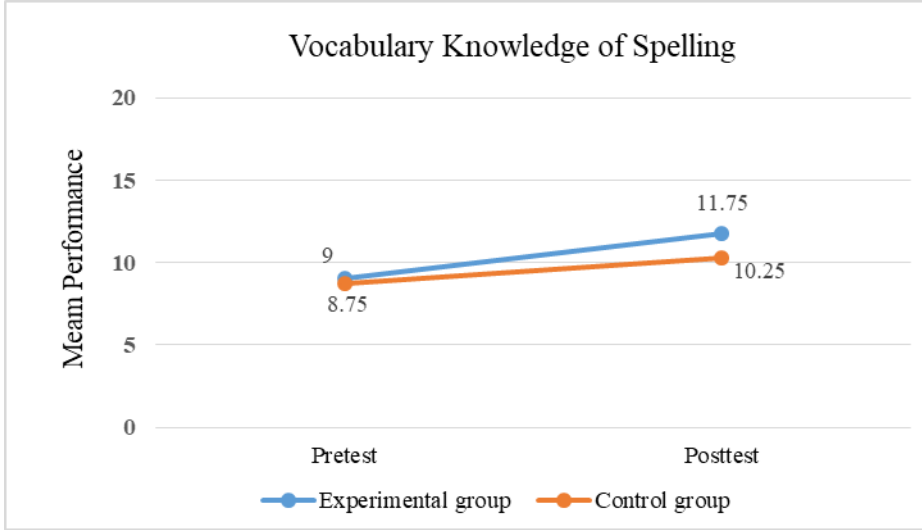


Figure 5: Students' performance on vocabulary knowledge of spelling L2 cloze test

4.3 Summary of overall performance

The quantitative data analysis derived from different vocabulary knowledge measures revealed that the experimental group participants outperformed their control group counterparts in all vocabulary knowledge tests. Table 15 and Figure 6 show a summary of the results.

Table 15: Summary of the results based on pretest and posttest performance

Group		Receptive word meaning		Productive word meaning		Receptive word form		Productive word form	
		Pre-test	Posttest	Pre-test	Posttest	Pre-test	Posttest	Pre-test	Posttest
Experimental	Mean	9.50	13.25	8.75	13.25	9.75	12.25	9.00	11.75
	S.D.	0.68	0.78	0.74	0.71	0.74	0.98	0.91	0.98
	%	47.50%	66.25%	43.75%	60.25%	48.75%	61.25%	45.00%	58.75%
Control	Mean	9.50	11.00	8.50	11.00	9.5	10.25	8.75	10.25
	S.D	0.71	0.63	0.66	0.65	0.66	0.72	0.72	0.72
	%	47.50%	55.00%	42.50%	53.75%	47.50%	51.25%	43.75%	51.25%
***t*-value**		0.00	17.38	1.95	12.74	1.95	15.93	1.67	9.25
***p*-value**		1.000	0.000	0.053	0.000	0.053	0.000	0.098	0.000

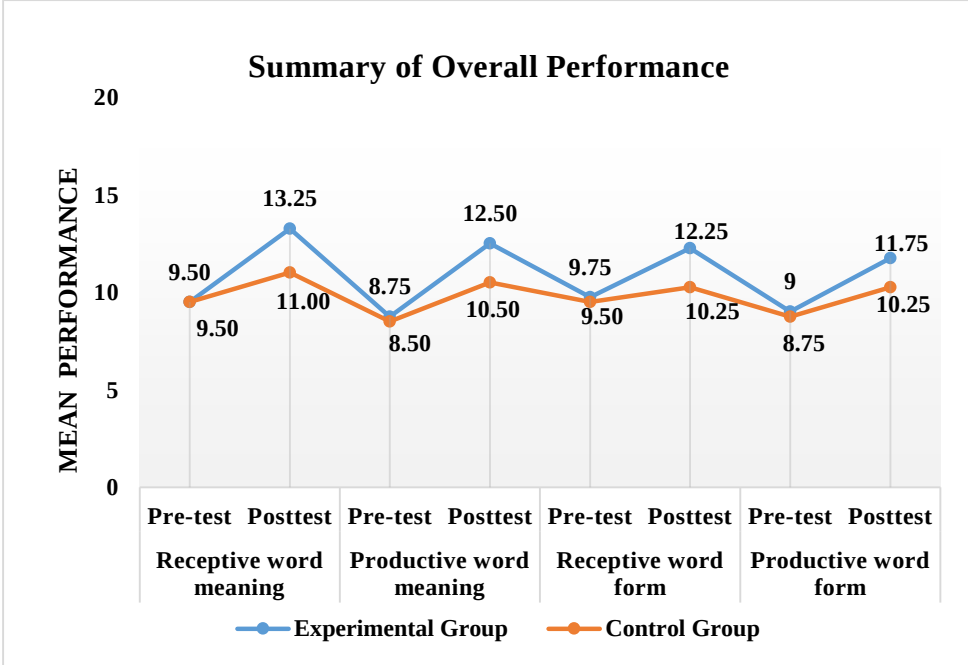


Figure 6: Thai primary school students' performance on receptive and productive vocabulary knowledge

Overall, this study demonstrates that the use of digital flashcards enhanced vocabulary knowledge among Thai primary school students. The findings also showed the developmental continuum of vocabulary learning after the intervention of digital flashcards. Moreover, the current findings showed that Thai primary school participants acquired vocabulary knowledge aspects differently in each skill. More precisely, the results showed that Thai primary school participants tended to gain word form-meaning (L2TT) before word-form-spelling (vocabulary spelling). Both groups of participants gained more knowledge of English vocabulary; however, experimental group participants significantly improved and outweighed the control group participants.

4.4 Students' perceptions toward using digital flashcards instruction

The questionnaire was used to explore the students' perceptions toward the use of digital flashcards to enhance vocabulary knowledge. The overall attitude for participants in using digital flashcards in vocabulary learning was very positive (90.43%), suggesting that the participants enjoyed studying with digital flashcards and

believed that digital flashcards were an effective instrument for learning English vocabulary.

Table 16: Student's Attitudes Questionnaire Analysis

No.	Items	$\bar{X}$	S.D.	%	Meaning
1	I enjoy learning vocabulary through digital flashcards from electronic devices.	4.78	0.65	95.62%	Very high
2	I think digital flashcards assist me in recognizing the meanings of the words.	4.77	0.74	95.51%	Very high
3	I think using digital flashcards is a good way in learning vocabulary.	4.73	0.63	94.52%	Very high
4	Using digital flashcards helped me to improve my recognition and recall of words.	4.71	0.78	94.25%	Very high
5	I enjoy using digital flashcards to learn vocabulary.	4.66	0.87	93.14%	Very high
6	I think digital flashcards guide me to spell the words.	4.65	0.67	93.12%	Very high
7	I feel comfortable when I use digital flashcards to learn vocabulary.	4.58	0.79	91.56%	Very high
8	Digital flashcards are appropriate for learning vocabulary at my level.	4.56	0.73	91.14%	Very high
9	I think digital flashcards facilitate me in becoming familiar with words.	4.45	0.54	89.03%	Very high
10	I feel motivated when I use digital flashcards to learn spelling and meaning.	4.42	0.72	88.31%	Very high
11	I think the pictures from digital flashcards assist me in recalling the words.	4.34	0.44	86.83%	High
12	I think the pictures in digital flashcards enable me in recalling the words.	4.33	0.69	86.63%	High
13	I feel much better when I use digital flashcards to learn spelling and meaning.	4.33	0.66	86.58%	High
14	Using digital flashcards allow me to learn new vocabulary.	4.26	0.68	85.15%	High
15	I feel that learning vocabulary by categorizing words into themes would help me recognize words faster easily.	4.25	0.71	85.03%	High
	Total	4.52	0.52	90.43%	Very high

The results from the questionnaire are shown in Table 6. A score of 5 indicated that the students strongly agreed with the statement, whereas a score of 1 indicated that students strongly disagreed. As shown in Table 6, 10 statements had a very high mean score between 4.35-4.78, and the remaining five had a high mean score between 4.25 - 4.33. The overall mean of the attitude questionnaire was 4.52 (S.D. = 0.52). The highest mean score was 4.78, obtained by statement 1 (*I enjoy learning vocabulary through digital flashcards from electronic devices).* This shows that the students enjoy

using digital flashcards and are more interested in learning when these electronic devices are used. This highest score is followed by the score of statement 2 (*I think digital flashcards assist me in recognizing the meanings of the words)*. It shows that students agree that the digital flashcard teaching helps them improve their vocabulary knowledge during the lecture. Statement 4 *(Using digital flashcards helped me to improve my recognition and recall of words*) was rated 4.71, suggesting that digital flashcards play an important role in making students easily recall and recognize the learned words.

The lowest mean score was 4.25, obtained by statement 15 (*I feel that learning vocabulary by categorizing words into themes would help me recognize words faster easily*), followed by statement 14 which scored 4.26 *(Using digital flashcards allow me to learn new vocabulary*). This indicates that some students did not feel that their learning was enhanced by the digital flashcard intervention.

In summary, the current findings indicate that eight weeks of digital flashcards intervention improved the students' vocabulary knowledge. Most participants were satisfied with the digital flashcards intervention as it helped them learn new vocabulary and enhance their vocabulary knowledge.

CHAPTER V
DISCUSSION AND CONCLUSION

The previous chapter proposed the study conclusions and answered the research questions. This chapter further explained and discussed the current results in the context of prior studies. Overall, the present study's findings revealed a deep understanding of the effectiveness and effects of using digital flashcards in teaching vocabulary and providing vocabulary knowledge to L2 learners, especially in a Thai EFL context. This chapter discussed the contributions of these findings to current pedagogy and vocabulary acquisition research. Finally, this chapter proposed the implications for vocabulary learning in using digital flashcards and recommendations for future studies.

5.1 The effect of digital flashcards on the form-meaning link of English vocabulary knowledge among Thai EFL primary school students

In response to Research Question 1 (What are the effects of digital flashcards on vocabulary learning among Thai EFL primary students), the quantitative data derived from four receptive and productive vocabulary skills tests were analyzed. The analysis of the current findings revealed the significant effects of digital flashcards on vocabulary knowledge among Thai primary school students. Specifically, primary school participants' vocabulary knowledge measured by three different tests significantly increased. However, in both cohorts of participants' word knowledge increase, the experimental participants' gain is substantially higher than their control peers. These findings suggest the benefits of digital flashcards in enhancing vocabulary learning. These results align with previous studies that digital flashcards benefit vocabulary learning processes (Nakara, 2011).

The account of the significant increase in vocabulary knowledge through digital flashcards is the result of the effectiveness of intentional vocabulary learning. That is, deliberate vocabulary learning speeds up learners' vocabulary development process due to focused repetition or memorization strategies. These strategies can be completed individually in a short period of time. The result also argues that intentional vocabulary learning retention rates are higher than those obtained with

incidental vocabulary learning (Hustijn, 2003). These suggest that deliberate attempts to learn vocabulary are effective and worth the effort. Another explanation of the development of vocabulary knowledge could be grounded in Schmidt's (2010) noticing hypothesis, indicating that seeing is the necessary condition for L2 vocabulary learning. As applied to vocabulary activities using digital flashcards, primary school participants must consciously notice L2 features or characteristics of the target words in the input activities and pay deliberate attention to form-meaning links of lexical items to optimize their learning. For these reasons, vocabulary is commonly taught explicitly and directly in foreign language classrooms to compensate for the limited exposure and resources that may otherwise be available. These findings align with previous studies that were learning deliberate vocabulary through word cards, or digital flashcards is very effective (Hung, 2015; Magnussen & Sukying, 2021; Nation, 2011).

The gain in knowledge of the form and meaning of the target words could be explained by the deliberate learning of vocabulary input that allows learners to practice form-to-meaning and meaning-to-form recall in repeated retrieval of the target words. In this regard, the directed conscious vocabulary learning through the digital flashcards facilitate students better remember and recall L2 vocabulary.

The significant gain in vocabulary knowledge could be explained by the cognitive processes of noticing and retrieval. Specifically, noticing involves a learner's attention to the target L2 word. While the noticing process directs or leads to L2 words being learned, the retrieval reinforces the meaning of the individual word in the learner's mind. This suggests that the more frequent the retrieval of the particular lexical item in a learning process, the greater the opportunity the target word will acquire more profound in the learner's memory. Indeed, these new encounters push learners toward a reconceptualization of their knowledge of such words. This phenomenon helps the students establish the memory of this word, and that is when digital flashcards meet these criteria and advance vocabulary knowledge. Deliberate vocabulary learning significantly outperformed the incidental group on vocabulary tests (Tabrizi & Feiz, 2016). Deliberate attempts to learn vocabulary are effective and worth the effort (Nation & Meara, 2010). These results are consistent with previous studies that

repetition and retrieval of the L2 word extend its meaning or definition, and repetitive exposure to and use of it will lead to the learner to better understand each meaning of the word students encounter (Elgort, 2011; Elgort & Nation, 2010; Hung, 2017; Hustijn, 2003; Kerdmuenwai, 2018; Magnussen & Sukying, 2021; Nation, 2013; Nation & Meara, 2010; Vidal, 2011; Waring & Donkaewbua, 2008). To conclude, the current study reaffirms the efficacy of digital flashcards for vocabulary learning and teaching.

5.2 Thai EFL primary school students' attitude about using digital flashcards

In response to Research Question 2, the quantitative data were derived from the questionnaire given to experimental group participants to explore the participants' attitudes toward the use of digital flashcards to enhance vocabulary knowledge. The analyses of the five-point Likert scale questionnaires indicate that, on average, primary school students have a high level of satisfaction with digital flashcards concerning rote vocabulary learning. The current findings showed that the positive attitudes towards deliberate vocabulary learning through the digital flashcard could be due to its simplistic features, easy to make; convenient to use or change according to the current context. Although flashcard learning is decontextualizing, flashcards are an effective mechanism for vocabulary learning and can provide vocabulary knowledge to learners through retrieval on spacing repetitions. Another explanation of the high satisfaction of digital flashcards could be because flashcards quickly speed up vocabulary knowledge for students. Furthermore, flashcards could boost learners' memory. The current findings are consistent with previous studies that flashcards facilitate learners focusing on form and meaning simultaneously for repeated retrieval of vocabulary items (Dizon & Tang, 2017; Magnussen & Sukying, 2021; Yuksel et al., 2020; Wilkinson, 2017)

The benefits of digital flashcards in accelerating deliberate vocabulary learning among Thai primary school students could be because of their efficacy, ubiquity and entertainment value. The flashcards include visual images and sounds, which could motivate students to learn the meaning and spelling of individual words. In addition, flashcards could assist students in memorizing and recalling vocabulary items more effectively. To sum up, the current findings provide support to the existing literature

that digital flashcards are an effective tool for deliberate vocabulary learning (Chung & Nation, 2004; Dizon & Tang, 2017; Nation, 2013; Nation & Meara, 2010; Vidal, 2011; Waring & Donkaewbua, 2008).

5.3 Conclusion of the study

The primary objective of this study was to investigate the effect of digital flashcards to enhance vocabulary learning among Thai primary school students. Through the analysis of the findings obtained from the students' four measures of form-meaning vocabulary knowledge, it was found that digital flashcards are an effective method for deliberate vocabulary learning, indicating a substantially higher level of improvement. Using digital flashcards facilitates students' involvement in classroom activities and motivate them to engage in the lesson. The current study also showed that the experimental group receiving the treatments on digital flashcards significantly improved performance in all four vocabulary tests than the control peers. The present study can reaffirm that digital flashcards are a useful method of enhancing L2 vocabulary learning and play an essential role in teaching and learning vocabulary to Thai primary school students. The study also showed that students have more robust motivation to learn new vocabulary through the use of digital flashcards. In conclusion, the current study confirms the significant benefits of digital flashcards in vocabulary learning.

5.4 Implications of the study

The current study has yielded several important implications. First, since vocabulary is an essential component of language learning, practitioners need to equip themselves with up-to-date technological pedagogical approaches. Specifically, the current study can be helpful for language teachers at all education levels. The current study could also help practitioners with foreign language teachings, such as syllabus planners, material developers and test developers. In addition, the current findings are also applicable to the learning of language skills and sub-skills, including listening, speaking, pronunciation, vocabulary and grammar. Specifically, this study proved the effectiveness of digital flashcards to facilitate vocabulary learning and teaching.

5.5 Limitations of the study

Due to the Covid-19 pandemic, certain limitations are imposed on the current study. First, the study participants chosen conveniently for the study were restricted to one government primary school in Northeastern Thailand because the government imposed social distancing measures and some lectures were carried online, and ehthic review was applied to one school only. Second, the researcher selected the target L2 words from the school textbook and compared them with the wordlist of the national curriculum because this textbook was assigned to be a curriculum textbook for grade six primary school; therefore it was chosen as a school textbook.

5.6 Suggestions for further studies

Due to its limitations, the current study would suggest those willing to investigate this area of L2 vocabulary research further, especially studies on the efficacy of using flashcards or word cards. First, students at other language proficiency levels are suggested, including different levels of education and various learning conditions and contexts. Second, interested researchers can investigate the effect of other types of alternative flashcard techniques on language skills, such as picture flashcards and paper flashcards. Third, exploring the relationship between digital vocabulary flashcards and learners' motivation and retention would be fruitful. Finally, more studies with heterogeneous populations may be needed to compare the differences in vocabulary improvement.

REFERENCES

REFERENCES

Alnajjar, M., & Brick, B. (2017). Utilizing Computer-Assisted vocabulary learning tools in English language teaching: Examining in-service teachers' perceptions of the usability of digital flashcards. International Journal of Computer-Assisted Language Learning and Teaching January 2017. doi:10.418/IJCALLT.2017010101

Anderson, J. C., & Freebody, P. (1981). Vocabulary knowledge. In J. T. Guthrie (Ed.). *Comprehension and teaching*, 77-177.

Astika, G. (1993). Analytical assessment of foreign students' writing. *RELC Journal, 24*, 61-72.

Baleghizadeh, S., & Ashoori, A. (2011). The Impact of two instructional techniques on EFL learners' vocabulary knowledge: Flash card-based instruction versus word lists. *MEXTESOL Journal*, *35*(2), 1–9.

Bernhardt, E. B., & Kamil, M. L. (1995). Interpreting relationships between L1 and L2 reading: Consolidating the linguistic threshold and the linguistic interdependence hypotheses. *Applied Linguistics, 16*, 15-34.

Cronbach, L. J. (1951). Essentials of psychological testing. New York: Harper & Row.

Durgunoglu, A. Y. (1997). Bilingual reading: Its components, development, and other issues. *Tutorials in bilingualism*, 255-276.

Elgort, I. (2011). Deliberate Learning and Vocabulary Acquisition in a Second Language. *Language Learning*, *61*(2), 367-413.

Engber, C. (1995). The relationship of lexical proficiency to the quality of ESL compositions. *Journal of Second Language Writing, 4*, 139-155.

Gairns, R. & Redman, S. (1986). Working with words: A guide to teaching and learning vocabulary. USA: Cambridge University Press

Hulstijn, J. H. (1997). Mnemonic methods in foreign language vocabulary learning. Theoretical considerations and pedagogical implications. In J.

Hulstijn, J. H. (2003). Mnemonic methods in foreign language vocabulary learning. Theoretical considerations and pedagogical implications. In J.

Hung H.T. (2015). Intentional vocabulary learning using digital flashcards. English Language Teaching, 8(10), doi:10.5539/elt.v8n10p107

Jeensuk, S., & Sukying, A. (2021). An investigation of high school EFL learners' knowledge of English collocations. *Journal of Applied Linguistics and Language Research, 8*(1), 90-106.

Jeensuk, S., & Sukying, A. (2021). Receptive and Productive Knowledge of English Collocations among Thai EFL High School Learners. *มนุษย สังคม สาร (ม ส ส.) คณะมนุษยศาสตร์ และ สังคมศาสตร์ มหาวิทยาลัย ราชภัฏ บุรีรัมย์, 19*(1), 159-180.

Kerdmuenwai, S. (2018). Using Electronic Flashcards to Improve Vocabulary Learning of Mathayomsuksa 2 Students.Master of Arts Thesis in English, Graduate School, Khon Kaen University. Koda, K. (1989). The effects of transferred vocabulary knowledge on the development of L2 reading proficiency. *Foreign Language Annals 22*, 529-540.

Komachali, M. E., & Khodareza, M. (2012). The effect of using vocabulary flashcards on Iranian pre-university students' vocabulary knowledge. *International Education Studies, 5(3)*, 134-147.

Krashen, S. (1981). Second Language Acquisition and Second Language Learning. Oxford: Oxford University Press.

Laufer, B. (1992). How much lexis is necessary for reading comprehension? *Vocabulary and applied linguistics*, 126-132.

Laufer, B., & Hill, M. (2000). What lexical information do L2 learners select in a CALL dictionary and how does it affect word retention? Language Learning &Technology, 3, 58–76.

Laufer, B., & Hulstijn, J. H. (2001). Incidental vocabulary acquisition in a second language: The construct of task-induced involvement. *Applied Linguistics, 22*, 1–26.

Laufer, B., & Goldstein, Z. (2004). Testing vocabulary knowledge: Size, strength, and computer adaptiveness. *Language Learning, 54*(3), 399-436.

Magnussen, E.,& Sukying, A. (2021). The Impact of Songs and TPR on Thai Preschoolers'Vocabulary Acquistion. *THAITESOL Journal, 34(1),* 71-95.

Nakata, T. (2008). English vocabulary learning with word lists, word cards and computers: implications from cognitive psychology research for optimal spaced learning. *RECALL, 20*(1), 3-20.

Nation, & Laufer. (1995). Vocabulary size and use: Lexical richness in L2 written production. *Applied Linguistics, 16*, 307-322.

Nation, I. S. P. (2001). *Learning vocabulary in another language.* Cambridge: Cambridge University Press.

Nation, P. (2006). How large a vocabulary is needed for reading and listening? *The Canadian Modern Language Review, 63*, 59-82.

Nation, I. S. P. (2007). The four strands. Innovation in language learning and teaching, 1, 1–12.

Nation, P. (2013). *Learning vocabulary in another language.* Cambridge, England: Cambridge University Press.

Nation, I.S.P. (2014). How much input do you need to learn the most frequent 9,000 words? Reading in a Foreign Language, 26, 1–16.

Nontasee, W., & Sukying, A. (2020). The Acquisition of Vocabulary Knowledge in Thai EFL High School Students. *Journal of Humanities and Social Sciences,* 6(01), 63-87.

Nontasee, W., & Sukying, A. (2021). The learnability of word knowledge aspects in Thai EFL high school learners. *Journal of Language and Linguistic Studies, 17*(1), 34-55.

Promluan, Y., & Sukying, A. (2021). The Impact of Extensive Reading on Thai Primary School Children's Vocabulary Knowledge. *Journal of Modern Learning Development*, *6*(5), 209-223.

Office of the Basic Education Commission, Ministry of Education. .(2016) *Performance Report of Primary Schools.* Bangkok: Office of the Basic Education Commission, Ministry of Education.

Olinghouse, N. G., & Leaird, J. T. (2009). The relationship between measures of vocabulary and narrative writing quality in second- and fourth-grade students. *Reading and Writing: An Interdisciplinary Journal, 22*, 545-565.

Oxford, R.L. (1990). *Language learning strategies: What every teacher should know*. Heinle & Heinle Pub.

Rai sa-nguan, P. S., & Sukying, A. (2021). Narrow reading and EFL learners' vocabulary learning in a Thai Buddhist university. *Journal of Buddhist Education and Research, 7*(1), 1-15.

Robinson, P. (1995). Attention, Memory and the Noticing Hypothesis. *Language Learning 45*(2), 283-331.

Schmitt, N. (2000). *Vocabulary in language teaching*. Cambridge University Press.

Schmitt, N. (2008). Review article: Instructed second language vocabulary learning. *Language Teaching Research, 12*(3), 329–363

Schmitt, N. (2010). *Researching Vocabulary: A Vocabulary Research Manual*. Basingstoke: Palgrave Macmillan.

Sukying, A. (2017). *The relationship between receptive and productive affix knowledge and vocabulary size in an EFL Context*. [Doctoral dissertation, University of Sydney]. https://ses.library.usyd.edu.au/handle/2123/17630

Sukying, A. (2018a). The acquisition of English affix knowledge in L2 learners. *NIDA Journal of Language and Communication, 23*(34), 89-102.

Sukying, A. (2018b). Investigating receptive and productive affix knowledge in EFL learners. In D. Hirsh (Ed.), *Explorations in second language vocabulary research* (pp. 183-218). Peter Lang.

Sukying, A. (2020). Word knowledge through morphological awareness in EFL learners. *TESOL International Journal*, *15*(1), 74-85.

Sukying, A. (2021). Choices of Language Learning Strategies and English Proficiency of EFL University Learners. *LEARN Journal: Language Education and Acquisition Research Network, 14*(2), 59-87.

Sukying, A. (2022). A taxonomy of English affix acquisition in EFL learners. In D. Hirsh (Ed.). *Research perspectives in language and education* (pp. 49-82). Peter Lang.

Sung, Chang, & McLaughlin. (2016). Acquiring literacy in a second language: The effect of book-based programs. *Language Learning, 41*,, 375-411.

Tassana-ngam, I. (2004). *The effect of vocabulary learning strategies training on Thai university students' word retention in the second language classroom.* Essex: University of Essex.

The National Institute of Educational Testing Service (Public Organization). .(2021) *Primary Schools Annual Report.* Bangkok: The National Institute of Educational Testing Service (Public Organization).

Thiendathong, P., & Sukying, A. (2021). Vocabulary Learning Strategies Used by Thai High School Students in Science, Language, and English Programs. *Arab World English Journal (AWEJ) Volume*, *12*.

Thornbury, S. (2002). *How to teach vocabulary.* Harlow: Longman.

Thornbury, S. (2006). *How to teach vocabulary*. Pearson Education.

Waring, R. (1997). A study of receptive and productive learning from word cards. *Studies in Foreign Languages and Literature, 21*, 94-114.

Waring, R., & Takaki, M. (2003). At what rate do learners learn and retain new vocabulary from reading a graded reader? Reading in a Foreign Language,15, 130–163

Webb, S. A. (2005). Receptive and productive vocabulary learning: The effect of reading and writing on word knowledge. *Studies in Second Language Acquisition, 27,* 33-52.

Webb, S. A. (2008). Receptive and productive vocabulary sizes of L2 learners. *Studies in Second Language Acquisition, 30*, 79-95.

Webb. S., & Kagimoto, E. (2011). Learning collocations: do the number of collocates, position of node words, and synonymy affect learning? *Applied Linguist,* 32(3), 259- 276.

Wilkinson D. (2017). EFL Vocabulary Acquisition through word cards: student perceptions and strategies. The Electronic Journal for English as a Second Language, 21(2).

Wimolkasem, N. (1992). *A comparative study of two approaches to vocabulary instruction.* Nakorn Pathom: Unpublished thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts, Mahidol University.

Yu, F., & Sukying, A. (2021). English Vocabulary Learning by Smartphones of Chinese EFL Learners in Thailand. *Journal of Modern Learning Development*, *6*(1), 149-163.

Yuksel H.G., Mercanoglu H.G., Yilmaz M.B. (2020). Digital flashcards vs. wordlists for learning technical vocabulary. Computer Assisted Language

Yunus, K., & Mohammad, A. B. (2016). The Bredth of receptive vocabulary knowledge among English major university student. *Journal of Nusansara Studie,s 1(1),* 7-17.

Zhang, X., & Sukying, A. (2021). Receptive and productive knowledge of lexical collocations in Thai university learners of English. *European Journal of English Language Teaching*, *6*(6).

APPENDIXES

Appendix I-A: Receptive word meaning (The L2 Translation Test)

Instructions: Look at the following description and choose the words with the correct meaning.
(จงเลือกคำศัพท์ที่มีความหมายตรงกับคำอธิบายที่กำหนดให้)

~~Subject~~	Invite	Medicine	Dangerous	Tourist
Scienti	Liquid	Explore	Wealthy	Straight
Favorite	Photographer	History	Forest	Exchange
Stranger	Ocean	Dozen	Healthy	Direction
Vegetable				

Example: An area of knowledge that you study at a school Subject

1. A person who travels to another country for fun. .....

2. To ask a friend to come to my birthday party. .....

3. We eat this thing when we are sick. .....

4. A plant is used for food. .....

5. Something likely to cause an accident; not safe. .....

6. A person who takes photos as a career. .....

7. A very rich person. .....

8. To search or to find something or some information. .....

9. It is flowing freely like water. .....

10. Keeping in one direction without bending or curving. .....

11. Information that tell you how to go to a place. .....

12. A group of twelve. .....

13. A person who studies or works in one of the sciences. .....

14. The study of things or events that happened in the past. .....

15. A large area of land covered with many trees and other plants. .....

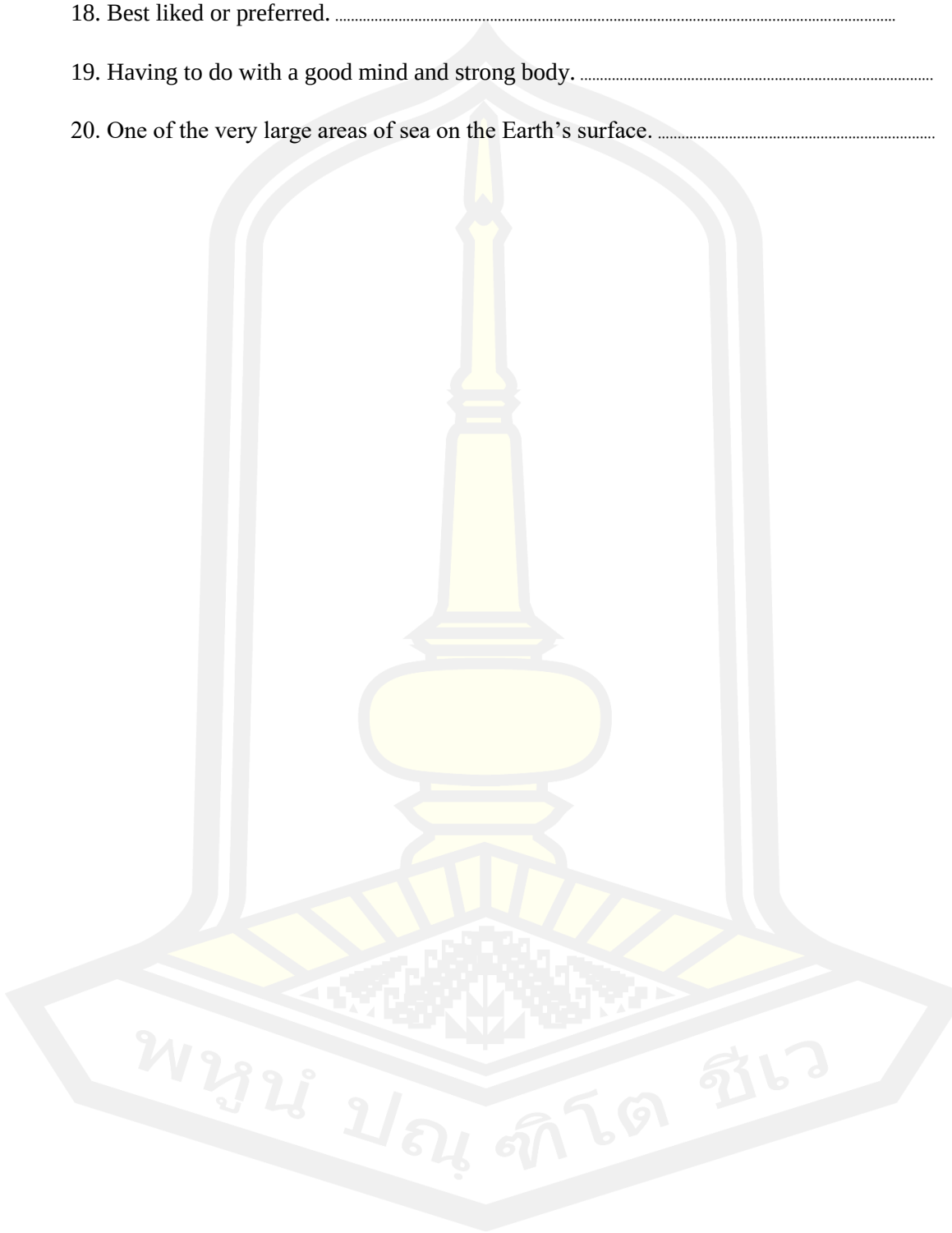
16. To give something to someone and receive something from that person. .....

17. Someone you do not know. .....

18. Best liked or preferred. .....

19. Having to do with a good mind and strong body. .....

20. One of the very large areas of sea on the Earth's surface. .....



Appendix I-B: Productive word meaning (The L1 Translation Test)

Instructions: Read the meaning of the following words in Thai and arrange the letters to form a correct word

(จงเรียงคำศัพท์ภาษาอังกฤษที่มีความหมายตรงกับคำศัพท์ในภาษาไทยโดยเขียนตามตัวอักษรที่กำหนดมาให้)

Word	Correct	Meaning
Example: p o o r a h p h e r g t	photographer	ช่างถ่ายภาพ
1. d t a i n c es	……	ระยะทาง
2. a e r f u l c	……	ระมัดระวัง
3. l e c e l e n x t	……	ดีเยี่ยม
4. c o i s u n	……	ลูกพี่ลูกน้อง
5. o c u h g	……	ไอ
6. o p s p i e o t	……	ตรงกันข้าม
7. a l n g u g e a	……	ภาษา
8. i o i n o n p	……	ความคิดเห็น
9. e e b t e w n	……	ระหว่าง
10. a v c t i e	……	คล่องแคล่ว

Word	Correct	Meaning
11. p l a i n x e	.....	อธิบาย
12. m o r t a n t p i	.....	สำคัญ
13. b a r c e e e l t	.....	เฉลิมฉลอง
14. o r g e t h e t	.....	ด้วยกัน,ร่วมกัน
15. c l u t u e r	.....	วัฒนธรรม
16. c a c e h n	.....	โอกาส
17. a a d w r	.....	รางวัล
18. a s m e	.....	เหมือนกัน
19. a u d l t	.....	ผู้ใหญ่
20. e o r n d m	.....	ทันสมัย

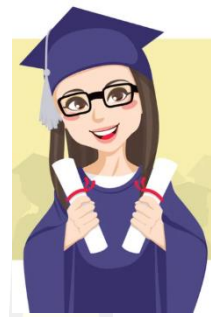
Appendix II-A: Receptive word form (vocabulary knowledge of spelling)

Instructions: Match the word with the picture, and complete the spelling

(จงจับคู่คำศัพท์กับรูปภาพและเขียนเติมตัวสะกดให้ถูกต้องลงในช่องว่างที่กำหนดให้)

Hea_ache	Coll_g_	Fev_r	S_omachac_e	Col_e_t
E_ p_y	S_eat_r	T_row	W_rm	Famo_s
Hu_t	F_ee_e	S_par_te	R_c_ive Si_ver	Sout_er_
S_re thr_ at	Stret_h	Fe_ti_al	Te_ri_le	

1. ……



2. ……

3. ……

4. ……

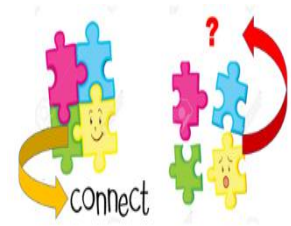
5. ……

6. ……

7. ……

8. ……

9. ……



10. .....

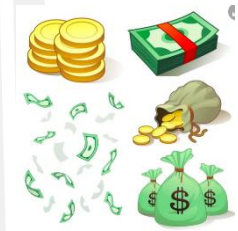
11. .....

12. .....

13. .....

14. .....

15. .....



16. .....

17. .....

18. .....

19. .....

20. .....

Appendix II-B: Productive word form (spelling L2 cloze test)

Instructions: Complete the missing word in each sentence in the space provided.

(จงเติมคำศัพท์ที่หายไปลงในช่องว่างให้สมบูรณ์)

1. This **r e s** _ _ _ _ _ _ _ serves good sushi and pizza.
2. I send a **m e s** _ _ _ _ from my mobile phone.
3. Her favorite **s u b** _ _ _ _ is English.
4. She missed her **f l i** _ _ _.
5. She has got a **t o o** _ _ _ _ _ _.
6. My next-door **ne i** _ _ _ _ _ lives in the house next to mine.
7. I don't know the **r e a** _ _ _ why he will not go on to college.
8. My **s e c** _ _ _ _ _ _ _ will phone you to arrange a meeting.
9. In hot **wea**_ _ _ _ , the temperature gets very high.
10. They buy some fruit and vegetables at the **g r o** _ _ _ _ shop
11. My family plans to go to the beach in summer **v a c** _ _ _ _ _.
12. Traveling by airplane, the ticket is **e x p** _ _ _ _ _ _.
13. He is not from Thailand; he is a **f o r** _ _ _ _ _ _.
14. All the students in my class are **f r i** _ _ _ _ _
15. You look so **d i f** _ _ _ _ _ _ today. Did you have your hair cut?
16. Christmas is one of the most fun and **e x c** _ _ _ _ _ holiday.
17. Have a **w o n** _ _ _ _ _ _ trip.
18. I am going to the **b u t** _ _ _ _ shop to buy some meat for my dinner.
19. Don’t throw **g a r** _ _ _ around your house.
20. Mt. Everest is the highest **m o u** _ _ _ _ _ in the world.

Appendix III: Questionnaire (Students' attitudes on using digital flashcards in enhancing vocabulary knowledge)

…….

Direction:

1. The purpose of this questionnaire is to explore students' attitudes towards using digital flashcards in enhancing vocabulary learning.

2. The survey has 2 parts: personal information and attitudes towards using digital flashcards

3. The data obtained will be useful for improving the teaching and learning, and there are no effect on your grades

4. The information you provide will be anonymous and confidential. It will be only used for research purposes and potential publications.

Part 1: Personal Information

Directions: Answer the following questions about your personal information by putting the ✓ in the bracket before filling in the information.

1. Gender ( ) Male ( ) Female

2. Class ( ) 6/3 ( ) 6/4

Part 2: Students' attitudes towards using digital flashcards

Directions: Please answer by checking (✓) sincerely according to your opinions

5 = Strongly agree 4 = Agree 3 = Neutral 2 = Disagree 1 = Strongly disagree

	Items	**Score Level**				
		5	**4**	**3**	**2**	**1**
1	I enjoy using digital flashcards to learn vocabulary.					
2	I think digital flashcards assist me in recognizing the meanings of the words.					
3	I think digital flashcards guide me to spell the words.					
4	I think the pictures in digital flashcards enable me in recalling the words.					
5	I think using digital flashcards is a good way in learning vocabulary.					
6	I feel motivated when I use digital flashcards to learn spelling and meaning.					
7	I feel much better when I use digital flashcards to learn spelling and meaning.					
8	Using digital flashcards allow me to learn new vocabulary.					
9	I enjoy learning vocabulary through digital flashcards from electronic devices.					
10	I think the pictures from digital flashcards assist me to recall the words.					
11	I think digital flashcards facilitate me in becoming familiar with words.					
12	I feel that learning vocabulary by categorizing words into themes would help me recognize words faster easily.					

	Items	Score Level				
		5	4	3	2	1
13	Digital flashcards are appropriate for learning vocabulary at my level.					
14	I feel comfortable when I use digital flashcards to learn vocabulary.					
15	Using digital flashcards help me to improve my recognition and recall of words.					

แบบสอบถาม ทัศนคติของนักเรียนต่อการใช้บัตรคำอิเล็กทรอนิกส์

ส่วนที่ 1: ข้อมูลส่วนตัว

คำชี้แจง โปรดทำเครื่องหมาย ✓ หน้าข้อความที่ตรงกับข้อมูลของผู้ตอบแบบสอบถาม

1. เพศ ( ) ชาย ( ) หญิง

2. ห้อง ( ) ป. 6/3 ( ) ป. 6/4

ส่วนที่ 2: ทัศนคติของนักเรียนต่อการใช้บัตรคำอิเล็กทรอนิกส์

คำชี้แจง โปรดทำเครื่องหมาย ✓ ในช่องระดับความคิดเห็นของท่าน

5 = เห็นด้วยมากที่สุด 4=เห็นด้วย 3=เห็นด้วยปานกลาง 2=ไม่เห็นด้วย 1=ไม่เห็นด้วยมากที่สุด

	หัวข้อ	ระดับคะแนน				
		5	4	3	2	1
1	ฉันสนุกกับการเรียนคำศัพท์ภาษาอังกฤษโดยใช้บัตรคำศัพท์อิเล็กทรอนิกส์					
2	ฉันคิดว่าบัตรคำศัพท์อิเล็กทรอนิกส์ช่วยให้ฉันจำความหมายของคำได้					
3	ฉันคิดว่าบัตรคำศัพท์อิเล็กทรอนิกส์แนะนำให้ฉันสะกดคำ					
4	ฉันคิดว่ารูปภาพในบัตรคำศัพท์อิเล็กทรอนิกส์ช่วยให้ฉันจำคำศัพท์ได้					
5	ฉันคิดว่าการใช้บัตรคำศัพท์อิเล็กทรอนิกส์เป็นวิธีที่ดีในการเรียนรู้คำศัพท์					
6	ฉันรู้สึกมีแรงจูงใจในการเรียนภาษาอังกฤษเมื่อใช้บัตรคำศัพท์อิเล็กทรอนิกส์เพื่อเรียนรู้การสะกดคำและความหมาย					
7	ฉันรู้สึกว่าภาษาอังกฤษของฉันดีขึ้นมากเมื่อใช้บัตรคำศัพท์อิเล็กทรอนิกส์เพื่อเรียนรู้การสะกดคำและความหมาย					

	หัวข้อ	ระดับคะแนน				
		5	4	3	2	1
8	การใช้บัตรคำศัพท์อิเล็กทรอนิกส์ทำให้ฉันได้เรียนรู้คำศัพท์ใหม่ๆ					
9	ฉันสนุกกับการเรียนรู้คำศัพท์ผ่านบัตรคำศัพท์อิเล็กทรอนิกส์จากอุปกรณ์อิเล็กทรอนิกส์					
10	ฉันคิดว่ารูปภาพจากบัตรคำศัพท์อิเล็กทรอนิกส์ช่วยให้ฉันจำคำศัพท์ได้					
11	ฉันคิดว่าบัตรคำศัพท์อิเล็กทรอนิกส์ช่วยให้ฉันคุ้นเคยกับคำศัพท์ต่างๆ					
12	ฉันรู้สึกว่าการเรียนรู้คำศัพท์โดยการจัดหมวดหมู่คำศัพท์เป็นธีมจะช่วยให้ฉันจำคำศัพท์ได้ง่ายขึ้น					
13	บัตรคำศัพท์อิเล็กทรอนิกส์เหมาะสำหรับการเรียนรู้คำศัพท์ในระดับของฉัน					
14	ฉันรู้สึกสบายใจเมื่อใช้บัตรคำศัพท์อิเล็กทรอนิกส์เพื่อเรียนรู้คำศัพท์					
15	การใช้บัตรคำศัพท์อิเล็กทรอนิกส์ช่วยให้ฉันพัฒนาการจดจำและการจำคำศัพท์ได้ดีขึ้น					

BIOGRAPHY

NAME	Miss Chadaporn Yowaboot
DATE OF BIRTH	April 11, 1991
PLACE OF BIRTH	Mukdahan, Thailand
ADDRESS	16/1 Soi Kinpratumtip, Mueang Mukdahan District, Mukdahan Province, 49000
POSITION	Teacher of English
PLACE OF WORK	Mukdalai school, Mueang Mukdahan District, Mukdahan Province, 49000
EDUCATION	2006 Junior High School in Mukdahan School 2009 Senior High School in Mukdahan School 2012 Bachelor of Arts (English), Khon Kean University 2022 Master of Education in English Language Teaching (M.Ed), Mahasarakham University