A STUDY OF ENGLISH VOCABULARY LEARNING USING THE DUAL CODING THEORY

BY

MS. VIMOLCHAYA YANASUGONDHA

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGLISH LANGUAGE TEACHING (INTERNATIONAL PROGRAM)

LANGUAGE INSTITUTE

THAMMASAT UNIVERSITY

ACADEMIC YEAR 2016

A STUDY OF ENGLISH VOCABULARY LEARNING USING THE DUAL CODING THEORY

BY

MS. VIMOLCHAYA YANASUGONDHA

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGLISH LANGUAGE TEACHING (INTERNATIONAL PROGRAM)

LANGUAGE INSTITUTE

THAMMASAT UNIVERSITY

ACADEMIC YEAR 2016

THAMMASAT UNIVERSITY
LANGUAGE INSTITUTE

DISSERTATION

BY

MS. VIMOLCHAYA YANASUGONDHA

ENTITLED

A STUDY OF ENGLISH VOCABULARY LEARNING
USING THE DUAL CODING THEORY

was approved as partial fulfillment of the requirements for
the degree of Doctor of Philosophy (English Language Teaching)

on January 31, 2017

Chairman
(Associate Professor Supong Tangkiengsirisin, Ph.D.)

Member and Advisor
(Assistant Professor Ketvalee Porkaew, Ph.D.)

Member
(Assistant Professor Apasara Chinwonno, Ph.D)

Member
(Assistant Professor Monnipha Somphong, Ph.D.)

Member
(Ajarn Chanika Gampper, Ph.D.)

Director
(Associate Professor Pornsiri Singhapreecha, Ph.D.)

Thesis Title	A Study of English Vocabulary Learning Using the Dual Coding Theory
Author	Vimolchaya Yanasugondha
Degree	Doctor of Philosophy
Major Field/Faculty/University	English Language Teaching Language Institute Thammasat University
Thesis Advisor	Assistant Professor Ketvalee Porkaew, Ph.D
Academic Year	2016

ABSTRACT

This study examined the effectiveness of the application of the three types of coding, which were L2 ➲ L1 (Thai) translation, pictorial, and in particular simultaneous L2 ➲ L1 and pictorial—Dual Coding Theory (DCT), employing 36 low frequency seven-letter English concrete nouns among 58 Thai EFL tertiary students who were at the beginning level. The investigation looked at the effectiveness of each type of coding in terms of the recognition rate (working memory) after three spaced presentations and the retention rate (long-term memory) among participants. The analyses were done by one way ANOVA and Paired T-tests. The findings suggested that the simultaneous L2 ➲ L1 and pictorial coding (DCT) group outperformed the other two groups both in the immediate posttest and the one-month delayed posttest, but no statistically significant differences were found among the three groups.

Keywords: Dual Coding Theory (DCT), working memory, recognition, long-term memory (LTM), retention, one-month delay

ACKNOWLEDGEMENTS

To the unconditional love of my mother, Thanomsri Siripanyo, and the endless support of my husband, Raak Yanasugondha.

With all my love and respect.

Vimolchaya Yanasugondha

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Symbols/ Abbreviations	Terms
ASEAN	Association of Southeast Asian Nations
AWL	Academic Word List
CALL	Computer Assisted Language Learning
CLT	Communicative Language Teaching
DVD	Digital Versatile Disc
EBE	English Bilingual Education
EF	Education First
EFL	English as a Foreign Language
ELLs	English Language Learners
EP	English Program
ESL	English as a Second Language
FL	Foreign Language
fMRI	functional Magnetic Resonance Imaging
GAT	General Aptitude Test
GPAX	Grade Point Average
GSL	General Service List
IP	International Program
JOL	Judgment of Learning
L2 ➲ L1	from Second Language to First Language
LINCS	Literacy Information and Communication System
LTM	Long Term Memory
MEM	Memory Strategy
MEP	Mini English Program
NIETS	National Institute of Educational Testing Service

ONET	Ordinary National Educational Testing Service
STM	Short Term Memory

CHAPTER 1
INTRODUCTION

This chapter begins by outlining the rationale behind the present study of why English language teaching is still a challenge in Thailand. Three major factors ranging from big to small scale are pinpointed. The first two factors are related to the global spectrum and domestic issues while the third is the idea of teaching English language vocabulary. The later sections of this chapter deal with the statement of the problem, objectives, research questions and hypotheses that the present study aims to answer. Finally, it ends with the justification, significance of the study, limitations, basic assumptions, and the terminology used in this paper.

1.1 Rationale

With the highest number of countries (fifty-five) adopting it as an official language and speakers of around three hundred million people, it is no wonder that English is regarded as one of the most important languages in the world. English language proficiency is an advantage in every means and its profusion in daily life is undeniable. However, Thailand has a problem with respect to English language literacy despite its proliferation. This issue is a major consideration among every stakeholder especially educators. There are three major aspects behind the problem, ranging from the global grounding to the most important factor of the domestic dimension in the country itself, with the last aspect dealing with the teaching of English language vocabulary.

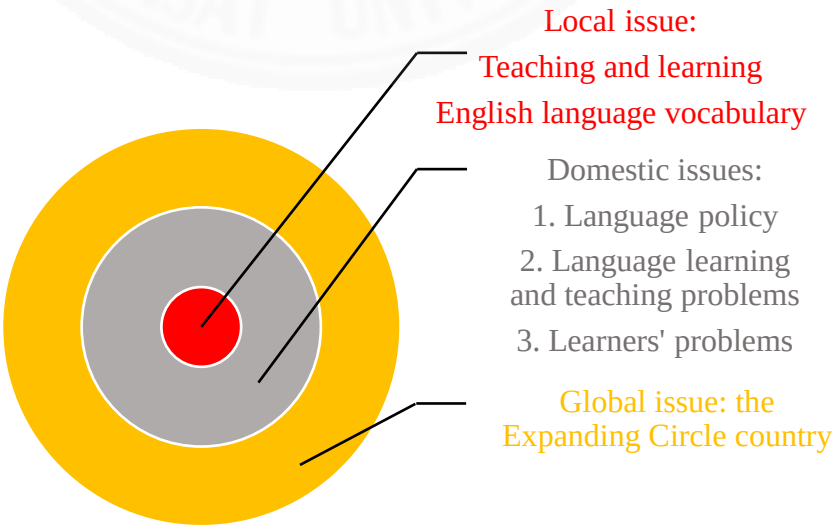
1.1.1 Global Grounding

The first of the three factors that fuses and at the same time diminishes Thai students' weakness in English literacy is due to the diffusion of English language across the world, which is known as the English Circle concept. As it has always been an independent nation, Thailand is considered a country in the Expanding Circle. English language in the curriculum of the Thai educational system has not been mandatory since the beginning of the contact with the English language, which has led to the current proficiency issues in the country. The idea of the English Circle is elaborated clearly next.

Kachru divided World Englishes into three concentric circles, the **Inner Circle**, the **Outer Circle** and the **Expanding Circle**. These three circles 'represent the types of spread, the pattern of acquisition, and the functional allocation of English in diverse cultural contexts', as the language travelled from Britain in the first diaspora to the other ENL countries (together with the UK these constitute the Inner Circle), in the second diaspora to the ESL countries (the Outer Circle) and, more recently, to the EFL countries (the Expanding Circle). The English spoken in the Inner Circle is said to be 'norm-providing', that in the Outer Circle to be 'norm-developing' and that in the Expanding Circle to be 'norm-dependent'. In other words, while the ESL varieties of English have become institutional and are developing their own standards, the EFL varieties are regarded, in this model, as 'performance' varieties without any official status and therefore dependent on the standards set by native speakers in the Inner Circle. (Jenkins, 2009, pp. 18-20)

Figure 1.1

Factors Governing Thai Students' English Language Literacy



Marked by an EFL label means Thailand is a community where "English is not the usual language of communication" (Thornbury, 2006, p. 74). In comparison to countries within the same region such as Brunei Darussalam, Malaysia and Singapore, who are in the Outer Circle and have adopted the ESL variation where English integrated into their environment, students in the EFL realm study English for general purposes. Thus, students in those countries find it more comfortable to use English. In contrast, the Expanding Circle countries rely solely on their own native language without formal inclusion of English in their environment, with Thailand no exception. Therefore, most of the students in Thailand still struggle with all of the four skills needed for their survival skill outside their native context. This is one of the roots of difficulty, leading to low English language literacy in the kingdom and disagreements about how to cope with the weakness of English language among Thai students. The second but the most important source of dilemma is stated in the next section.

1.1.2 Domestic Dimension

The second and also the most important area which frames the weakness of English competence among Thai learners derives from the context within the country itself. Three local issues are interconnected. The first deals with the general issue of the national language policy, the second one with the language learning and teaching problem, and the last and also the most specific one with learners' problems.

1.1.2.1 National Language Policy

Domestically and contemporarily, the English language education policy in the country is under the supervision of the Ministry of Education, whose direction is once again under the country's National Economic and Social Development Plan. What makes students' proficiency in English less than satisfactory is explained below.

In terms of foreign language teaching policy, the strategy of the Ministry of Education targets any of the foreign languages, not English language in particular. One of its five strategies pinpoints that in order to improve learners' quality and standard (according to the direction of the Eleventh National Educational

Development Plan 2012-2016 of the Ministry of Education), there should be a means by which learners could incorporate a foreign language skill into their analytical learning process (translated from the Eleventh Educational Development Plan 2012-2016 of the Ministry of Education of Thailand, p. 16). English language skills among students are thus less than satisfactory since English is not a priority. The hard evidence can be seen from the report of the Ministry of Education during 2013-2017. The summary of the report stated that the quality of the education in the country has not been satisfactory for some time, with the results from ONET (Ordinary National Educational Test) showing that the mean score for English, Mathematics, Science, and Social Science were all under fifty percent in the year 2010 (translated from the Eleventh Educational Development Plan 2012-2016 of the Ministry of Education of Thailand, p. 6). This first problem led to the implementation of a new learning and teaching system in the country, which is discussed next.

1.1.2.2 Language Learning and Teaching Problems

In its report, the Ministry of Education summarized that the problems found in English language teaching can be divided into four areas. Firstly, the teaching-learning methods lack an emphasis on both the incorporation all of the four skills and an inadequate practice, and with too much stress on teaching structure and vocabulary drills. Thus, learners cannot communicate in English well. (translated from the strategic plan for the reformation of English language teaching and learning to improve the country's competency level of the Ministry of Education of Thailand 2006-2010, p. 4). Secondly, they claimed that teachers in general were not well equipped financially or instrumentally. Thirdly, they stated that learners cannot communicate using English language as a medium. Lastly, it was asserted the atmosphere was not conducive for English usage. These problems have been tackled by incorporating several English programs into schools such as EP (English Program), MEP (Mini English Program), IP (International Program), EBE (English Bilingual Education) and EIS (English for Integrated Studies) and also by shifting the importance of teachers to the learners by using the "Flipped Classroom" technique in hope that these programs and the amended technique might improve English language ability among Thai students. However, the results up to the present are still not

satisfactory as seen from the mean score of the standardized national English tests or ONET among students. The details are elaborated in the next section.

1.1.2.3 Learners' Problems

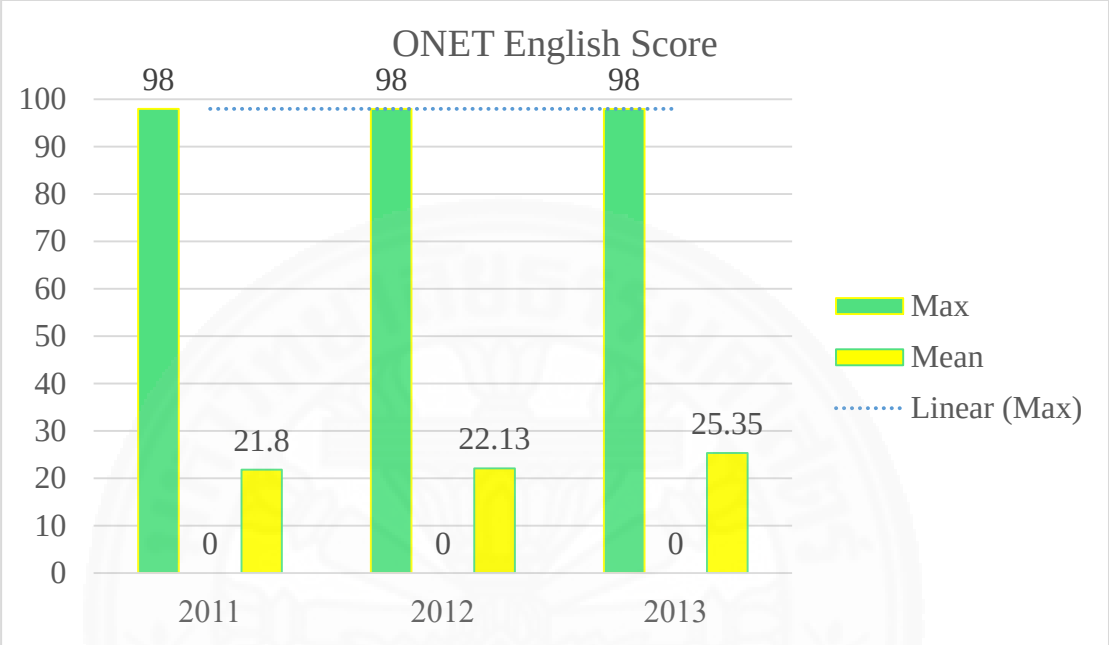
The results of the national English language test among high school students in 2013 were very much the same as during the previous years. Two national standardized tests, which are ONET and GAT 2 (General Aptitude Test 2), serve as evidence.

From the years 2011 to 2013, the ONET mean scores for students who sat for the national English test (M.6 or Grade 12 students) were at 21.8, 22.13 and 25.35 out of the total points of 100, respectively (Figure 1.2). It is clearly seen that most of the students could only do a quarter of the test. However, the ONET score might not give a complete picture since it is meant for students of all disciplines. The results of the GAT 2 score provide a closer look at test takers who are more serious about the English test at the transition to the college level. GAT is the General Aptitude Test, which is divided into two parts. The first part (GAT 1) deals mainly with analytical skill, which is in Thai language, and the second part (GAT 2) is the test of communicative English, namely speaking and conversation, vocabulary, structure and writing, and reading comprehension. The GAT test is aimed at being an indicator of how compatible a student is for tertiary level education.

Very much like the ONET English mean scores during 2011-2013, the GAT 2 mean scores are not very convincing either. While the ONET English mean score was only a quarter of the total score with test takers of roughly four hundred thousand a year, the GAT 2 mean score was only about one-third with a smaller number of test takers (Figure 1.3). What is more discouraging than the ONET mean score is the diminishing GAT 2 mean score during the same three-year period. Though all sectors regulating English language study in the country are trying very hard to cope with both the world and region's changing atmosphere, the outcomes are not yet satisfactory.

Figure 1.2

ONET English Scores 2011-2013



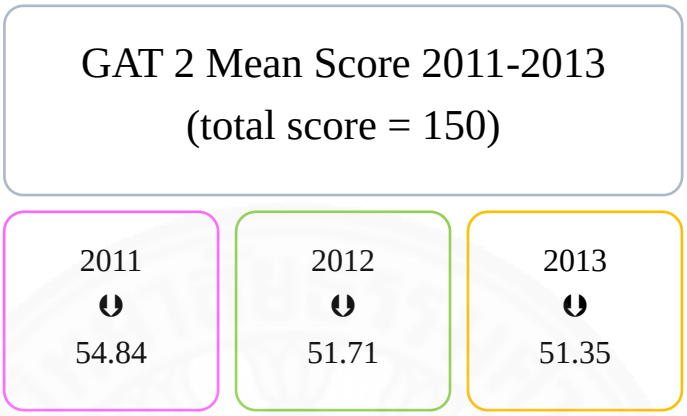
Note. numerical data retrieved from www.niets.or.th

This local issue is not promising when compared with neighboring countries within the same region. Figure 1.4 compares the number of students who enrolled in colleges during 2014. Though Thailand ranked number two, only behind Singapore, in the number of students at the tertiary level in the ASEAN community, the statistics from the Ministry of Education show that total enrollment of students in the academic year 2013 in Thailand for bachelor's degree was roughly under two million. Naturally, the higher, the better. However, this number is not impressive compared to Thai students' low English mean score during both examinations as shown earlier. English language skill is thus a major obstacle both during and after education. Thailand needs to improve the quality of its students, especially in English language skill, if it wants to gain momentum in the region.

Within the context of this study, of the roughly five thousand students registered for the academic year 2013 at the tertiary institution chosen for the experiment, about seven percent or 370 students had a mean score on the 2013 ONET English score of 25.35.

Figure 1.3

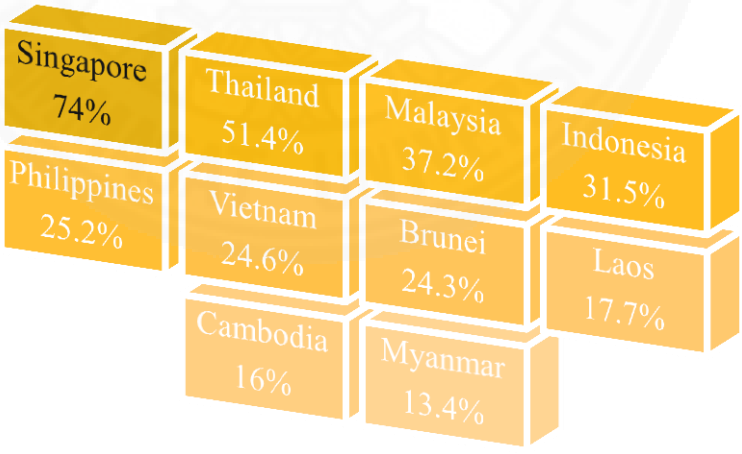
GAT 2 Mean Scores 2011-2013



Note. numerical data retrieved from www.niets.or.th

Figure 1.4

ASEAN 2014 Tertiary Education Percent of Enrollment

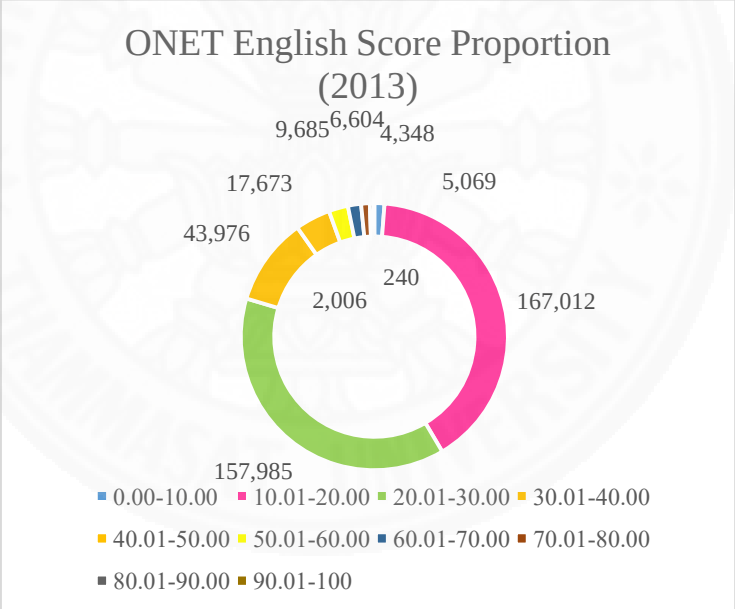


Note. adapted from Horton and Taylor (2015)

In the 2013 academic year, newly accepted undergraduate students were placed in three English courses of Remedial, Fundamental English I and Fundamental English II based on their ONET English scores. While this is not so high when compared with the total number of over 400,000 ONET English test takers in 2013 or almost two million college students nationwide, the figure is still not satisfactory. The GAT 2 mean score of 2013 confirms the reality of the low English ability among students in this study. Figures 1.5 and 1.6 also reflect the English ability among Thai students of the academic year 2013 nationally.

Figure 1.5

Overall 2013 ONET English Score Segments (www.niets.or.th)



Note. numerical data retrieved from www.niets.or.th

As mentioned earlier, English language skill is just one of the impediments for Thai students. More discouraging is the big picture when compared with other countries around the world. EF or Education First, which is a language institute with its headquarters in Switzerland, has reported a standardized measurement of adult English Proficiency around the world since 2011, the results of which should give stakeholders in English education in Thailand a chill. In 2011,

Thailand was ranked number 42 out of 44 countries in English proficiency. In 2012, Thailand was 53 out of 54 countries, and in 2013, Thailand was number 55 out of 60 countries. During those three EF editions, the English proficiency criteria were divided into five categories of very high proficiency, high proficiency, moderate proficiency, low proficiency and very low proficiency. It is not surprising that Thailand was in the very low proficiency group for three for three consecutive years. It would not be so disappointing if we did not compare with neighboring ASEAN countries like Indonesia and Vietnam whose English context is also defined as ones in the Expanding Circle. Indonesia was number 34 and Vietnam was number 39 in 2011, with a ranking of very low proficiency. In 2012, both moved up to number 27 and 31, respectively, with a ranking of low proficiency; and in year 2013, Indonesia was number 25 while Vietnam was number 28, with both ranked as moderately proficient. Table 1.1 below sums up this piece of data.

Table 1.1

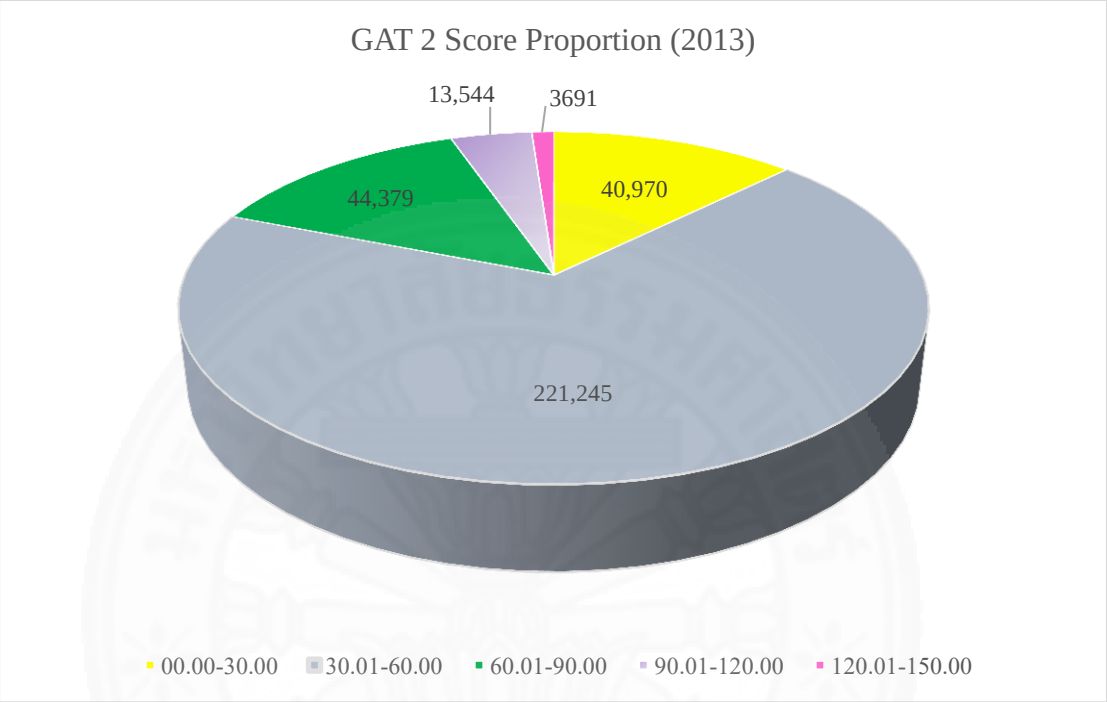
EF English Proficiency Index

	Thailand	Indonesia	Vietnam	
2011*	42/44	34/44	39/44	*# 1 Norway
EF EPI Score	39.41	44.78	44.32	69.09
Proficiency Level	**very low**	**very low**	**very low**	very high
2012**	53/54	27/54	31/54	**# 1 Sweden
EF EPI Score	44.36	53.31	52.42	68.91
Proficiency Level	**very low**	low	low	very high
2013***	55/60	25/60	28/60	***# 1 Sweden
EF EPI Score	44.44	53.44	52.27	68.69
Proficiency Level	**very low**	moderate	moderate	very high

Note. numerical data retrieved from www.ef.edu

Figure 1.6

Overall 2013 GAT 2 Score Segments



Note. numerical data retrieved from www.niets.or.th

The results from both the local and global tests are testimonials for contemplation among English educators in Thailand. Why the majority of English language learners in this country are at such a low level is a problem to consider and definitely one to try very hard to cure. The best start is to create a firm foundation. One of the best ways to help students gain momentum is by building up their vocabulary, which they can use to improve their English ability.

1.1.3 Teaching and Learning English Language Vocabulary

No one can dispute the power of language. Johann Wolfgang von Goethe, a famous German scholar, once claimed that "The limits of my language are the limits of my universe." What Goethe was trying to express was the power of human language, which is made up of countless units, and language is definitely one of the world's most complex systems. Human languages are the most powerful and convenient means of communication both historically and contemporarily. It has been estimated that there are

roughly 6,500 languages on earth. Languages come in several genres—written or spoken, verbal or non-verbal, oral or signed, etc. Languages could be geographically, socially and/ or culturally bound. Languages are defined by their class such as being either vernacular, which is a native language of a specific population like those among scholars, or vehicular, which is in fact lingua franca. Languages are characterized by many factors e.g. linguistically or phonetically. However, whatever defines or governs it, the word language cannot surpass one of its meaningful units, which is "vocabulary". Without it, a language could convey nothing.

Vocabulary is the most fundamental aspect of all language students native or non-native learning both receptively and productively. For Expanding Circle non-native speakers, as stated earlier, students learn English within an atmosphere that does not aim towards communication as much as those who are in the Outer or Inner Circles. The Expanding Circle students learn English receptively and they read more than they speak. In order to understand what they read, they certainly need the help of vocabulary. Read (2000, p. 190) affirms that "it is a well-established finding in research on the reading comprehension of native speakers that vocabulary is the most important contributing factor. The same applies to second language readers." Also, cited in Read (2000, p. 191) Harrison (1980) maintains that "research studies consistently find vocabulary to be the single predictor of text difficulty."

Wilkins (1972) gave the world a classic quote on the impact of vocabulary, "Without grammar very little can be conveyed, without vocabulary nothing can be conveyed." This statement shows the gigantic capability of vocabulary. By definition, vocabulary is "the body of words used in a particular language" (Vocabulary, n.d.) though grammarians and linguists often refer to it as lexis. The English word vocabulary comes from the Latin word vocabularium for a singular usage or vocabularia for a plural usage.

Language learning is an activity inextricably interconnected with vocabulary. They are greatly congruent. Children from infancy learn language through vocabulary informally from their parents and surroundings at an initial stage followed by formal education in the schooling system. Whether it is a child's first or second language, words are accumulated daily and this process never stops. Read (2000, p. 43) observes that "there is a general agreement that vocabulary acquisition

occurs at an impressively fast rate from childhood throughout the years of formal education and at a slower pace into an adult life." Both teachers and learners are very hopeful that the size of the vocabulary repertoire should not stop growing. While a lot of matters in this world are not size dependent, vocabulary size really matters.

Academically, it is widely accepted that vocabulary knowledge is one of the keys to success in language learning. Students learn with two receptive channels, which are either listening or reading or both. While listening to their teachers, students' understanding is based on their cognition of words' meanings. For reading, this is also true since most textbooks are in print form and students have to read to be able to understand them. People with a greater number of known words can, of course, read faster with less hurdles from words' definitions. Vocabulary size is expandable depending on endless factors such as congenital factors like gender or birth order to an individual's learning styles. Figure 1.7 shows the renowned Dale's cone of learning, which refers to remembering one experience through different sources of contact.

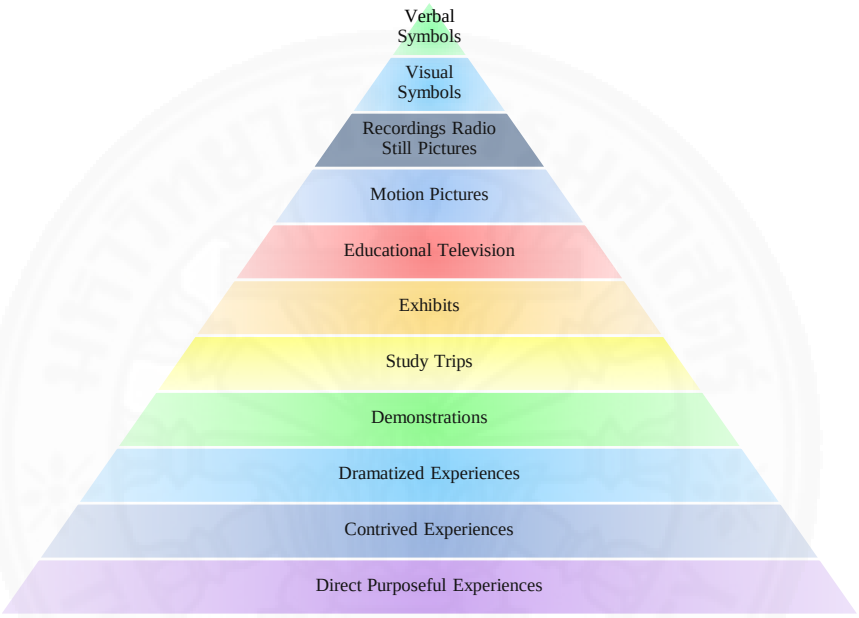
The vocabulary learning process, whether native or non-native, first or second language, has some similarities and differences. They are similar in that all learners have to undergo the same protocol of receiving and decoding a word's meaning. However, native speakers have more opportunities for language exposure than non-native speakers, which means that non-native learners have more obstacles to overcome environmentally. Equipping non-native learners, especially those at a beginning level, with a robust vocabulary in a favorable circumstance so that they can better understand words' meaning is a huge advantage for them.

Language learners who are at the entry level face more obstacles than those who are more advanced. The difference between advanced and beginning learners is very much like a life cycle. Advanced learners could be compared to middle-aged or old people who have already gone beyond the threshold period of struggling and they are also more equipped with several learning strategies when confronting difficulties. In language learning, beginners are discouraged most when challenged with unknown words. Unlike advanced learners, some beginners might retire from the activity unless they have come up with an appropriate technique.

Thousands of vocabulary teaching techniques have been tested and trialed with the hope to help learners learn and remember better.

Figure 1.7

Edgar Dale's Original Cone of Experience



Note. from Fadel and Lemke, 2008, p. 6

As such, vocabulary learning is a means to an end, not an end in itself. Teachers and learners always seek ways to facilitate the process of learning new words by experimenting with different strategies. Successful language learners choose the most applicable approach and ultimately become fluent language users. However, some low proficiency non-native beginners still have problems finding ways to cope with new vocabulary. Students who are not highly motivated rarely succeed in learning a completely different language like English. Again, some students do not see how beneficial it is for them to be English literate since the society they live in is monolingual.

In conclusion, what has been stated so far reflects the need to improve the English language ability among Thai students by addressing the root cause of the

problem, especially by attacking the base group of low achievers or beginners and the basic English skill of vocabulary addition among them.

1.2 Statement of the Problem

With the presented rationale about problems regarding Thai EFL students as evident in their low English ONET and GAT 2 score, this study aims to attack the problem starting from its core by means of improving vocabulary skill among Thai EFL learners especially beginners. The reason behind this is to help low achievers who are known to lack specific strategies for adding more English words to their vocabulary repertoire by equipping them with the Dual Coding Theory technique, which can be easily applied as a medium. Also, this can be of help to teachers as an extra tool in English language vocabulary teaching for low achievers. The idea of the Dual Coding Theory, which is the application of both verbal and nonverbal representation into the subject matter, should provide purposeful assistance for both learners and teachers. This is in line with the study by Nutsreeya (2009), which showed that teachers, no matter the type of class, resort to media while teaching reading to their students. If proved effective, it is hoped that this will be a springboard for learners to build a greater word repertoire so that they can rely on themselves both in and outside classroom for a more meaningful and an effective way of learning English language.

In order to comply with the life-long learning principle as mandated by the Eleventh National Economic and Social Development Plan (2012-2016) and with the changing context of the ASEAN community in the region, a method of aiding learners to better learn English vocabulary as a core skill by students themselves was highlighted in this study. Low English proficiency mean scores among Thai students is an indicator that they are confronted with the problem of English language literacy and it is a priority for practitioners in relation to the structure of English teaching.

English language study in Thailand has adopted CLT (Communicative Language Teaching) as a framework. CLT gears students toward communicative competence instead of linguistic competence, which was emphasized in the previous era of grammar translation. CLT focuses on the use of real life language situations where speakers must be able to interact with other speakers so as to make communication successful. Like all matters in this universe, this type of strategy has

both pros and cons. Students who are risk takers can adapt themselves with ease and success is not beyond their reach. However, weak students definitely face greater challenges. To make the picture clearer, CLT, which is both authentic and task based, requires quite an adventurous learner, a quality already embedded in successful learners whereas weak learners do not truly possess this kind of personality. Achievement during this process is not unidirectional; rather, it is like a cycle. Being brave is what makes language learners successful. What makes them brave is the fact that they are equipped with better tools, which is their repertoire of both grammar and vocabulary. So, teachers must be a medium to connect these two ends together. Teachers should provide students with appropriate tools so that they find their way to success easier. They must also be patient enough so as to wait for those who are staggering behind in order to achieve the goal.

Foreign language study is an art, but it is also a kind of science. Educators should be able to provide their students with both language elements and innovative equivalents without losing the core values of productivity and competence.

To conclude, this project, therefore, attempted to find a method to facilitate the recognition and retention rates of new words learned among low proficiency EFL students in Thailand and to explore the effectiveness the Dual Coding Theory, which might be able to better facilitate learners and teachers of English vocabulary in terms of sighting exposure both verbally and nonverbally. The overall objective was to look for a more efficient way to help Thai EFL learners remember words in English language better.

1.3 Objectives

1.3.1 To compare which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word recognition among Thai EFL learners.

1.3.2 To compare which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word retention among Thai EFL learners.

1.3.3 To investigate if the use of L2 ➲ L1 translation facilitates word retention among Thai EFL learners.

1.3.4 To investigate if the use of pictorial coding facilitates word retention among Thai EFL learners.

1.3.5 To investigate if the use of simultaneous L2 ➲ L1 translation and pictorial coding facilitates word retention among Thai EFL learners.

1.3.6 To investigate students' opinions towards each type of coding: L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial.

1.4 Research Questions

1.4.1 Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word recognition among Thai EFL learners?

1.4.2 Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word retention among Thai EFL learners?

1.4.3 To what extent does L2 ➲ L1 translation coding facilitate word retention among Thai EFL learners?

1.4.4 To what extent does pictorial coding facilitate word retention among Thai EFL learners?

1.4.5 To what extent does simultaneous L2 ➲ L1 translation and pictorial coding facilitate word retention among Thai EFL learners?

1.4.6 What are students' opinions towards each type of coding: L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial?

1.5 Hypotheses

1.5.1 H_0: There are no differences among the three types of coding, namely, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word recognition among Thai EFL learners.

1.5.2 H_0: There are no differences among the three types of coding, namely, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word retention among Thai EFL learners.

1.5.3 H_0: The use of L2 ➲ L1 translation coding does not facilitate word retention among Thai EFL learners.

1.5.4 H_0: The use of pictorial coding does not facilitate word retention among Thai EFL learners.

1.5.5 H_0: The use of simultaneous L2 ➲ L1 translation and pictorial coding does not facilitate word retention among Thai EFL learners.

1.6 Justification

This research was conducted primarily to shed more light on evaluating a technique that might facilitate low achievers Thai EFL learners remembering more words. The researcher wanted to help both weak students discover how to remember unknown words and also teachers by means of unsophisticated technology; as stated by Nagy and Townsend (2012, p. 101), "there are times when simple exposure to definitions or explanations of words can have a positive impact on word learning." Also, cited in Sadoski & Paivio (2012, p. 3), Marks mentions that "By the late twentieth century, DCT had become recognized as "one of the most influential theories of cognition this century". This study might yield more insights to the world of English L2 research.

1.7 Significance of the Study

It is expected that the findings of this research will be useful to two groups of people. In particular, Thai EFL learners both in and outside classroom contexts and teachers teaching English vocabulary will benefit from this study appropriately.

First, Thai EFL learners who are either in or out of the schooling system and especially those whose English proficiency is low will be able to apply the method of coding simultaneous L2 ➲ L1 translation and pictorial whenever they come across new words in English. It is also hoped that they will make use of this method in and outside classroom for the purpose of life-long learning.

Secondly, teachers who teach English vocabulary can be certain that the coding of simultaneous L2 ➲ L 1 (Thai) translation and pictorial does not obstruct or interfere with learners during the learning process. They can also simply apply it for the purpose of teaching and learning when the situation permits.

1.8 Limitations

1.8.1 The target groups of this research were three groups of Thai tertiary level students whose English proficiency was low at their entry level. They were in the academic year 2014. The institution selected was located in Pathum Thani.

1.8.2 The study took place during the second half of the academic year 2014, which was from January 2015 to May 2015. The total period of the second semester

lasted sixteen weeks with a one week interval during examinations. The word presentation was carried out once a week for three consecutive weeks.

1.8.3 In order to avoid the loss of subjects, the study aimed to be completed within the first twelve weeks before the midterm examination took place on week nine. A vocabulary screening test was conducted at the outset of the study to look for unanimously unknown words among the subjects followed by three consecutive presentations each week, a one month delayed posttest, and finished with a semi-structured interview at no later than three weeks after the delayed posttest. The twelve week schedule was a heavy time constraint.

1.8.4 Only data from students who attended the three presentations and sat for both immediate and delayed posttests were used to determine the effectiveness of word recognition and word retention for each type of coding. The number of participants was reduced drastically by all these variables due to their unpredictable attendance.

1.8.5 All the words used were concrete nouns due primarily to their ease of pictorial production and their low ambiguity as a secondary reason since pictures cannot handle abstract nouns that are not properly modality specific.

1.8.6 Since the sensory input was linguistic and visual forms and both, subjects with visual and linguistic impairment did not benefit.

1.8.7 During word presentation, an electronic device was used for precise timing between each word and also for its adaptive nature.

1.9 Basic Assumptions

1.9.1 Using the ONET (Ordinary National Educational Test) score of the standard university examination administered by the National Institute of Educational Testing Service as a criterion, this study assumed that students' English skills were comparable to a certain extent.

1.9.2 This experiment was designed to simulate real life use. Real life applications are further subject to personal preference.

1.9.3 Technology always advances, and this experiment was conducted in 2015. Therefore, it might or might not be applicable in the future.

1.10 Operational Definition of Terms

1.10.1 Dual Coding Theory (DCT) was a term coined by Allan Paivio in 1971. The theory posits that double sensory inputs of linguistic and visual are better than a singular sensory input. Traditionally, it was believed that the brain's left (linguistic/ language) and right (visual/ picture) hemisphere operated separately and the mixing of both interfered with the ability to learn, which actually is the idea behind single coding.

1.10.2 EFL refers to English as a Foreign Language, which is a system where English is taught to students whose community's use of English is not an official language.

1.10.3 Long-term Memory (LTM) refers to the function of memory that is outside the realm of working memory. Long-term memories can last only a day or a lifetime. Its capacity is limitless and not time bound.

1.10.4 L2 ➲ L1 translation coding refers to the use of a Thai word as a medium in giving a definition of each unknown English word.

1.10.5 Pictorial coding refers to the use of a picture as a medium in giving a definition of each unknown English word.

1.10.6 Simultaneous L2 ➲L1 translation and pictorial coding refers to the use of both a Thai word and a picture at the same time as media in giving a definition of each unknown English word.

1.10.7 Vocabulary screening test refers to a test given at the outset of the experiment. Students defined or translated fifty-nine English words into Thai briefly. Words that students were unable to define or translate were put into the study.

1.10.8 Immediate posttest refers to a matching test type of English words with L1 definitions, pictures or both prescribed to students after the last (third) round of word presentation.

1.10.9 Delayed posttest refers to a matching test type of English words with L1 definitions, pictures or both prescribed to students one month after the immediate posttest and done solely without word presentation.

1.10.10 Word recognition refers to a learner's ability to memorize a word's meaning and/or its description in relation to working or short-term memory or the

stage of moving from an unlearned to learned word as shown by the score of the immediate posttest after three spaced presentations of unknown words.

1.10.11 Word retention refers to “how well the item learned persists in the learner’s memory” (Nation & Webb, 2011, p. 279) or the duration of time new words can be kept in a learner’s long-term memory, not working or short-term memory as shown by the score of the delayed posttest, which was one month after the immediate posttest.

CHAPTER 2
REVIEW OF LITERATURE

This chapter examines the literature related to the present study. Six aspects are reviewed: a) Dual Coding Theory b) word recognition c) word retention d) L2 ➲ L1 translation e) pictorial coding and the chapter ends with f) research studies pertaining to the application of Dual Coding Theory.

2.1 Dual Coding Theory

Dual Coding Theory (DCT) was a theory proposed by a Canadian Psychologist named Professor Allan Urho Paivio from the University of Western Ontario during the seventies. In terms of psychological learning, the theory was listed under a cognitive school, which posits that humans are equipped with appropriate tools inside their physical body. These tools, whatever the system, the brain or the body, are readily adaptive during system functions. The theory is an interaction toward the concept of the theory of single coding, which maintains that during a learning session, one channel of input of either verbal or non-verbal is enough for the learning process, with more than that considered an extra load for learners. Paivio sought to prove that the concept of unitary coding was not true and his study aimed at double coding instead. Paivio's dual coding refers to verbal and nonverbal channels, and he strongly asserted that two was better than one. Table 2.1 represents the subsets under verbal and nonverbal frames of sensory channels under DCT.

DCT is a modality specific theory. Modality or mode is a term used in experimental psychology, especially in the fields of memory and learning, to refer to any of the various senses such as the visual modality or touching modality. Thus, modality specific refers to the fact that the performance of the learner is dependent on the presentation mode of what was put forth for students to study. In other words, how the studied items are encoded determines how well the learner learned. As such, DCT emphasizes that cognition is based on sensory experience. Formerly, it was believed that the two sensory modes of verbal and nonverbal usually confused learners since they had to cope with two kinds of data at one time. Paivio's theory maintains that the application of verbal and nonverbal instruction is appropriate and

Table 2.1

Orthogonal Relationship between Mental Codes and Mental Sensorimotor Modalities as Theorized by DCT

	Mental Codes	
Sense Modality	**Verbal**	**Nonverbal**
Visual	Visual language (writing)	Visual objects
Auditory	Auditory language (speech)	Environmental sounds
Haptic	Braille, handwriting	"Feel" of objects
Gustatory	-	Taste memories
Olfactory	-	Smell memories
Emotion	-	Felt emotions

Note. from Sadoski and Paivio, 2013, p. 30

they do not interfere with each other since each system works independently but at the same time they are integrative and interconnected. Though the two systems are both naturally and structurally distinct, they support each other during all the three stages of brain memory function of encoding, storing and retrieving. Naturally, the verbal system is specialized for processing sequential information while the nonverbal system processes spatial and synchronous information. The term sequential used for the verbal system could be described as the reciting of the alphabet. For example, people would say the word "face" as f-a-c-e. In contrast, the nonverbal system, which is spatial or synchronous, could be exemplified by the thought of one's face. When people imagine a face, they see a complete image of a face with all its properties of eyes, nose, mouth, etc. The virtue of both systems is they are supportive without disturbing each other. Paivio (1990, p. 75) clearly points out that "The implication has always been that the imaginal and verbal systems have important functions in the encoding, storage, and retrieval of episodic information." Table 2.2 provides a snapshot of DCT in general.

Table 2.2

Summary of Theoretical and Empirical Assumptions and Phenomenal Domain of DCT

General empiricist assumption	Cognition is served by two modality-specific symbolic systems that are experientially derived and differentially specialized for representing and processing information concerning nonverbal objects, events, and language.
Unit-level-properties	Representational units are modality-specific perceptual motor analogues Units vary hierarchically in size Synchronous versus sequential intraunit organizational structure
System-level properties	Functional independence and partial interconnectedness systems Interunit connections between systems and within systems Processing operations 1. Activation of representations 2. Representational, referential, and associative levels of processing 3. Synchronous versus sequential organization processing 4. Transformational processing 5. Conscious and automatic processing
Basic functions	Evaluative functions Mnemonic functions Motivational and emotional functions
Empirical variables	Theoretical assumptions are linked to classes of operational indicators and procedures: Stimulus attributes, experimental manipulations, individual differences in cognitive habits and skills, and subjective reports
Phenomenal domain	Processing of verbal and nonverbal information in perceptual, memory language, and complex problem-solving tasks; neuropsychology; issues in epistemology and philosophy of science

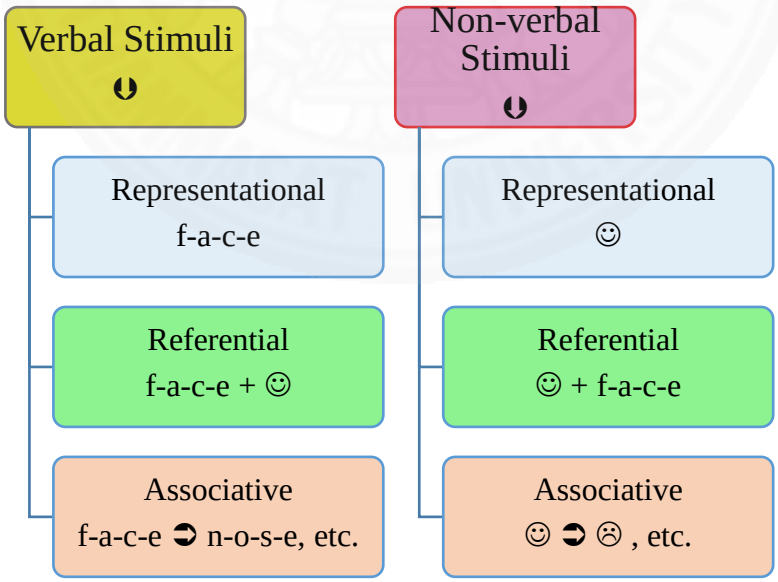
Note. from Paivio, 1990, p. 55

What Paivio meant by verbal or in his term “logogens” is humans’ natural linguistic pieces and chunks or even inner speech, while non-verbal or in his term “imagens” refers to objects, events, or kinesthetic. These logogens and imagens work under three main themes of processing, which are a) representational b) referential and c) associative. Representational processing refers to the direct encoding of either

verbal or non-verbal stimuli alone that impinge on one's sensory receptors. For instance, when people spell the word "face" as f-a-c-e verbally or when they imagine the face of a person, which, of course, is non-verbal. Both systems work without referring to words or objects outside the theme of "face". Next to the representational processing is the referential processing. Paivio points out that both systems are referential when interconnected. A student spelling the word "face" would be able to link this word to his or her friend's happy face while a student imagining a friend's happy face would also be able to stretch this out to how they spelled the word "f-a-c-e". The last type of processing is associative. This means that under verbal coding, one might not stop at the word "face". One could also link the word "face" to perhaps "nose" "mouth" "teeth", etc. For non-verbal coding, one would also think of a friend's unhappy face at the same time. Figure 2.1 represents the processing of information regarding verbal and non-verbal stimuli under DCT.

Figure 2.1

DCT Processing Information of Verbal and Non-Verbal Stimuli



The idea of DCT involves the function of the human brain actively working with the linguistic and pictorial inputs it receives. Occasionally, stimuli intake is

through language and we think only of language. Or, intake might be through images and we keep thinking only about images (representational). Other times, intake could switch between systems (referential) or might go deeper into each system (associative). Sadoski and Paivio refer to this as "the nature of two great symbolic systems of cognition: language and mental imagery".

DCT has engaged deeply in the field of language instruction since its inception. The literature and research studies often revolve around human literacy and even extend to the field of second language learning especially vocabulary learning. This ranges from the formation of teaching techniques to several pieces of research to prove its function.

One example of Paivio's attempt to promote better learning in the field of second language vocabulary learning in relation to DCT is the design of the "hook technique". The technique was different from the mnemonic technique since it used learned L2 words as a retrieval cue for unlearned L2 words and it does not include an acoustic link between L1 and L2. The results were positive in his experiment with French language vocabulary learners in 1972 and 1983, and he extended this experiment to a French grammar class with Clark, Pressley and Desrochers, which again proved satisfactory. Apart from the invention of this technique, some other value of DCT in vocabulary learning was brought to light by Sadoski (2006, p. 228), who maintained in his paper that "DCT principles can be helpful in understanding the acquisition and teaching of meaningful vocabulary." Two major methods for learning meaningful vocabulary are incidental and direct. Sadoski confirms that the use of the direct method in addition to incidental learning can "markedly" improve vocabulary learning citing the work of Baumann, Kame'enui and Ash, 2003; Beck and McKeown, 1991; Blachowicz & Fisher, 2000; Stahl & Fairbanks, 1986, Power & White, 1989. Over a period of three decades, many other research studies have affirmed this. Myer and Anderson (1991) tested words before pictures and word-with pictures animation and found that the word with picture group outperformed the previous group in both a creative problem solving test and on a problem test. Plass, Chun, Mayer and Leutner (1998) found in their study of a German course that students remembered words better when they chose to view a translation together with a picture or video than when seeing a translation alone. Kost, Foss and Lenzini Jr.

(1999) determined that the use of a combination of text and pictures in the gloss outperformed either of the two alone in both production and recognition in their German class. Dubois and Vial (2000) conducted research on how different multimedia presentation modes affect the learning of foreign language vocabulary (Russian) and found that co-referencing of the different sources yielded a better result on word memorization. Yeh and Wang (2003) employed three types of vocabulary annotations, which were text annotation only, text plus picture and text plus picture and sound, and found out that the version of text plus picture was the most effective type of vocabulary annotation among their EFL college students in Taiwan. Yoshii (2006) applied both L1 and L2 glosses with and without pictures and found that there were significant differences between picture (text-plus-picture) and no picture (text only). Showing the addition of picture yielded an overall mean of higher recognition rate among students in both L1 and L2 glosses during an immediate posttest. Jalilehvand (2012) tested text length with and without pictures with 79 first-grade female EFL students and found that participants performed better on texts with pictures. Sombatteera and Kalyuga (2012) found in their research that an application of auditory with main phrase visual text resulted in better learning than with full text or key words. Godwin-Jones (2013) mentioned in his article that the "CALL literature of the past decade is rich in studies of incidental vocabulary learning and the efficacy of various approaches to glossing. Some point to the desirability of *dual-coding* (i.e., providing both a translation/definition and image: Sadoski, 2005)." Farias, Obilinovic, Orrego, and Gregersen (2014) found still images helped more than text and video combined in vocabulary learning. Some pure scientific research has also proved the virtue of DCT toward concreteness. Jessen, Heun, Granath, Klose, Papassotiropoulus and Grodd (2000) used functional magnetic resonance imaging (fMRI) to detect the brain regions during the encoding of concrete nouns and found greater activation in the lower right and left parietal lobes, in the left inferior frontal lobe and in the precuneus during such episodes compared to abstract nouns. This was strong evidence suggesting the unlikeliness of the single coding theory and confirmation of DCT.

There were, however, some pieces of research that were neutral and did not point to the superiority of DCT. Lotto and De Groot (1998) found that the

presentation of picture and L2 pairs was inferior to the presentation of L1-L2 word pairs during learning. Schnotz and Bannert (2003) studied three groups of students using text with carpet diagrams, text with circle diagrams and text only. They found that the group using text with circle diagrams performed the poorest among the three groups and the best was the text only group. Chan and Black (2006) questioned whether their learners required different kinds of support or learning experiences to understand systems of varying degrees of complexity and used three types of formats, which were the text only format, the text and static visuals format and the text and direct manipulation animation format. They found out that for simple and moderately difficult systems, students did not perform significantly differently on recall, model-based reasoning, and transfer but as the systems became more complex, students with the text and direct manipulation animation format outperformed the other two groups. Adulseranee and Lockard (2007) found that the use of written text yielded a better result on an immediate posttest in social studies than the use of written text with graphics, an audio text with graphics and a written text with audio and graphics but the group of written text with audio and graphics outperformed the other three groups during the delayed posttest.

2.2 Word Recognition

In the context of the present study, word recognition refers to a learner's ability to memorize a word's meaning and/or its description in relation to working or short-term memory. In other words, it refers to the stage of moving from an unlearned to a learned word as shown by the score of the immediate posttest after three spaced presentations of unknown words. Therefore, the literature review in this section is based on two areas. The first area is the knowledge of word recognition and the second area is word recognition in relation to working memory.

2.2.1 Definition of Word Recognition

Word recognition was one of the most fundamental cognitive skills for reading comprehension as it transfers a reader from the beginning level to the fluency stage. Grabe (2012, p. 23) asserts that "inefficient word-recognition processes are a major obstacle for learners." Without it, reading comprehension could never take place.

According to Literacy Information and Communication System (LINCS), word recognition is the ability of a reader to recognize written words correctly and virtually effortlessly. Cited in Grabe (2012, p. 22), Perfetti stated that "In reading, the singular recurring cognitive activity is the identification of words." This is also sometimes referred to as "isolated word recognition", which is the opposite of contextual reading where readers made use of the words around context to help guess the meaning while reading. As the name suggested, this type of skill requires readers to be able to spot the meaning of each printed word individually and instantly without the use of the context. Normally, the two major ways of recognizing printed words are either an individual or contextual. Beginners whose language proficiency skills are elementary often use word recognition as a primary means of understanding written work. According to Grabe, readers recognize each word by means of the interaction between the four: orthographic, phonological, semantic and syntactic.

1. Orthographically, words are written in different shapes in different languages of mostly long or short vertically, horizontally or in curves of either right-handed or left-handed. Grabe (2012, p. 24) states that "Words read by sight (not completely processed phonologically before the word meaning is accessed) demonstrated that readers make strong use of orthographic information. Sight reading is a common early word-recognition strategy for beginning readers."
2. Phonologically, words are pronounced differently and with various degrees of difficulty across languages. This is one of the predictors among foreign language learners in regard to understanding a written text during a foreign language session. Schmitt and McCarthy (2011, p. 143) mention that "Familiarity with phonological features and a word's phonotactic regularity (its familiar combinations of features) were shown to affect accuracy in perceiving, saying and remembering the word." Avoidance may occur if readers find an unfamiliar phonological word or words with a more difficult phonology system, and the result was unsatisfactory for the reading atmosphere.

3. Semantically, according to Schmitt and McCarthy (2011, p. 149), there are four semantical features of words:
   3.1 Abstractness, which is a quality of a word in opposition to concreteness. A word being abstract is known to be more difficult to understand by nature due to its complexity.
   3.2 Specificity and register restriction refers to the use of words in different situations and degrees of meaning varying across disciplines and topics. Depth of meaning is more problematic among foreign language learners than native speakers.
   3.3 Idiomaticity, which refers to the co-occurrence of words. Nation (2011, p. 56) maintains that "Knowing a word involves knowing what words it typically occur with." However, this issue is outside the realm being investigated in this study.
   3.4 Multiple meaning, which is often a homonym referring to a word with more than one possible meaning. Native speakers have less problems dealing with these words since they have more exposure to them.
4. Syntactically, sequencing words are governed by rules so as to show the relationships of meaning within sentences (Thornbury, 2006, p. 221). This parameter is, again, outside the realm of this research.

Grabe (2012, p. 26) concluded that "The effect of semantic and syntactic processing other respects is less apparent because semantic activation processes are slower than phonological and orthographic processes, though they are observable with nonfluent readers and with words that are unusual or difficult to process."

Testing word recognition skill is one of the dimensions that must not be left out. When testing vocabulary, Nation (2011, p. 358) preliminarily cautions that "Three important distinctions affecting difficulty in learning a word are: reception/production, recognition/recall, and imprecise/precise." The point is made clear between recognition and recall as shown below.

> Recognition items were easier because even with partial knowledge a test-taker may be able to make the right choice. The

> recognition/recall distinction has been a matter of some debate in memory research (Baddeley, 1990: 271-275), but when the distractors are not very close in form and meaning to the target word, then recognition tests are easier than recall tests. (Nation 2011, p. 359)

What is well known among teachers is that recognition tests are the opposite of recall tests. Read (2004, p. 154) clearly states the differences between the two: "Recognition here means that the test-takers are presented with the target word and are asked to show that they understand its meaning, whereas in the case of recall they are provided with some stimulus designed to elicit the target word from their memory." One of the interesting points noted by Nation and Webb (2011, p. 233) is that "Immediate post-tests measure an increase in knowledge from unknown or partially known to degrees of partial knowledge." What must also be taken into account is the skill of being receptive and productive during the teaching method. The tests functioned most fruitfully and their results were most valid when their form matched the pattern taught. What most teachers expect is the transition of word recognition skill to the stage of automaticity among readers where they can detect the meaning of a word with both speed and accuracy. However, Grabe (2012, p. 29) emphasizes that "The ultimate goal of word-recognition processing is rapid, accurate and automatic recognition so that cognitive attention can be directed to building textual meaning rather than to recognizing words." Hence, in order for this to happen, learners needed a lot of practice and its virtue is that "Automatic processes do not place great demands on processing resources in working memory (minimizing capacity constraints) and thus can be carried out while focusing on other tasks." (Grabe, 2011, p. 28)

2.2.2 Word Recognition and Working Memory

In case of physiological brain function, word recognition skill is considered as one of the low level processes closely tied to working memory. The brain is one of the most complicated and sophisticated organs inside a human body. Up to this century, its myth and magic were still a secret which scientists and physicians could hardly tap into.

There have been many theories and models about human brain memory function, which are still controversial, such as Craik and Lockhart's level of processing model of how shallow or deep a learner engaged in learning interacts with learning or Sweller's cognitive load model of the limited ability of our brain to handle different pieces of information at a time. While there has been no resolution regarding the models mentioned above, this unit would only entail a connection between word recognition and its relation to the aspect of human working memory. The human brain is the central area where memories are executed. The words short-term memory and long-term memory have been common for a long time. However, the term "working memory" was first used during the second half of the twentieth century by Alan Baddeley in 1974. His idea was an alternative to the idea of Richard Atkinson and Richard Shiffrin a decade earlier about the short-term and long-term memory. While Atkinson and Shiffrin proposed the model of modal or multisensory brain model in connection to short-term and long-term memory, Baddeley posited that short-term memory was insufficient and inappropriate because it only envisaged the idea of storage and duration in comparison to long-term memory. Baddeley's terminology of working memory came to replace the phrase "short term memory". His definition of working memory expanded its meaning to consciousness and elapsed time of a person during an episode of motor functioning. Fadel and Lemke (2008, p. 9) sum up the ability of working memory as "The working memory is dual coded with a buffer for storage of verbal/text elements, and a second buffer for visual/spatial elements." This kind of memory works like the information processing of a computer. This similarity means that it is where the initial identification and analysis of incoming sensory input takes place. One very important piece of information about working memory is that about ninety-eight percent of the information put there would be discarded at this point. Working memory must be a function that takes place attentively. The other aspect of working memory in opposition to long-term memory is that it is extremely time and capacity limited. Its work span lasts only for seconds and, according to Miller's The Magical Number of Seven, Plus or Minus Two (1956), an average person can store only five to nine pieces of information at a particular time. Cited in Grabe (2012, p. 33), Miller defines working memory by writing that "Working memory is not a 'box' located somewhere

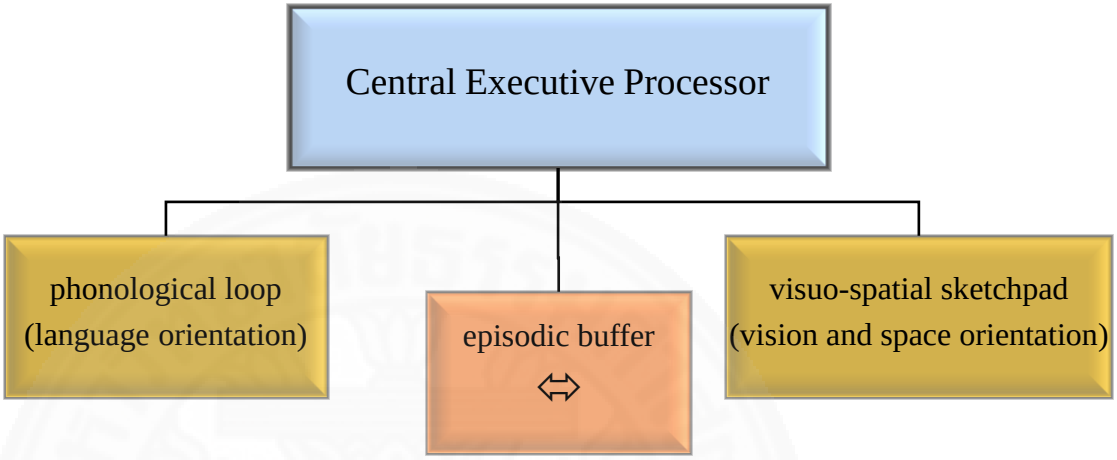
in the brain; rather, it is best understood as those parts of long-term memory networks that are active in a given moment." This idea is clearly elaborated below.

> In their (Baddeley and Hitch) theory, working memory is composed of a limited capacity attentional control system, *the executive control*. It is supported by two subsidiary systems: the *phonological (or articulatory) loop* and the *visuo-spatial sketchpad*. The phonological loop holds and rehearses sounds and speech-based information; the visuo-spatial sketchpad does the same with visual images and spatial relation.
>
> The phonological loop has two purposes. First, the loop is a store for holding phonological information for a few seconds or for refreshing the stored sounds with subvocalization (inner speech). Second, it is the component that decodes and stores visual information (written words) in phonological form for storage and rehearsal. All language information used in working memory is stored and rehearsed phonologically. The phonological loop performs critical functions for word learning and word-recognition skills. Storage, rehearsal, and reinforced memory of new words in phonological form in working memory is the foundation of vocabulary learning (Baddeley, 2006; De Jong, 2006) (Grabe 2012, pp. 33-34).

Nation (2011, p. 61) maintains that "Explicit learning, unlike implicit learning, involves conscious attention to, and awareness of, the specific skills or language knowledge that a reader is focusing on. It requires rehearsal (in working memory) to establish a first memory of the information that can be registered in long-term memory and reactivated for subsequent explicit processing." This type of learning is very much in line with learning vocabulary in isolation or intentionally as most low proficiency EFL learners do in general. Their activity during learning new words employ superficial skill of working memory for word recognition. Grabe (2011, p. 35) confirms that "The role of working memory in low-level processing for reading is relatively direct and well-established. Working memory supports phonological, orthographic, and morphological processing for word recognition."

Figure 2.2

Baddeley's 2007 Model of Working Memory



2.3 Word Retention

In the context of the present study, word retention refers to "how well the item learned persists in the learner's memory" (Nation & Webb, 2011, p. 279) or the duration of time new words can be kept in a learner's long-term memory, not working memory or short-term memory. In other words, this relates to the score of the delayed posttest, which was one month after the immediate posttest. Therefore, the literature review in this section is based on the following two areas. The first area is the connection between word retention and the importance of repetition and the second area is word retention in relation to long-term memory.

2.3.1 Definition of Word Retention

In general, word retention refers to the ability to recall or retain what has been learned earlier after a period of time. What should not be neglected is the idea behind how subjects recall or retrieve information, and this is where the aspect of repetition fits in. Thornbury (2006, p. 196) mentions that "Repetition underlies many language learning activities, and it has always been considered a sound learning strategy." Nation (2011, p. 79) states that "repetition contributes mainly to strength of knowledge." Schmitt and McCarthy (2011, p. 276) stress that "Memory clearly

plays a role in vocabulary learning and the benefits of revision or repetition have been clearly demonstrated in studies of vocabulary learning" while Zimmerman (2009, p. 9) indicates that "Word learning is incremental. In order for a new word to be retained, it must be encountered again (and again) before it is forgotten." Moreover, she emphasizes that "The importance of repetition to word learning is one thing that all vocabulary researchers agree on." The incorporated idea of repetition and retention is clarified as follows.

> If we view our memories as a dynamic network of ideas, interacting with each other in multi-faceted formats, then the more ways in which new language can be linked to what is already there and included in the interactions, the more effective the storage will be.
>
> This [Repetition] has been identified as the single most important factor in making language memorable…The more we encounter a language item, and the more often we called upon to use it, the more readily it will become part of our repertoire (Bilbrough, 2011, p. 43).

Repetition is one of the key factors in learning that make retention possible and language learning is no exception. In regard to the function of repetition in learning another language, Nation (2011, p. 67) observes that "If too much time has passed between the previous meeting and the present encounter with the word, then the present encounter is effectively not a repetition but is like a first encounter. If however a memory of the previous meeting with the word remains, then the present encounter can add to and strengthen that memory." In vocabulary learning, repetition was broadly divided into two major types whether it be incidental or intentional learning depending on the degree of spacing. They were spaced repetition and massed repetition. The former refers to the process of exposing learners to words at intervals over an extended period of time while the latter refers to the process where learners are exposed to words within a short amount of time. A caution regarding this aspect is highlighted below.

> In fact, the number of repetitions is only one of the factors influencing learning. The spacing of intervals between the encounters and the types of tasks are also important. The rate at which we forget is fastest immediately after the word is presented; it then decreases with time. Therefore, be sure to repeat a new word soon after you first present it, and then at spaced intervals of increasing length. (Zimmerman, 2006, p. 10)

In second language and vocabulary research, the virtue of spaced repetition is rather conclusive. Cited in Nation, Baddeley states that

> …because long-term learning depends on physical changes in the brain, spacing repetitions allows time for the regeneration of neuro-chemical substances that make these changes. Massed learning does not allow enough time for these substances to regenerate and thus they cannot continue to make the physical changes needed for learning. (Nation, 2011, p. 77)

The issue of how teachers should space the intervals of words is explained below.

> A very robust finding in memory research in general (Baddeley, 1990) and second language vocabulary learning research in particular (Bloom and Shuell, 1981; Dempster, 1987) is that spaced repetition results in more secure learning than massed repetition. Massed repetition involves spending a continuous period of time, say fifteen minutes, giving repeated attention to a word. Spaced repetition involves spreading the repetitions across a long period of time, but not spending more time in total on the study of words. For example, the words might be studied for three minutes now, another three minutes a few hours later, three minutes a day later, three minutes two days later and finally three minutes a week later. The total study time is fifteen minutes, but it

> is spread across ten or more days. This spaced repetition results in learning that will be remembered for a long period of time. The repetitions should be spaced at increasingly larger intervals. (Nation, 2011, p. 76)

Nation also cautions teachers that simple learning of a definition of a word over four repetitions may be more appropriate. Nation also cites Pimsleur's suggestion that the repetition should be greater during later exposures with the initial exposures closer together. The connection between spaced repetition and retention is elaborated on below.

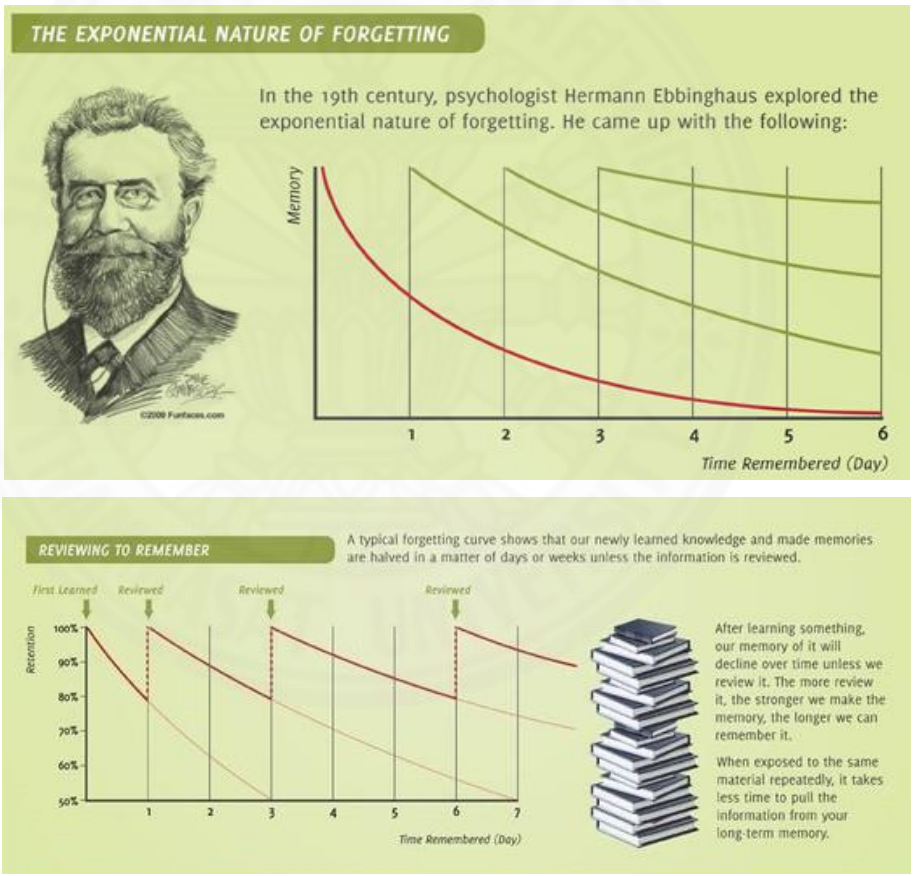
> The general principle which lies behind the spacing is that the older a piece of learning is, the slower the rate of forgetting. This means two things. Firstly, after a piece of learning, the forgetting is initially very fast and then slows down. Secondly, on the second repetition, a piece of learning is older than it was on the first repetition and so the forgetting on the second repetition will be slower than it was. On the third repetition the forgetting will be even slower. (Nation, 2011, p. 77)

This idea of forgetting is very much in line with Ebbinghuas, a German pioneer in the memory and spacing effect who developed the theory of the Forgetting Curve during the nineteenth century. The idea of the Forgetting Curve is that human memory declines over time and the curve shows that the information learned is forgotten if there is no attempt to retain it, which actually is the idea behind spaced repetition. Recent research and review articles also support this premise (Heidari-Shahreza and Tavakoli, 2016; Endress and Potter 2014; Carpenter, Cepeda, Rohrer, Kang and Pashler, 2012; Hintzman, 2010; Chen and Truscott, 2010; Karpicke and Roediger, 2008; Webb, 2007). What is clear is that spaced repetition is very beneficial for learning across disciplines but the ideal length of the gap remains a controversial issue. Carpenter, Cepeda, Rohrer, Kang and Pashler (2012) conclude that "the optimal spacing gap depends on when the information will be tested in the

future…In general, the optimal spacing gap equaled 10-20% of the test delay. In other words, the longer the test delay, the longer the optimal spacing gap." What should be noted here is that test delay refers to the time elapsed between the final study presentation and the test since some research studies mention the danger of waiting too long for a review.

Figure 2.3

Ebbinghaus Forgetting Curve



Note. adapted from https://www.pinterest.com/pin/226798531206651551/

2.3.2 Word Retention and Long-term Memory

Literacy is very much dependent on memory, especially long-term memory. Humans needed to be able to retrieve what is stored and retention is the word that directly deals with memory, particularly long-term memory.

> Information used in working memory fades when immediate activity ends, but some network of integrated information will remain and be stored in long-term memory: we can say that this information is "learned". In this way, working memory and long-term memory "communicate" via activation levels and integration processes. (Nation, 2011, p. 33)

Without the ability of long-term storage, recall cannot take place and there is certainly no learning. It must be noted that long-term memory in the brain alone cannot fulfill its function properly without experience.

> ...without long-term memory—in the form of mental representations of how texts are organized, as well as our knowledge of the world—we would not be able to bring our experience to bear in making sense of texts at all. (Bilbrough, 2011, p. 3)

Human's long-term memory, therefore, is as a consolidation of working memory or short-term storage with subject matters one learned during their course of life.

Long-term memory is unlimited in terms of both time and capacity. Statistically, long-term memory in humans can store up to 10^9 to 10^{22} bits of information over a lifetime. The property of long-term memory is identified below.

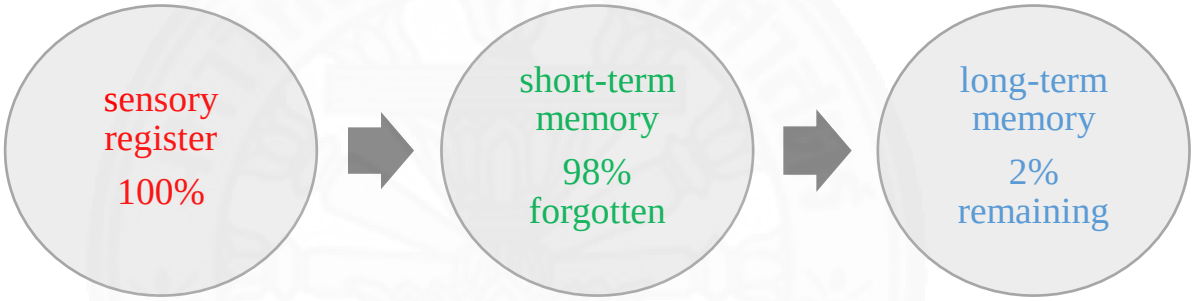
> The storage of information in long-term memory—unlike in working memory—is a largely subconscious process and is apparently not constrained by either time or capacity. Material can be stored in long-term memory for anything between a few days and a lifetime, depending on the richness of links that were made with existing

material in the initial encoding, and on the regularity of opportunities to retrieve and reactivate it. (Bilbrough, 2011, p. 5)

Figure 2.4 depicts how sensory motors and the two types of memory are interconnected in terms of information retention.

Figure 2.4

Atkinson and Shiffrin's Multistore Model



It was widely known and accepted that only limited pieces of information learned at the level of sensory perception proceed or can be transferred to the long-term memory domain. As put earlier, working memory has time and capacity limitations while long-term memory does not. Only roughly two percent left after the activity stops during the working memory episode continues its way to the long-term memory domain and this is where retention occurs.

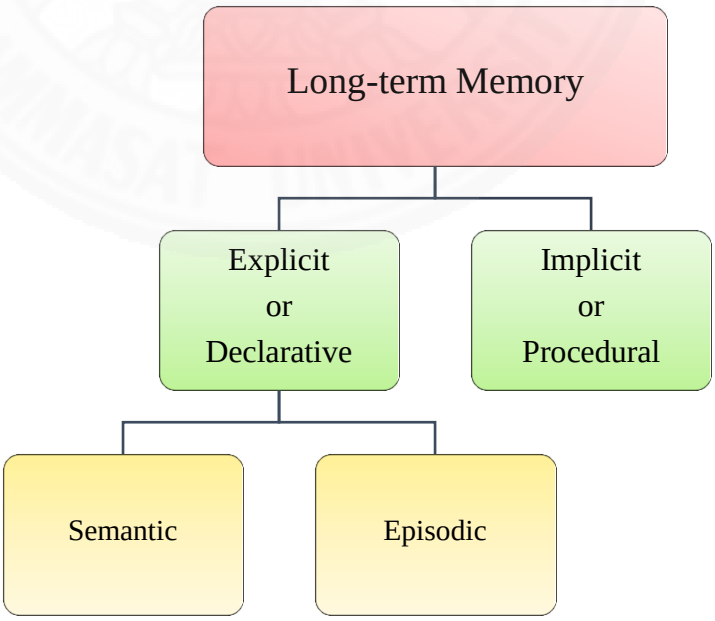
Human long-term memory has two distinct patterns, explicit or declarative, which are further divided between semantic and episodic, and implicit or procedural. Figure 2.5 displays the hierarchy of long-term memory in its simplest fashion.

After the working memory is infused with modalities, some is forgotten but about two percent still makes its way to the long-term memory. Jensen (2008, p. 155) remarks that "It is important to think process, rather than location, when discussing the memory system. The current understanding is that multiple

sensory memory locations and systems are responsible for our learning and recall." The volcano metaphor could be used for the memory system. It is active when engaged in the process of working memory; it is passive when the information learned is forgotten and it is dormant while it is kept before being retrieved or recalled in the stage of long-term memory. Long-term memory is primarily semantic while working memory is more sensory or perceptual based. An important caution is that there is no specific brain area responsible for the storing of memory. The spread of storage across brain areas is said to be a protection against loss of all information. While various parts of the four lobes of the brain are responsible for different types of sensory activation connected with working memory, one particular area in the temporal lobe called the hippocampus is necessary for the transfer of short-term data to long-term storage. How the brain lobes of the human brain worked together is explained roughly next.

Figure 2.5

Long-term Memory Hierarchy



> Even within these storage areas, there is further fragmentation, with semantic memories (such as what the capital of France is) located in a separate region (the temporal pole) from memories of past event (which are more widely distributed across the temporal cortex). Evidence also shows that different processes occur when we have a sense of vague familiarity about a past event, compared with when we can confidently recall it, and these are carried out by different parts of the medial temporal lobes. (Seth, 2014, p. 118)

Parker (2009, p. 110) maintains that "Many mental faculties are not controlled by just one area of the brain. For example, there is no single "memory centre". Thoughts, feelings, emotions, awareness, and memory involve many parts of the brain." All parts of the brain mutually help one another in consolidating memory, both sensory and long-term. However, a key factor protecting information from being forgotten is repetition. Endress and Potter (2013, p. 2) confirm this strongly by saying "It is well established since the onset of experimental psychology (Ebbinghaus, 1885/1913) that once an item is in LTM, repeated exposure increases its memory strength and delays its forgetting."

In sum, long-term memory in humans is exceptional in terms of language whereas semantic is said to be a primary function in contrast to the rest of the animal kingdom. Living creatures have brains that are functional and adaptive. For example, dogs have more receptors in their brain that are sensitive to smell. Hard evidence on the differences between human and animals can be seen from chimpanzee studies at the Primate Research Institute in Kyoto University. They were found to have extraordinary visual memory, allowing for information to be deposited in their long-term memory after only a single exposure. Seth (2014, p. 36) posits that "There are many theories for what caused the massive expansion of the human brain, including bipedalism (which freed up the hands for tool use), larger social groups and the emergence of language."

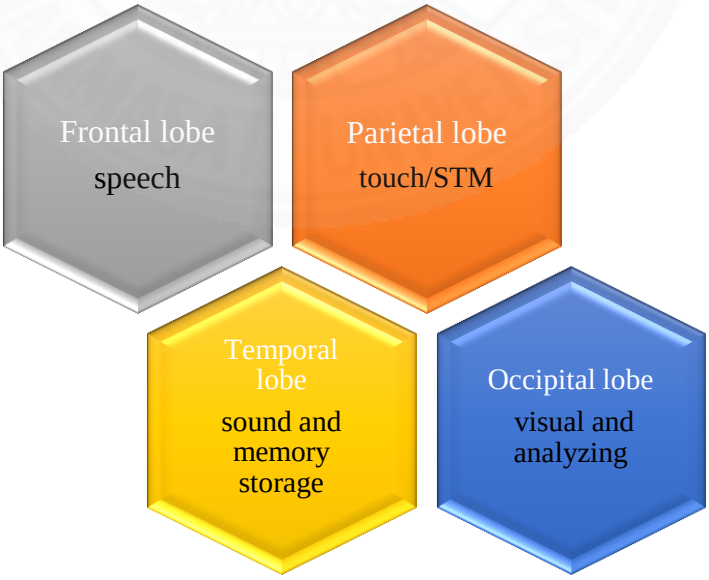
2.4 L2 ➲ L1 Translation

Practically, there are hundreds of ways of conveying the meaning of unknown words to students verbally or nonverbally such as a definition in either L1 or L2, a demonstration, a picture or diagram, context clues or an L1 translation. In the context of the present study, this section reviews the aspect of how words are learned verbally as opposed to visually.

Theoretically and verbally, two major ways of learning a word are either incidental or intentional or a combination of both. Verbal learning refers to the state when learners encode the linguistic features using a phonological loop under the execution of working memory as a platform for transferring information to their long-term memory whenever circumstances permit. Incidental learning is learning that comes "without the intended purpose of learning a particular linguistic feature" (Schmitt, 2010, p. 29) while intentional is the opposite. The argument between these

Figure 2.6

Simplified Brain Lobes Functions



two schools is still unresolvable but the research of Hulstijn (1992), as cited in Nation (2001), compares both of them and the results showed that the incidental learning conditions proved very low in learning words. Schmitt (2010, p. 257) maintains that "It may well be that different kinds of exposure lead to stronger memory traces, with most current research showing explicit engagement outperforms incidental engagement." Nation (2001) cautions teachers about the use of either of the instructions, recommending a balance or mixing and matching. Nation (2008, pp. 1-6) lists the ultimate four jobs of vocabulary teachers in order of importance as planning, training independency, testing and teaching. One of the four parts of the planning stage should focus on the language focused learning section where an approximately twenty-five percent ratio should be dedicated to the direct study of language items. He also highlights another interesting aspect, which is that when learners encounter new words deliberately, the word is learnt at a much greater degree than when it is not focused on (Nation, 2011, p. 252). This leads to the point of using glosses as one of the intentional ways of word learning verbally.

Glossing is a brief definition or a synonym of the target word and it can be either in L1 or L2. There are many advantages of providing students with glosses because they do not have to keep guessing the meaning of unknown words, which can reduce their cognitive load during reading. However, the issue of using L1 or L2 is still controversial. Nation (2011, p. 351) confirms that this should not be of concern as long as they are easily understood and maintains that "Translation is one of a number of means of conveying meaning and in general is no better or worse than the use of pictures, real objects, definitions, L2 synonyms and so on." Read (2004, p. 21), citing Lado, Baldwin and Lobo, 1967; Mishima, 1967; Laufer and Shmueli, 1997, wrote that "Research supports the use of the first-language as an effective way of communicating word meaning." This is in line with Schmitt (2010, p. 34), who contends that "Research indicates that it does not matter much whether the gloss is an L2 description or an L1 translation, as long as the learner can understand the meaning" as he cited the work of Jacobs, Dufon and Fong 1994; Yoshii: 2006. He goes on to support the use of L1 translation by asserting that "there was no reason not to use L1 translation with less proficient learners" (p. 35) since a lot of language teachers are worried about the interference and transfer that might take place during

the course of learning. Also, they might perceive this kind of instruction as obsolete (Grammar) translation of the last century when compared to the modern Communicative Approach. Nation and Webb sum up the use L1 translation beautifully.

> Learners may prefer translations as ways of learning the meaning of a word because relating to the L1 provides the possibility of transferring L1 semantic, grammatical, and collocational knowledge to the understanding and use of the new word (see Webb 2007a for evidence of this). This transfer may not always be correct, but it does allow the L2 word to fit into a reassuring existing framework of knowledge....
>
> L1 definitions are perfectly acceptable ways of conveying word meaning. (Nation &Webb, 2011, p. 272)

To solidify the use of L1 translation, some research papers and studies are cited here. Yoshii (2006) examined the effectiveness of L1 and L2 glosses on incidental vocabulary learning in a multimedia environment and found out that there were no significant differences between L1 and L2 glosses for definition supply and recognition tasks. Liu (2008) studied the effects of L1 use on L2 vocabulary teaching and found that during L2 vocabulary teaching process, the proper application of L1 can effectively facilitate the memorization of new words. Pakzadian (2012) discovered that there was no significant difference between the use of paraphrase and the use of mother tongue translation among her students in learning new words. An article by Mart (2013) quoted Nunan and Lamb (1996), argues that "it is impossible to prohibit the use of L1 especially at lower levels." He goes on to quote Ross (2000), who views that "translation develops three qualities essential to all language learning: accuracy, clarity and flexibility" as students had opportunities to compare and contrast similarities and differences between the two languages. One of the most striking citations from the same article was from Bouangeune (2009), who states that "in order to prevent the misunderstanding of the meaning, especially new word, teachers should provide clear, simple, and brief explanations of the meaning, especially in the learner's first language." Lin and Hsiao (2011) investigated the annotations of both L1 and L2 with and without visual aids and their results indicated that there was no

significant difference between the definition languages. A study by Mart (2013) determined that the use of L1 in the classroom did not hinder Iranian students' foreign language learning.

While there is no conclusive answer regarding the application of L2 ➲ L1 translation, its relevance to this study is summed up below.

> …at beginning levels, strategies of rote memorization, bilingual translation and glossing can be valuable in assisting learning of, for example, the phonetic and graphological shapes and patterns of words. In so far as surface forms of basic concrete words are concerned, then explicit learning may be more likely to help… (Carter, 2012, p. 196)

Nation (2011, p. 351) also agrees on this point, in emphasizing that "First language translations provide a very useful means of testing vocabulary, both receptively and productively, and in recall and recognition items."

All in all, the application of L1 is known to be fast and efficient. It is the teacher's job to tailor their teaching appropriately. As language teachers, they have to be mindful of the fact that two languages are never the same and not every word has a direct translation.

2.5 Pictorial Coding

In language learning and in the context of the present study, pictorial coding refers to an application or addition of static pictures or images without the presence of any linguistic features into vocabulary instruction as an aid to facilitate learners. Originally, its application was involved with human history for thousands of years and it is one of the oldest techniques people have been using as an aid for memorization. Its educational value is indisputable in terms of ease and directness, not to mention its concreteness.

In language literacy, pictorial coding has been used as a means of communicating meaning during vocabulary sessions for centuries. Several other methods for communicating meaning are for example giving translation, providing definitions or performing actions. Equipping learners with pictures and diagrams is one of the most valid ways for teachers to teach vocabulary. Nation (2011, p. 85)

views that “An advantage of using actions, objects, pictures or diagrams is that learners see an instance of the meaning and this is likely to be remembered.” Bilbrough (2011, p. 9) affirms that “Visualization is central to the storage of new information in long-term memory.” It must be noted at this point that visual learning is not to be confused with verbal learning as when students see words. Visualizing involves with the brain process concerning non-linguistic features employed at the working memory stage using a visuo-spatial sketchpad as a springboard for transferring information to long-term storage. One of the most fundamental uses of pictorial coding is the use of flashcards or word cards where information of words and or picture is provided on the other side of the card. Though considered a decontextualized method of instruction and uncommunicative, the use of flashcards with pictures is highly effective in many aspects if applied appropriately. This could be used with either high or low frequency words. For learners themselves, they can control the number of repetitions or they can add on extra information as they wish. One must not confuse flashcards with word lists. The two major differences between them are as follows. A flashcard or a word card is a small piece of paper with the L2 word on one side and the information of a word together with or without the picture on the other side. A word list is a regular size piece of paper where students write an L2 word with its definition or translation next to it. Nation (2011, p. 296) describes flash cards as “the formation or association between a foreign language word form (written or spoken) and its meaning (often in the form of a first language translation, although it could be a second language definition or a picture or a real object, for example.” He also strongly recommends to “Use pictures where possible” (p. 304) although

> Not all words are picturable, but for those that are, the actual drawing of the picture on the card could improve memory. A suitable picture is an instantiation of the word and this may result in a deeper type of processing than a first language translation which does not encourage the learner to imagine a real instance of the meaning of the word. (Nation, 2011, p. 305)

Grabe and Stoller (2011, p. 34) extend the idea that “Flash cards, while sometimes considered passé, can prove effective not only for vocabulary building and vocabulary collecting (we all want our students to be word collector), but also for word recognition.” Also, “Word recognition practice can be provided more directly through oral paired reading, timed word-list reading, word matching, word (and phrase) recognition exercises and flash cards.” Flashcards can be used with many techniques depending on the purpose of users. Some of them as suggested by Nation are listed below:

1. Use recall. This was the simplest way of using flashcards. Learners try to retrieve the word’s meaning from memory at their own leisure.
2. Learn receptively, then productively. This is actually the other way around of the above technique. After sometime recalling a word’s meaning, learners might try the picture side and recall the word instead.
3. Keep changing the order of cards in the pack and put difficult words closer to the beginning. This technique is straightforward. Its value is to make sure that learners do not fall into ‘serial learning’ when one word activates the meaning of the following word. Learners must be able to recall each word’s meaning independently.
4. Say the word aloud or to yourself. Ellis (as cited in Nation, 2011, p. 307) states that it is evident that “putting items into the ‘phonological loop’ is a major way in which items pass into long-term memory. According to Seibert (1927), silent rote repetition of vocabulary lists is not the most efficient way of learning.”

Opponents of intentional learning often criticize it as being far too decontextualized and not suitable for communicative purposes but Nation (2011, p. 301) strongly disagrees, arguing that to say “The first, that word cards are not good for remembering is simply wrong; the research shows otherwise.” Nicholson also supports this below.

> Flashcards can foster automaticity by helping children read words accurately and quickly. Critics argue that flashcards only teach children to ‘bark’ at print and do not contribute to the bottom line of reading, which is

> comprehension. But recent research suggests the opposite, that teaching children to read words faster can improve reading comprehension dramatically. (Grabe & Stoller, 2011, p. 135)

Research studies have pinpointed the superiority and the positive effects of using pictures for many reasons. This confirmation is briefly and simply given below.

> Concrete vivid images are most influential. Neuroscientists theorize that this is because (1) the brain has an attentional bias for high contrast and novelty; (2) 90 percent of the brain's sensory input is from visual sources; and (3) the brain has an immediate and primitive response to symbols, icons, and other simple images. (Jensen, 2008, p. 56)

Godwin-Jones (2010) asserts that flashcards continue to be a popular method of working with vocabulary, typically with the L2 and L1 on opposite sides.

Research studies showing the positive effects of using pictorial coding should incerase the confidence of those who are skeptical about its effectiveness.

The results of Jalilehvand's study (2011) comparing text reading comprehension with and without pictures confirmed that length had no significant effect on the reading comprehension of her participants but they performed better on texts with picture, which confirmed that pictures were the key variable influencing EFL students' reading comprehension at high school levels.

Nugroho (2012) found during action research with Indonesian students that they learned vocabulary more easily with flash cards with an improvement in achievement.

However, some contradictory results were found in the study of Lotto and De Groot (1998). They compared two teaching methods of word association and picture association and found that L1 - L2 word pairs provided a better opportunity for acquiring L2 words than the presentation of L2-picture pairs. Schnotz and Bannert (2003) also found that presenting graphics was not always beneficial to the acquisition of knowledge since some of the graphics might interfere the mental model among learners. Basoglu, and Akdemir (2010) compared the effectiveness of students'

vocabulary learning using mobile phones and flash cards. Their findings showed that using mobile phones as a vocabulary learning tool was more effective than the use of flashcards, which were more traditional. Baleghizadeh and Ashoori (2011) found no significant difference between the use of flashcards and word lists in their elementary level of Iranian English language proficiency students. Tavakoli and Gerami (2013) investigated the difference between the use of the key word method (KWM) and the pictorial method on EFL learners and found that the former was better than the use of the latter in terms of word retention in both immediate and delayed posttests.

2.6 Relevant DCT Based Research Studies

As mentioned earlier, the genesis of DCT was conceptualized as an aid to provide educational value. Its idea was expanded into several disciplines and language learning was one of the fields that embraced its benefits. Following are some of the studies aimed directly at testing the effectiveness of the DCT approach. The results of most studies showed the benefits of DCT. However, this was not unidirectional since some did not favor the theory.

Mayer and Anderson (1991) conducted a two-phase experiment with students from the psychology subject pool at the University of California at Santa Barbara whose background was said to be minimal regarding using or repairing mechanical devices. The first phase of the experiment focused directly on the hypothesis of whether the application of DCT simultaneous coding helped or hindered students during learning while the second phase of the experiment was an extension and a replica of the first phase testing the students' verbal recall of information areas after the problem solving performance.

In the first phase of the experiment, participants were divided into two halves of fifteen each. Both groups were presented with an animation of a bicycle tire pump operation. Verbal description of the mechanism was shown before the animation for the first group and during the animation for the second group. The results showed that the words-with-pictures group outperformed the words-before-pictures group on tests of creative problem solving that involved reasoning about how the pump worked. This supported the effectiveness of the DCT hypothesis of simultaneous double representation, which claimed to build better referential connections in learners while learning.

In the second phase, the experiment was divided into two parts. The first part was exactly the same as the first phase experiment with the addition of a verbal recall of information exercise after the problem solving section. Students were reduced to twelve in each group. The results showed that both groups performed equally well in verbal information recall but the words-with-pictures group score of problem solving was better than the words-before-pictures group, which suggested a better referential connection quality embedded in DCT. In the second part, the dependent variables remained the problem solving and verbal recall of information performance among students. However, instead of applying words with pictures before and during the animation, they put students in four groups of words only, pictures only, words-with-pictures and control group in order to isolate the effects of words and pictures. The results again showed that words-with-pictures group outperformed the other three groups in problem solving. However, in the verbal recall part, both the words-with-pictures and the words-only group did equally well on the test, which matched the representational values of the nature of the verbal test.

Mayer and Anderson concluded that without narration during the presentation, pure animation acted just like no instruction and did not help students understand better.

Plass, Chun, Mayer and Leuter (1998) studied visual and verbal support students in learning a second language in a multimedia learning environment and found that students remembered words better when they chose both visual and verbal annotations.

In their study, participants were 103 English-speaking college students enrolled in a German class in California. They asked students to read a 762-word German language story through a computer program. Students could choose freely whether they wanted a visual or verbal annotation or both. Their verbal annotation referred to English translation while their visual annotation referred to picture or video clip that represented the word. After reading the eleven-page story at their own pace at a computer station, students were asked to take a 24-word vocabulary test and a comprehension test without turning back to the story. For the vocabulary test part, students were classified into how they selected the annotations, which were verbal (English translation), visual (picture or video clip), both or none. The results showed

that students learned words better when they chose the combination of visual and verbal annotations. For the comprehension part, students were asked to write a summary of the story or "recall protocol" in English. This part was done to check against each student's strong learning preferences (that was done before the study), which were classified into visualizers, verbalizers or neither of the two. The results showed that students learned better when they had the opportunity to receive their preferred mode of annotation.

Kost, Foss and Lenzini (1999) investigated the effectiveness of pictorial and textual glosses on incidental vocabulary growth when reading in a foreign language among 56 English native enrolled in the second semester of a German class at Purdue University. They conducted both a production test and a recognition test of 14 target words two weeks apart. The results showed that students who utilized the combination of text and picture annotation scored better on the recognition of target words in terms of both short-term memory and retention.

During the experiment, each student received a 272-word German passage with one of the annotations, which were text, pictures or both. After reading (without time limits), students were tested again without time limits regarding fourteen target words, productively and receptively. The results suggested that students using both types of annotation performed better than the other two groups during both immediate and delayed tests but the results were not statistically different. They concluded that the combination of pictures and text in the marginal gloss is one of the most effective tools for the purpose of vocabulary gain through reading.

Rodriguez and Sadoski (2000) studied the effects of rote rehearsal, context, keyword and context/ keyword methods on immediate and long-term retention.

They recruited 160 EFL ninth graders in Venezuela and spread them over the four types of the abovementioned methods. The rote learning class was taught to repeat the English word and its Spanish translation several times in order to associate the word's pronunciation and meaning. The context class was taught to read sentences in which the English word was used. Students were then asked by the teacher to think what the word meant and were also asked to remember the word. The keyword class was done by teachers asking students to link the English word with sounds in the Spanish word and telling the meaning of the target word to students.

The context/ keyword class combined the method of the context and keyword class together. After class, students were asked to finish the cue-recall test that consisted of a list of 15 words with spaces and to write the Spanish translation with the time allowance of five minutes. The results indicated the superiority of the context/ keyword over the other methods especially in the one-week delayed test. Students were able to retain from 1.5 to nearly 4 times more correct definitions compared with the other three methods. Therefore, they maintained that the method was very promising.

De Groot and Keijzer (2000) wanted to learn more about the factors that determine both the learning and retention of foreign language words. The three factors were word concreteness, cognate status and word frequency. They checked the foreign learning and forgetting experience among 40 native Dutch psychology students at the University of Amsterdam using paired-associate training technique and found that what was difficult to remember would be forgotten easier.

In the first series of the study, they tested the factor of cognate status. A set of 60 Dutch words with half of the concrete (high imageability) and the rest abstract (low imageability) were paired with new (pseudo) words. The training involved six presentations and the test took place after the second, the fourth and the sixth round with a retest one week after training. Half of the words were paired with a cognate translation in a pseudoword fashion while the other half was matched with the non-cognate translation. Half of the students were put for the productive knowledge test and the other half was put for the receptive knowledge test of the newly learned vocabulary. They indicated that the stimulus materials were manipulated on word concreteness, cognate status, and word frequency. The results for both the productive and receptive tests showed better overall recall for concrete and cognates than for abstract and noncognates.

In their second series, they tested the word frequency dimension. Much of the procedure remained the same. However, instead of pairing each of the thirty words of concrete and abstract words with cognate and noncognates, they categorized words into either high or low frequency Dutch words based on the CELEX corpus. The results showed that word frequency was not significant in learning and forgetting.

Their conclusion towards DCT was that concrete words were stored in both a visual system and a verbal system, facilitating easier learning and remembering, while abstract words were stored in the verbal system only.

Markham, Peter and McCarthy (2001) studied the effects of native language and target language captions on foreign language students' DVD video comprehension among 169 intermediate university students studying Spanish as a foreign language. The purpose of their study was to see how Spanish, English or no captions affect the comprehension of students using a DVD as a material. The results showed that the English caption group performed at a substantially higher level than the other two groups.

Students were split into three conditions of the captions mentioned above. They watched a seven-minute long DVD episode whose audio was in Spanish. After the show, they were asked to write a summary of what they had seen in English and to complete a 10-item multiple-choice test regarding words that were in the DVD. The results indicated that the no captions condition was a major hindrance for comprehension since students scored the lowest among the three groups. The English caption group scored the highest for both tests. The researchers confirmed that using captions was an augment to second language learning as proposed by DCT.

Yoshii and Flaitz (2002) conducted a study titled "Second Language Incidental Retention: The Effect of Text and Picture Annotation Types". By "incidental", they meant "learners' acquisition of the meanings of words as they engage in other tasks such as comprehension of reading or listening passages." They recruited one hundred fifty-one (69 females and 82 males) participants with the average age of 24.6, both beginner and intermediate ESL students who were enrolled at the University of Florida. They placed students into three groups, which were the text-only group, the picture-only group and the text-and-picture group. They measured students' performance based on scores on three exercises, which were definition supply in either L1 or L2, word recognition and picture recognition. The performance check was done twice with the first one as an immediate test and the other as a two-week delayed test. All the words used in this study were verbs with confounding linguistic factors such as cognates removed. The results showed that the combination group outperformed the other two groups significantly in both immediate

and delayed posttests across almost all measures except during the delayed posttest of the definition supply exercise of lenient scoring. They also found out that different proficiency levels had no interaction with students' performance in all the exercises prescribed during both the immediate and delayed posttests. However, the retention rate among the three groups did not differ significantly. In other words, all three groups of different annotation suffered an equivalently declining rate of word retention over time.

Kuo and Hooper (2004) studied the effects of visual and verbal coding mnemonics on learning Chinese characters in computer-based instruction among 92 English native speakers at the high school level who had no background in Chinese language. Participants were randomly assigned to five treatment groups while learning Chinese characters: 1) translation 2) verbal mnemonics 3) visual mnemonics 4) dual coding mnemonics and 5) self-generated mnemonics. The results showed that students who generated their own mnemonics scored higher than the other four groups.

In the experiment, every group studied 30 Chinese characters with one of the method explained above. Group 1 (translation) students were equipped with English translation alone. Groups 2 (verbal mnemonics) students were equipped with both translation and a brief verbal description of each character's etymology. Group 3 (visual mnemonics) students were equipped with both translation and a picture representing its Chinese character's meaning. Group 4 (dual coding mnemonics) students were equipped with translation, picture and a verbal description. Group 5 (self-generated coding) students were the same as that of Group 1 but the researchers encouraged students to create their own methods such as drawing a picture or writing a sentence to remember Chinese characters. After the training sessions, both immediate and delayed posttests were conducted. The scores showed that Group 5 (self-generated mnemonics) always ranked first during both tests followed by Group 4 who always ranked second for both tests. However, scores across five groups did not differ statistically. Nevertheless, their conclusion was geared toward the use of dual coding since students in Groups 1-3 might "instinctively" resort to mental images that associate Chinese characters with their meanings.

Shapiro and Waters (2005) investigated the cognitive processes underlying the keyword method of foreign vocabulary learning among 104 psychology students. Students were asked to memorize 30 Latin words, which were divided evenly between high and low imagery value.

Only 56 participants were in the actual experiment since 48 of them were used to pretest the stimuli. All subjects were presented with 30 Latin words and were told that they had to do a recall meaning task afterwards. All of them were asked to imagine the word's meaning interacting with the keyword provided (the Given condition) or of their own (the Self-Generated condition) depending on the condition each student was assigned to. The results showed that the Given condition group outperformed the Self-Generated group in both immediate and one-week delayed posttests for the high imagery condition words. They concluded that the use of visual imagery was fundamental to the use of the keyword method.

De Groot (2006) replicated the study in 2002 by studying the effects of stimulus characteristics and background music on foreign vocabulary language learning and forgetting.

In her experiment, she compared the three stimulus variables, which were the frequency and concreteness of the native language (L1) and the (phonotactical) typicality of the foreign language (FL) words. Baroque music was played during class but not at test time. There were 36 Dutch native psychology participants who were experienced FL learners. Eighteen of them were in the music condition and the rest were in the silent room. They studied 64 word pairs for two rounds divided into 32 word pairs as described next. Each pair consisted of a Dutch word and a nonword, which 32 were phonotactically typical in Dutch, and the other 32 were phontactically atypical in Dutch. All the nonwords were noncognates as well. The 32 word pairs were also further halved between concreteness (concrete or abstract) and frequency (frequent and infrequent). Students studied word pairs on a computer for two rounds for three times. They also did the learning-then-test after each round. After the three tests, they were scheduled for the one-week later test whose circumstances were the same during the first three tests. The main findings were that students in the music room learned words that were paired with typical nonwords better during the three immediate tests. During the one-week delayed posttest, students forgot L1 words that

were infrequent and atypical nonwords more than words that were frequent and typical nonwords. This was confirmation that materials that were difficult to learn had a higher forgetting rate. The researcher concluded that "in order to establish the new FL forms in memory, more autonomous FL representations gradually develop through processes of revision and bypassing and severing earlier connections between L1 and FL representations."

As for music and non-music conditions, both led to equal forgetting rates over the delayed one-week test. De Groot maintained that it was promising for a new piece of research mapping different arousal factors together.

Akbulut (2007) investigated the immediate and delayed effects among advanced EFL students between different types of glosses, which were 1) definitions of words, 2) definitions coupled with associate pictures and 3) definitions coupled with associated short videos. The results showed that the first group scored lowest both during immediate and delayed tests.

Sixty-nine Turkish freshmen were involved in the study. They were randomly assigned into each treatment. They were asked to read a passage and do a test that came in four formats (three vocabulary tests with one reading comprehension test) immediately after the reading session. The first one was the form recognition test asking students to indicate the words they remembered from the text. The second one was a meaning recognition test divided into two multiple-choice parts of synonym recognition and definition recognition. The third one was a meaning production test asking students to write the L1 equivalents or synonyms of target words. The fourth part was a reading comprehension test with 12 multiple choice questions and 22 true-false questions. Three weeks after the first test, students were given a vocabulary test unannounced. The results for all the three vocabulary tests were unidirectional with the video group performing the best and the picture and video group performing better than the definition only group both at immediate and delayed posttests. For the reading comprehension test, there were no differences among the groups. The researcher concluded that providing visuals regardless of types was better than giving definitions alone.

Chen, Hsieh, and Kinshuk (2008) studied the effects of short-term memory and content representation type on mobile language learning among 156 college students in Kaohsiung.

Students were divided into four groups as classified by their short-term memory (STM) ability in learning styles. These four groups were 1) learners with higher STM ability in both verbal and visual components 2) learners with lower STM ability in verbal and higher STM in visual components 3) learners with lower STM ability in both verbal and visual components and 4) learners with higher STM ability in verbal and lower STM ability in visual components. The four conditions provided for learning were 1) English word with its spelling 2) English word with its spelling plus written annotation 3) English word with its spelling plus pictorial annotation and 4) English word with its spelling plus pictorial annotation and written annotation. Twenty-four English words after the 1500th of the most common 2284 words suggested by Bauman (1995) were selected for mobile vocabulary learning. Testing was done by asking students to write down the Chinese meaning of each word. The quantitative and qualitative results both suggested that the most suitable method to help students learn in a mobile language learning environment was to provide them with more pictorial and less written annotation.

Kim and Gilman (2008) investigated the effects of text, audio and graphic aids in multimedia instruction for vocabulary learning among 172 middle school students in Seoul, South Korea using a web-based self-instruction program. It was found that students learned better resorting to variables 3 and 4 below.

The six variables in their study were 1) visual text 2) visual text and added spoken text 3) visual text and added graphics 4) visual text, added graphics, and added spoken text 5) reduced visual text and added spoken text and 6) reduced visual text, added graphics, and added spoken text. Fifteen English words were instructed using one of the six variables above. Students did a 30-question test regarding the words studied after the test once and one week after the first test. As stated earlier, Group 3 and Group 4 performed better on both the recognition and retention tests. The researchers concluded that the findings of the study supported the idea of the visual aids in vocabulary acquisition since text alone was not meaningful enough.

Shahrokni (2009) studied the effects of online textual, pictorial and textual pictorial glosses in second language incidental vocabulary learning among 90 adult elementary Iranian EFL learners. The results showed that a combination of text and still images resulted in better word learning.

Students assigned to groups of thirty each read a text with 25 target words. After reading, they were asked to do a word and picture recognition test and two reading comprehension items as a guard against guessing the main concern of the research. The results confirmed the superiority of DCT since students in the combination group scored significantly higher in both word and picture recognition tests.

Silverman and Hines (2009) conducted a study of the effects of multi-media enhanced instruction on the vocabulary of English-language learners (ELLs) and non-English language learners in pre-kindergarten through second grade in the US and found that multi-media enhanced instruction did not benefit non-ELLs.

Their 85 subjects were 68% non-ELLs and 32% ELLs. Children were equipped with multimedia and non-multimedia conditions for 45 minutes per day three days a week for a period of 12 weeks. Random assignment was done within grades. Both before and after the treatment, children were assessed on three concepts 1) knowledge of target words 2) general vocabulary knowledge and 3) science-concept knowledge. It was found that non-ELLs did not benefit from (but did not affect negatively) enhanced multimedia condition, but ELLs did. They concluded that, in terms of pedagogical implications, this finding was important in light of second language learning among children.

Jalilehvand (2012) examined the effects of text length and pictures on reading comprehension among seventy-nine randomly selected female Iranian students who had studied English for four years from three high schools. Their ages were between fourteen and sixteen and they all had the same English proficiency level. Four variables were tested in order to reveal how text lengths and pictures affected students' reading comprehension. The four conditions applied were long text (original) with and without picture and a shortened version of two-thirds text with and without pictures. The results showed that participants performed better on long text

and on texts with pictures. This suggested that text length had no effect but pictures were a key variable affecting reading comprehension.

Zarei (2009) investigated the effect of bimodal (English dialogs to English subtitles), standard (English dialogs to L1 (Persian) subtitles and reversed subtitling (L1 dialogs (Persian) to English subtitles) on L2 vocabulary recognition and recall among 92 undergraduates at a university in Iran. They were randomly assigned into three groups of the different subtitling mentioned above to watch a British TV comedy episode that lasted 30 minutes each at the end of class. Participants were also required to watch the films at home and the researcher gave them a short quiz about the film at the beginning of the next session. At the end of the experiment, students were asked to finish 40 multiple-choice test items and 40 questions of fill in the blank with one or two initial letter(s) provided in a delayed test after one week. The results showed that both the bimodal and standard subtitling groups were better than the reversed subtitling group in both the recognition and recall tests. The research concluded that this was due to the combination of orthography and phonology that helped strengthen learning.

Hummel (2010) examined the role of active translation towards short-term L2 vocabulary retention with 191 native French speaking university level students in a TESL program.

The researcher investigated three types of translations, which were 1) L1 to L2 2) L2 to L1 and 3) rote-copying (exposure and copy) task. The results showed that there was significant short-term recall for all three types.

Students were assigned to the three different conditions. The first group was asked to write a translation from an English sentence to a French sentence with the target word underlined. The second group did a reverse task. The third group was asked to simply copy the sentences. It must be noted that in this third group only, students copied two sentences during year 1 but in year 2, they were asked to copy only an English sentence. The data was collected twice in the fall semesters of two consecutive years. After finishing the task that took 5-10 minutes, students were required to do the recall L1 equivalents of those 15 L2 target words. The results showed that the exposure and copy group outperformed the other groups, leading to the conclusion that retention was higher due to attentive focus during copying, which

was in contrast to their hypothesis that active translation might result in greater retention.

Lwin, Morrin, and Krishna (2010) extended the idea of DCT outside the verbal and nonverbal to olfactory boundary. Their experiments were divided into two parts. Both experiments investigated how scent affected memory at a different stage of triggering. In their first experiment, they infused scent at the time of encoding and checked its effectiveness after five minutes and a two-week delay. In their second experiment, they infused scent both at the time of encoding and retrieval, which was a week after. In both tests, not only scent was used, the effect of images was also tested. In the first experiment, 100 female participants were recruited while in the second experiment, 140 participants of which eighty per cent were female were used. The results showed that image helped improve memory for verbal information, which was in line with the idea of DCT. However, their extension of scent was proven to be effective during the long delay of two weeks, not the five minute short delay for the first experiment; meanwhile, in the second experiment, when equipped with both scent and image, the recall rate was substantially higher than the other three groups. They concluded that scent was like pictures to some extent.

Carpenter and Olson (2012) studied whether new words in a foreign language were learned better from pictures than from native language translations among a total of 116 undergraduates at Iowa State University over a series of four experiments

In Experiment 1, 116 students were asked to (free) recall 43 Swahili words paired with either a picture or English translation according to the condition they were assigned to. The results showed that pictures were more advantageous in recalling than English translations.

In Experiment 2, 24 students were involved. This time after a 42-word (one word was removed) presentation and students' judgment of learning (JOL) of rating from 0% to 100% of how likely they would be to recall the word, they were given a cued recall test. Students were generally overconfident in how well they would be able to recall a Swahili word matched with pictures compared with its English translation.

In Experiment 3, 50 students undertook the same procedure as in Experiment 2. However, students were split into the Warning Group and the No Warning Group.

The Warning Group received a caution against being overconfident about something. The results showed that the Warning Group had better recall of Swahili words from pictures over English translations.

In Experiment 4, 64 students were asked to rate the ease of each pair in terms of studying, understanding and a linking rating from 0% to 100%. Students thought that Swahili words paired with pictures were easier to study, understand and link than words with English translation.

The researchers concluded that pictures could facilitate learning of foreign language vocabulary as long as students were not too confident about its power.

Jared, Poh and Paivio (2013) made an extension of the dual coding assumption into the area of bilingualism by studying the mapping between real-world referents and verbal forms among bilinguals. Their assumption was that when two languages were learned at different times and in different contexts, the association of nonverbal objects might be stronger than the other. They assumed that there were two verbal channels among bilinguals instead of only one like those among monolinguals. Their participants were 40 Mandarin-English bilinguals of which 13 were males and 27 were females whose age average was 20.7. These subjects spoke Mandarin 40% of the time with their families when at home and they spoke English 60% of the time. Participants were asked to complete a culturally-biased picture-naming task accompanied by culturally-unbiased pictures as fillers in either Mandarin or English. The culturally-biased pictures used for testing were either Chinese or Western (Canadian) congruent and would appear on a computer screen until testers gave out a verbal answer aloud. The results showed that culturally-biased pictures were named faster than in the culturally-congruent language than in the culturally-incongruent language. They also found that pictures that were Chinese related were named more quickly than pictures that were Canadian related. The researchers concluded that when bilinguals studied languages at different times and in different contexts, their nonverbal images were available to one of the specific languages more than the other, which supported the assumption of two verbal channels available for bilinguals.

Most of the research studies reviewed above gives credence to the superiority of DCT across various groups of subjects. However, two of the studies pointed to the other direction.

Acha (2009) studied the effectiveness of multimedia programs in children's vocabulary learning. Her study involved 135 Spanish third and fourth graders.

In the experiment, participants read a short English language story presented by a computer program. There were 12 unknown English words in the 101-word story and students received either one of the three presentations, which were verbal annotation, visual annotation or both. The researcher mentioned that the frequency for those 12 key words was between 1 and 18 per million. Children were randomly assigned to each of the three annotated presentation. After finishing reading, students were asked to perform an immediate vocabulary test and a delayed posttest two weeks after. The results showed that the group with verbal annotation performed better both in the immediate and delayed posttests than the group with visual annotation and the group with both annotations. The researcher concluded that this might be due to cognitive load among children. The connection of word to word was more accommodating for small children than picture to word, which required a heavier cognitive load.

To conclude, the assumption of DCT is grounded in two facilitative modalities of verbal and nonverbal input. The verbal route includes visual, auditory or haptic while the nonverbal input encompasses taste, smell, and emotions. The theory strongly posits that this double route does not increase the cognitive load as some opponents have cautioned. Rather, they facilitate each other in providing better understanding, recognition and retention among learners across fields of studies through the capacity of representing, referencing and associating.

CHAPTER 3
RESEARCH METHODOLOGY

This chapter provides detailed information regarding to the design of the study. First is the section detailing the conception of the research design. Next is the two consecutive parts of subjects used and the sampling frame. After that, the execution of instruments, procedure and the pilot test are comprehensively discussed. The chapter ends with the data analysis section, which explains the use of the statistical procedures for this study.

3.1 Research Design

The commonly used quasi experimental nonequivalent groups design (NEGD) sampling was employed in this research. The reason behind this was the nature of course allotment for freshmen students stratified by the university, which forbade true random sampling. The three groups were randomly assigned for each level of the independent variable, which was a vocabulary teaching method. The first group was treated with the use of a L2 ➲ L1 translation coding. The second group was equipped with the pictorial coding, and the third group was treated with the simultaneous L2 ➲ L1 and pictorial coding.

3.2 Subjects

This study aimed to investigate which vocabulary teaching strategy(ies) would facilitate Thai EFL learners who were low achievers to remember vocabulary better since this was the group who needed help the most in building their vocabulary repertoire in order to be able to advance further in English language learning. Fifty-eight freshmen English as a Foreign Language (EFL) students at a government university in Pathum Thani province, Thailand, participated in this research. As a matter of fact, there were altogether one hundred and sixteen students in the study. However, only those who had watched the three presentations and sat for both the immediate and delayed posttests were deemed eligible for this research study. Participants were randomly assigned into three instruments of twenty-two, seventeen and nineteen in each group, respectively (forty-nine, thirty-four and thirty-three in bulk correspondingly). The instrument designated for the first group was L2 ➲ L1

translation coding, the second group was pictorial coding and the third group was simultaneous L2 ➲ L1 and pictorial coding. The genders of the participants were twenty-two males and thirty-six females. Most of them were nineteen years of age and half of them were in the faculty of Science and Technology while the rest spreading across disciplines. Table 3.1 provides a snapshot of participants in this study. All participants were single L1 (Thai), with hardly any possibility of disparity in L1 ➲ L2 transfer incongruence. The tertiary level education application process and the acceptance protocol in Thailand are explained next.

To be eligible to secure a seat in this government university, students must provide the university with four portions of scores for acceptance evaluation through a process called admissions. Admissions requirements included four parts of scores that each student had to submit. The first part was a student's GPAX or grade point average during three years of high school (Matayom M.4-6 or Western schooling system Grades 10-12 approximately), which accounted for 20%. The second part was the ONET (Ordinary National Education Test) score, which accounted for 30%. ONET was a test done to ensure the standard of the Thai schooling using the curriculum mandated by the Ministry of Education, and was carried out by NIETS (National Institute of Educational Testing Service, Public Organization). ONET was administered to three levels of students, Pratom 6 (Western schooling system Grade 6 approximately), Matayom 3 (Western schooling system Grade 9 approximately) and Matayom 6 (Western schooling system Grade 12 approximately). The ONET score used in this research was the English score of students who sat for the test during their Matayom 6 level in 2013. The university in this study used a cutoff point between zero and twenty-five of the English ONET score to place students in the English remedial course. The ONET test was comprised of eight subjects, which were Thai, Mathematics, Science, Social Studies-Religion-Culture, English, Health and Physical Education, Arts, and Occupation-Technology. The third part was the GAT (General Aptitude Test) score, which accounted for 10-50% depending on the criteria of each faculty. The GAT test included two parts, which were GAT 1 and GAT 2. The first part tested the analytical thinking skills of students while the second part tested the knowledge of communicative English, which were again broken down into four areas

Table 3.1

Demographic Characteristics of Participants

	Group 1	**Group 2**	**Group 3**	**Percentage of sample (*N* = 58)**
Characteristics				
Gender				
Male	7	7	8	37.9
Female	15	10	11	62.1
Total	22	17	19	100
Age				
19	14	12	15	70.7
20	4	5	3	20.7
others	4	0	1	8.6
Total	22	17	19	100
Faculty				
Science and Technology	1	14	14	50
Commerce and Accountancy	9	0	0	15.5
Public Health	5	0	0	8.6
Law	5	0	0	8.6
others	2	3	5	17.2
Total	22	17	19	100

of 1) speaking and conversation 2) vocabulary 3) structure and writing and 4) reading comprehension. However, the GAT score was not taken into consideration when the new students at the university chosen in this study were placed into the three English fundamental courses (English Course I, II and III). These scores were calculated by the committee to yield a minimum score required for entry to each college. Scores varied from year to year but did not deviate much from the previous years.

3.3 Sampling Frame

Purposive sampling was used to assign subjects into three groups in this research after the subjects were previously stratified by the system as beginners in accordance with their English ONET score upon acceptance. The university put students whose English ONET score was between zero and twenty-five into the beginning level of the English course offered. This purposive or judgmental selection helped maintain and balance the homogeneity between subjects with respect to

diversity to a certain extent. Purposive sampling is one of the nonrandom selection methods used when researchers "knowingly select individuals based on their knowledge of the population and in order to elicit data in which they are interested" (Mackey and Gass, 2005, p. 122). The English language score from the ONET (Ordinary National Education Test) was used to frame three groups of newly accepted tertiary (freshmen) level students who were considered low achievers. Low achievers were those whose repertoire of words was very limited, precluding possible fluency and accuracy. Therefore, these groups of students were selected to be participants in the study because they were considered the most in need of an applicable strategy to help increase their vocabulary on their own if the experiment proved feasible. As of the academic year 2014, low achievers were students whose English ONET scores were between zero and twenty-five enrolling in English Course I or the beginning level of English foundation course. The criteria for each academic year's score did not deviate much from one another.

3.4 Instruments

The five types of instruments employed in this study are elaborated below. All the tasks were carried out by the researcher solely throughout the course of the experiment. This was done especially to maintain the parallel direction of the experiment.

3.4.1 Vocabulary Screening Test

Read (2004, p. 49) states that "The use of a pre-test allows the researchers to select from a set of potential target words ones that none of the subjects are familiar with." To be precise, the aim of the vocabulary screening test in this research was not far from a pretest and was used as a vocabulary teaching or building tool. It was intended to pull out words that were not recognizable by students. After known or familiar words were removed from the vocabulary screening test, the remaining unknown words were used as part of the instrument to investigate the effectiveness of each of the coding executed during the experiment. The vocabulary screening test consisted of fifty-nine low frequency words to ensure the validity of the results. To further explain this, high frequency words were not included in the vocabulary screening test at all so as to avoid unexpected exposure that might ruin the experiment. At first, the researcher collected as many seven-letter words as possible.

(See Appendix A) The reason underlying the limited number of letters was the law of "The Magical Number of Seven, Plus or Minus Two" proposed by Miller (1956), who postulated that the working memory in the human's brain was time and capacity bound to about five to nine codes each time it processed information. These words were chosen from the Webster's New Explorer Crossword Puzzle Dictionary (2011). After ruling out possible confounding factors like diphthongs, words with affixes, and words with special features that could be morphologically guessed by students, only fifty-nine words remained for use in the vocabulary screening test to ensure a symmetrical assignment. Words starting with vowels were ruled out. Also, the fifty-nine words were checked against students English course books to avoid duplication. All the confounding factors were carefully eliminated. In order to comply with testing rules during this vocabulary screening test or pretest stage, a productive test format looking for knowledge from students, which could be none, partial or full, was used. Students were asked to translate the words they saw in English into Thai. Read (2004, p. 17) posits that "At a beginner's level of learning a second language, it may be sufficient for the learners to show that they understand L2 words by being able to match them with an equivalent word in their own language or with an L2 synonym." Also, according to Read (2004, p. 168), "Another practical consideration is the proficiency level of the learners. L1 is likely to play a greater role in assessing the vocabulary knowledge of lower proficiency learners than those who are more advanced." During this vocabulary screening test level, a score of zero was given for an incorrect answer, one for partial knowledge and two for a correct answer. The words that received one or two points were eliminated from the study. Only words that received zero were put into production for sighting. All of the words were standalone words and there was no formulaic language. Moreover, none the words were instantial or context bound. They could not be "morphologically" analyzed. These confounding factors were carefully ruled out. Words considered to be profanity and blasphemy were excluded, but not proper nouns. Though low frequency words were not recommended for valuable time teaching, the rationale behind it is from Bangers (as cited in Carter, 2012, p. 222), who argues "low frequency words will often be crucial to an understanding of the discourse". Also, Chacón, Abello-Contesse and Torreblanca-López (2010, p. 157) confirm that "A low

frequency unit might be vital if it is the only one that conveys the particular semantic value and cannot be easily replaced with other lexical units." Next, only thirty-six words that received zero out of the fifty-nine words tested were used in this experiment. The process of the vocabulary screening test is detailed below.

During the vocabulary screening test, subjects were required to translate the meaning of the fifty-nine words into short L1 (Thai) word(s). (See Appendix B) This was done to avoid students blanketing definitions of each word translation that might lead to subjectivity as to whether students answered correctly or not during scoring. The test was of a productive test format. It looked for knowledge of the word meaning from students, which could be none (or no knowledge of the word meaning at all), partial knowledge or full knowledge of the word meaning. A score of zero was given for the incorrect answer and a blank answer, which meant that students had none or no knowledge of the word meaning. One point was given for an answer that reflected some correct part of the definition, which showed that students had partial knowledge of the word meaning, and two points were given for answers with correct definition, which displayed that students had full knowledge of the word meaning. Words that received one or two points during scoring were eliminated from the study. As a result, thirty-six words for which none of the students could give a correct translation or definition were left to be used in the study. At the presentation stage that occurred three times one week apart (See Appendices C-E), these words were further randomized in order to avoid primary and recency effects during the experiment. This was in line with the idea of memory effect of serial learning. Nation (2008, p. 110) explains this phenomenon as "an item triggers the knowledge of the following items because they have been learned and practiced in a set order. This is not the kind of learning wanted with word cards. Each word should independently trigger its meaning."

3.4.2 Immediate Posttest

"Immediate post-tests measure an increase in knowledge from unknown or partially known to degrees of partial knowledge." (Nation & Webb, 2011, p. 233) As such, the aim of the immediate posttest in this study was to check the effectiveness of the coding among groups of students in order to see how well they recognized the word they had seen three times during the study. Read (2000,

p.49) stresses that the immediate posttest after the task is given "to measure whether the learners have some understanding of the vocabulary items while the text is still fresh in their minds but it does not give an indication of whether they will remember them on a longer term basis." The format used for the immediate posttest in the study was recognition. Its essence is explained below.

> Recognition here means that the test-takers are presented with the target word and are asked to show that they understand its meaning, whereas in the case of recall they are provided with some stimulus designed to elicit the target word from their memory…,where recognition means that the subjects give the L1 translation of an L2 and recall refers to the reverse process; they give the L2 word in response to the L1 translation. (Read, 2004, p. 155)

Word recognition was, therefore, tested by using the immediate posttest after the third presentation as a criterion. Word recognition refers to subjects knowing what each L2 word means without its application of use. Students were asked to match the L2 word with its L1 meaning, the picture or both. In this study, the recognition matching task was thus applied and conducted in accordance with how each group of students saw the coding during the presentation. Students in each group had to match those thirty-six L2 words that they had seen in class three times with the type of coding in relation to which group they were assigned to during the experiment. Group 1 students received thirty-six L1 words as their definition matching task. (See Appendix F) For this first group, a sheet of A4 paper was divided into two columns vertically. The left-hand side column contained a list of thirty-six L2 target words with a blank in front and the right-handed column contained a list from number 1 to number 36 with the L1 definition words. Group 2 received the pictorial matching task. (See Appendix G and H) For this group, students were given two pieces of A4 paper. The first sheet of paper was the list of the thirty-six L2 target words and the second sheet of paper was the thirty-six pictures students saw, both were in a horizontal manner. This was due to paper constraints since A4 paper was not big enough to accommodate thirty-six words and pictures combined. Group 3

received two parts of matching tasks of definition and pictorial. (See Appendix F-H) The first part was the same as that of Group 1. However, for Group 3, after they finished the first part of the definition matching task, they were given a short simple math exercise that was on the back of their paper of definition matching task to refresh their mind as recommended by an expert (See Appendix L). After about a one-minute refreshing exercise, Group 3 continued with the second part, which was exactly the same as that of Group 2. It must be noted that the thirty-six words in this immediate posttest were listed exactly in the same order for all the three groups but were different from that of during the three presentations in order to avoid memory effect. The pictures listed for the matching exercise were also the same for both Group 2 and Group 3 but again were different from that of during the three presentations. The time given for this immediate posttest for Group 1 and 2 was fifteen minutes. This immediate posttest was conducted right after the third time students watched the presentation, which was in week four after the outset of the experiment since the vocabulary screening test was conducted. The results from this immediate posttest were also used as a tool to triangulate with the results gained from the delayed posttest to determine the impact of each coding prescribed to each group of students. The test was done receptively, which was when a learner could identify the meaning when they saw the word form, in accordance with the technique used. It was considered a recognition skill test, not a recall test.

3.4.3 Delayed Posttest

> If our goal is to use the delayed post-test to measure retention, we need to find a rational way of deciding how long we would want and expect learners to retain their knowledge of the word gained from the treatment. At the very least, we would want knowledge of the words to remain until the learners have a chance to meet the word again and thus build on and strengthen the knowledge. At the most optimistic, this would mean that the time between the immediate post-test and the delayed post-test at the very minimum should reflect time between two classes. This would mean that there should be at least

> two or three days between the immediate and delayed post-tests. (Nation & Webb, 2011, p. 280)

The aim of the delayed posttest was to check the retention rate or how well the item learned persisted in the learner's memory of each of the coding (or both for Group 3) students had seen after a period of one month. Schmitt (2010, p. 257) maintains that "… only delayed posttests give a true indication of durable learning. This is the main reason why delayed posttests are so important in vocabulary research." Accordingly, the word retention part was tested by using a one-month delayed posttest as a criterion. Each group of students received the test method just as in the immediate posttest. However, to avoid a memory effect, the word order and pictures were again reshuffled (See Appendix I-K). Again also, for Group 3, between the definition and pictorial matching tasks, a different refresher of a brief math exercise was used and put on a different piece of paper instead of being printed on the back as done in the immediate posttest. This was done to ensure that students finished their definition matching exercise completely before moving on to the pictorial matching (See Appendix M). The test was, again, done receptively in accordance with the technique used. It was considered a recognition skill test, not a recall test. "Delayed post-tests typically show movement in the other direction, from known to partially know to unknown." (Nation & Webb, 2011, p. 233)

Nation and Webb (2011, p. 278) state that three major purposes of a delayed post-test were retention, strength of knowledge and the effect of intervening variable. With regard to retention, they posit that "Delayed post-tests are typically administered two weeks or more after the immediate post-test…" and (p. 279) that "A delayed post-test measures retention, that is, whether the item learned will persist in the learner's memory." They also contend that (p. 280) "…having a delay of two weeks between the immediate and delayed post-tests would be sensible."

3.4.3.1 Scoring for Immediate Posttest and Delayed Posttest

Group 1 and Group 2 students received one point if they could correctly match the L2 word with the L1 translation or the picture. For Group 3 students, they would get one point only when they correctly matched the L2 word with both the L1 translation and the picture, and they would receive only 0.5 point if

they could correctly match half of either coding. This was done to prevent a surplus of extra scoring for Group 3 students since they had to do the matching twice with the L2 ➲ L1 translation first and then the L2 words with pictures after. The reason behind this double matching was due to the paper constraint. Though one piece of an A4 paper was big enough to hold thirty-six L1 translation words, it was not large enough for thirty-six pictures and resizing the pictures would have lowered the visual clarity of the pictorial coding. However, as stated earlier, the researcher followed the suggestion by an expert to refresh the subjects with a small and easy math exercise before they started the second matching.

3.4.4 Three Types of Coding

Three types of coding accompanying low frequency words were used. They were L2 ➲ L1 translation coding, pictorial coding and simultaneous L2 ➲ L1 translation and pictorial coding, which were all in a compact disc (CD) format. Each coding was computerized for an exact timing of a five-second interval between each word using a PowerPoint presentation program. That meant, a cycle of thirty-six words lasted less than two minutes each time they were on display. Black print on white background was used as a medium to avoid subjectivity and disruption. Font size and picture used were checked for feasibility before exposure to ensure their visual clarity. During the three presentations, all words and pictures were reshuffled to avoid primary and recency effects.

3.4.5 Semi-Structured Interview

In the hope of eliciting a broader spectrum for this present study that aimed at vocabulary retention among EFL beginners, an integrated methodology was used to diversify data between quantitative and qualitative. Semi-structured interviews were employed as the primary means of qualitative data collection to find out which type of coding was the best vocabulary teaching method for low proficiency EFL learners to retain words in their memory.

A variety of interview types are used in second language acquisition research. According to Seliger and Shohamy (2003, p. 167), the advantage of interviews in the field of second language is " They have been used recently for obtaining information about strategies which language learners use in the process of producing and acquiring language in a variety of contexts." Normally, the four major

categories of interviews are a) single or multiple sessions b) structured interviews c) unstructured interviews and d) semi-structured interviews. An elaboration of the semi-structured interview can be found below.

> In other words, the interviewer provides guidance and direction (hence the '-structured' part in the name), but is also keen to follow up interesting developments and to let the interviewee elaborate on certain issues (hence the 'semi'- part)." (Dornyei, 2011, p. 136)

A precise summary of semi-structured interviews is given below.

> These might be highly structured using interview schedule or they may be semi-structured interviews, based on an interview guide that lists only areas for discussion. However, it may be more appropriate to use a far less structured approach in order to explore interviewees' feelings about, say, the level of stress they experience in the workplace. (Plowright, 2011, p. 16)

Accordingly, Seliger and Shohamy categorize interviews by degree of explicitness ranging from very open to very structured. They confirm that "In 'semi-open interviews there are specific core questions determined in advance from the interviewer branches off to explore in-depth information probing according to the way the interview proceeds, and allowing elaboration, within limits" (2003, p. 167). A brief and conclusive overview of interview patterns is also provided.

> The nature of the interview will determine the type of data obtained. Specifically, more structured interviews will elicit brief and concise data in the form of checks, marks and short responses, while open interviews will elicit generally more elaborated data in the form of impressions, descriptions, and narratives obtained from interviewees (Seliger and Shohamy, 2003, p. 168).

Since this interview part was aimed at bringing out students' opinions toward each type of coding, it dug deeper into the subjects' perception towards each coding (or both for Group 3). Also, it shed more light on student' points of view toward unpredictable areas as a means of triangulation across different sources of data since quantitative data cannot tap into humans' thinking. However, qualitative informants are capable of doing so.

Nine students were taken for the interviews with three students from each group. The interview session was done privately on a one-to-one basis and was also tape recorded. No interview lasted longer than fifteen minutes. Questions were divided into two parts (See Appendix N). The first few questions were aimed at creating a relaxing atmosphere and rapport between the interviewer and interviewees. They probed with general questions like confirming the interviewee's name, English class section and some general personal background data. The second part contained content questions and the informants were asked six questions. The expert recommended not asking whether each participant favored the coding outright as it was considered a leading question. The first question asked what informants thought about the size of the presentation. The second question asked informants' idea about the black and white presentation. The third question asked whether informants thought culture and experience play a part in learning a new word or not. The fourth question asked whether informants thought if it was good or not to put the part of speech of each word into the presentation. The fifth question asked if informants tried some other word learning strategies while watching the presentation and the last question asked how informants could help improve the presentation. The interview session ended with the researcher thanking the interviewee. The findings gained from this semi-structured questionnaire were used to broaden the results derived from the immediate and delayed posttests.

3.5 Research Procedure and Data Collection Procedure

At the outset of the research, subjects were asked to do a vocabulary screening test in order to check students' knowledge about words that would be used in the study. This test was in a translation format asking a student to supply the meaning of the target English words in Thai using short Thai word(s) to avoid students blanketing definition of each word translation that might result in subjectivity during scoring.

The vocabulary screening test consisted of fifty-nine words that met the criteria of the words to be tested and outside Michael West's General Service List (GSL) and Averil Coxhead's Academic Word List (AWL). The main reason was to test words that were not the high frequency words since the chance of encountering high frequency words could be a confounding factor that might contaminate the results of the study. Nation (2011, p. 11) underlines this idea by stating that "The classic list of high-frequency words is Michael West's (1953a) *A General Service List of English Words* which contains around 2,000 word families. Almost 80% of the running words in the text are high-frequency words." Coxhead's Academic Word List was excluded since subjects were currently taking academic courses at a university level. Coxhead's list contained five hundred seventy headwords and Nation (2011, p. 12) explains that "The text is from an academic textbook and contains many words that are common in different kinds of academic texts….This small list of words is very important for anyone using English for academic purposes." Chacón, Abello-Contesse and Torreblanca- López (2010, p. 157) also remarks on Coxhead's word list in general, writing that "Word lists may contain lexical units that, due to cultural ethnocentricity, are not relevant to students' needs." Thus, at the onset of the experiment, two hundred and twenty-five words with seven letters were selected from the dictionary as a preliminary collection to ensure low frequency. As stated earlier, the reason behind selecting words with only seven letters was according to the law of seven by George A. Miller, a renowned cognitive psychologist. One week after the vocabulary screening test session, each group of students was given a timed computer program containing those thirty-six unknown words, all in the same order for the three groups. The use of only thirty-six words out of the fifty-nine words vocabulary screening test was done in order to avoid the "pretest alerting effect" (Nation & Webb 2011, p. 265). The program was timed in order to verify that each word received an exact amount of time so as to avoid variation. All the three coding emphasized the importance of different tangible sensory input. Bilbrough (2011, pp. 8-9), citing Heath and Heath (2008), affirms that concreteness is one of the six criteria that "facilitates the process of making material memorable." Each of the unknown words for the first group of students was accompanied by a simple L1 (Thai) translation identifying its meaning below the target word. Ellis (as cited in Nation, 2011, p. 65) confirms that "…simple

definitions were the most effective." Also, Nation and Webb (2011, p. 241) point out that "…because form and meaning is the standard measurement of vocabulary learning", and "because form and meaning have the greatest value to learners" (p. 230). For the second group of students, each of the unknown word was accompanied by a picture identifying its meaning under the target word. The third group of students was given with the target word above and the L1 translation and picture below on the left and right column. The size of the words and pictures were determined to be proper for viewing beforehand. Colors used for both words and pictures were also carefully monitored to avoid disruption or to favor the audience. Thus, only black print on white background was used. The sighting was done once a week for three consecutive weeks. Week one was devoted to the vocabulary screening test. On week two, students encountered thirty-six words for the first time. On week three, students encountered the same set of words but in a different order from week two for the second time, and on week four, students encountered words with a different order from week two and three, for the last time.

Immediately after the third presentation, students were given an immediate posttest to match the L2 words with L1 translation or picture (or both for Group 3) they had been exposed to. Spacing was done in accordance with the scientific law as cited in Nation (2011, p. 68) "Research indicates that repetitions need to be increasingly spaced with a short gap between early meetings and much larger gaps between later meetings (Pimsleur, 1967;Baddeley, 1990: 156-158)."

A delayed posttest was done on week eight, or four weeks after the immediate posttest to check for the retention rate of each of the coding administered. It should be noted that there was no word presentation during this session. The delayed posttest was administered only after a regular class session. Justification for the time lapse of four weeks between the immediate and the delayed posttests is provided below.

> If our goal is to use the delayed post-test to measure retention, we need to find a rational way of deciding how long we would want and expect learners to retain their knowledge of the word gained from the treatment. At the very least, we would want the knowledge of the words to remain until the learners have a chance to meet the word again and thus build on and

> strengthen that knowledge. At the most optimistic, this would mean that the time between the immediate post-test and the delayed post-test at the very minimum should reflect the time between two classes… It is not enough just to see what was done in previous research. (Nation & Webb, 2011, p. 280)

Also, as Bilbrough (2011, p. 79) put it "They (researchers) also suggest that the optimal moment for retrieving a language item is when it is on the verge of being forgotten". The results between the three groups were then compared.

Both the immediate and delayed posttests were in a receptive recognition skill test format. Unlike the more difficult productive recall format that requires students to generate answers by themselves without clues or selections given, a recognition test meant that "the test-takers are presented with the target word and are asked to show that they understand its meaning." (Read, 2000, p. 155) A basic matching task requires learners to make a connection between target words and their synonyms or definitions. As such, it is a recognition rather than a recall task, focusing on basic word learning. (Read, 2000, p. 171) Scoring was zero for an incorrect answer and one for a correct answer.

In testing students' knowledge of word meanings in this study, all choices were in L1 in compliance with the rule of testing that maintains that the testing format and learning format should match each other. On top of everything, matching definition with L2 words signifies a receptive skill test whereas the translation from L2 to L1 manifests a productive skill measure. Nation and Webb (2011, p. 305) maintain that "If words were learned receptively, then a test of receptive knowledge is more likely to be sensitive to learning." This was a boon for low proficiency students as L1 choices are easier than L2 choices for beginner level students. Read (2000, p. 17) agrees with this as he states that "At a beginner's level of learning a second language, it may be sufficient to match them with an equivalent word in their own language or without L2 synonym.", and that "L1 is likely to play a greater role in assessing the vocabulary knowledge of lower proficiency learners than those who are more advanced" (p.168). Table 3.2 clarifies the idea of how to assess vocabulary knowledge receptively and productively in diverse strains. To be precise, however,

this study adopted the "Meaning" strain pertaining to form and meaning as when students learned words receptively.

The classroom and students' physical environments were also carefully considered to minimize any confounding factors that would arise during the experiment.

The above procedure was based on scientific research that maintains that repetition is essential for vocabulary learning because one meeting is never enough. In the field of psychology, spacing effects are divided into two main types as stated earlier in Chapter 2. The first one is called spaced repetition, which is an occasional encounter with an object for a period of time; the second one is called massed repetition, which is an intensive encounter with an object for a short period of time. Scientific results have confirmed that spaced repetition helps people retain information better in long-term memory than massed repetition. Research has suggested that learners might need to be exposed to a language item up to sixteen times before it is fixed in long-term memory. Nation and Webb (2011, p. 43) confirm this, saying that "The levels of processing hypothesis would predict less secure learning for the less met and easily learned items." Nation (2011, p. 79) asserts that "Experimental evidence showed that simultaneous presentation of a word form and its meaning is best for the first encounter and, thereafter, delayed presentation is best because there is then the possibility of effort leading to successful recall." Also McKeown, Beck, Omanson and Pople (as cited in Nation, 2011, p. 80) found that "if simple definitional learning was the goal then more repetitions were better than fewer". Thus, a total of eight weeks with three spaced presentations was justifiable for both the presentation, immediate and delayed posttests to be conducted.

During the presentation for all the three groups, words and their coding were always put in a mixed order each week the students saw them. This was again to avoid a memory effect of primary and recency. This experiment tested only word recognition, not recall, and only receptively since the input was done in a receptive way. Schmitt (2010, p. 86) posits that "In *passive recall*, the form is given, and the meaning must be produced. Finally, *passive recognition* refers to when the form is given, and the meaning must be recognized (again, usually from options)."

Table 3.2

What Is Involved in Knowing a Word

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 the meaning?
Meaning	**form and meaning**	**R**	**What meaning does this word form signal?**
		P	What word form can be used to express this meaning?
	concept and referents	R	What is included in the concept?
		P	What items can the concept refer to?
	associations	R	What other words does this 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 words occur with this one?
		P	What words or types of words must we use with this one?
	constraints on use (register, frequency …)	R	Where, when and how often would we expect to meet this word?
		P	Where, when and how often would can we use this word?

R = receptive knowledge, P = productive knowledge

Note. from Nation, 2011, p. 27

All three groups of students received the presentation, immediate and delayed posttests and semi-structured interview within the timeframe of their regular class sessions since the researcher had set a clear set of procedures in advance, and the entire process was administered by only one researcher. Nation and Webb (2011, p. 23) maintain that "If the class teachers had a clear procedure to follow, this would reduce the effect of this variable (the surrounding conditions). Having the teachers

administer the tasks in a normal lesson time may reduce the “Hawthorne effects” of making learners aware that they are in an experiment, thus causing them to change their behavior.”

The teaching plan and procedure for all three experimental groups is summarized as follows.

Teaching Plan & Procedure Synopsis

1. On the first week, a vocabulary screening test of the fifty-nine words selected from the preselected two hundred and twenty-five words of a seven-letter word file was administered to all three groups of students. All words were nouns and no words starting with vowels were on the list, which made all words equal in terms of load of processing. Words starting with letters with more than one possibility were carefully reduced to fifty-seven, plus one each of words starting with the letters X and Z yielded altogether fifty-nine.
2. Each student had to write the meaning of each of the L2 word in L1 (Thai) in a paper-pencil fashion. Students were informed that a penalty was counted if the answer was incorrect to avoid guessing. Misspelling was accepted.
3. The time limit for the vocabulary screening test was 20 minutes (approximately three words per minute) and students could go back and forth freely in answering those words.
4. After the vocabulary screening test, the researcher removed words for which any student could give a correct or partially correct translation (one point for partially correct and two points for a completely correct answer). Finally, only thirty-six words (high enough to avoid the ceiling effect that takes place when test takers can do all the test items, thus leaving no room to check where their maximum capacity actually ended) were left to be used in the experiment.
5. On the second week, Group 1 students was shown the PowerPoint presentation of the words with L2 ➲ L1 translation coding, Group 2 words with pictorial coding, and Group 3 words with simultaneous L2 ➲ L1 translation and pictorial coding. The time spent on all thirty-six words was three minutes for each round (each cue of word lasted five seconds). The presentation was administered during the middle of the teaching session. Students were asked to

watch the program attentively, but they did not have to do anything after the presentation.

6. On the third week, the procedure remained the same as it was on the first week except that the word order in the presentation was rearranged to avoid memory or primary and recency effects.
7. On the fourth week, the procedure remained the same as it was on the first and second weeks. The immediate posttest was added after the word presentation, which was approximately fifteen minutes before the class ended.
8. On the eighth week, which was a month spacing after the third presentation, students were given a delayed posttest (without word presentation) but with the words and or pictures on the test paper rearranged. The test was given fifteen minutes before the class ended as usual.
9. From the tenth to twelfth weeks, one-third of the students from each group were selected for a semi-structured interview. The questions asked about each student's opinion towards each of the coding (or both for Group 3) they encountered during the experiment. Also, they were given an opportunity to express their opinions and/or their preference toward the coding they experienced. The data obtained from this semi-structured questionnaire were used to broaden the dimension of the results derived from the immediate and delayed posttests. Table 3.3 provides a brief timeline of the experiment.

Table 3.3

Experiment Timeline

Date	**Action**
Four months before the experiment	Pilot test
During the experiment	
Week 1	Vocabulary screening test
Week 2	First presentation
Week 3	Second presentation
Week 4	Third presentation and immediate posttest
Week 8 (one month after the immediate presentation)	Delayed posttest
Weeks 10-12	Semi-structured interview

3.6 Pilot Study

The preliminary purpose of conducting the pilot study was to examine if the instruments and the pedagogical procedure had to be amended. Therefore, before administering the present study, a pilot study was conducted with a class of EFL beginner level freshmen at the same university one semester earlier since they were comparable in terms of English ONET scores. It was ensured that all L2 ➲ L1 translation definitions and pictorial coding conveyed true and comprehensible meaning to students by three adult experts.

Issues were found in the pilot study and they were fixed for the real experiment. Physical factors like background color, font, picture size and time intervals between words were not subject to comment as much as students' worries about how the presentation might affect their regular curricular grade. The researcher bore this major issue in mind and assured students during the three presentations of the real experiment that what they saw would not affect their grade in the course. The pilot study also reminded the researcher to notify students during the experiment to put away their stationery such as pens or pencils since some of them might be inclined to taking notes during the presentation. Lastly, the best time for the presentation was determined to be in the middle of the teaching session after all students had settled in for the class. If done at the beginning of the class or too early into the class, latecomers might arrive and interrupt the presentation session.

3.7 Data Analysis

3.7.1 Research Questions

3.7.1.1 Research Question 1: Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word recognition among Thai EFL learners?

One-way ANOVA was used to measure the difference in word recognition ability among the three groups after the immediate posttest. The results would show the difference in each teaching strategy. A further run of post-hoc comparison for ANOVA was also executed to find out more subtle information of each of the method compared for a closer picture of which was the most powerful technique and which was the least.

3.7.1.2 Research Question 2: Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word retention among Thai EFL learners?

One-way ANOVA was used to measure the difference in word retention ability among the three groups after the delayed posttest. The results would show the difference in each teaching strategy. A further run of post-hoc comparison for ANOVA was also executed to find out more subtle information of each of the method compared for a closer picture of which was the most powerful technique and which was the least.

3.7.1.3 Research Question 3: To what extent does L2 ➲ L1 translation coding facilitate word retention rate among Thai EFL learners?

A Paired T-test was conducted to determine the difference in students' performances after the immediate and delayed posttests within each group to see the effectiveness of this type of coding.

3.7.1.4 Research Question 4: To what extent does pictorial coding facilitate word retention rate among Thai EFL learners?

A Paired T-test was conducted to determine the difference in students' performances after the immediate and delayed posttests within each group to see the effectiveness of this type of coding.

3.7.1.5 Research Question 5: To what extent does simultaneous L2 ➲ L1 translation and pictorial coding facilitate word retention rate among Thai EFL learners?

A Paired T-test was conducted to determine the difference in students' performance before and after the immediate and delayed posttests within each group to see the effectiveness of this type of coding.

Since the researcher was interested in the success rate, the process was done experimentally, and analytically, nor observationally.

3.7.1.6 Research Question 6: What are students' opinions towards each type of coding, namely, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial?

A semi-structured interview was used to elicit answers to this question. A ratio of ten percent of subjects, or nine subjects with three from each type of coding, chosen from the ones with the maximum score, the minimum score and the middle score were selected from each group to sit for an interview one to three weeks after the delayed posttest was conducted (weeks ten to twelve). The interview was tape recorded and was done on a one-to-one basis.

3.7.2 Research Hypotheses

3.7.2.1 H_0: There are no differences among the three types of coding, namely, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word recognition among Thai EFL learners.

3.7.2.2 H_0: There are no differences among the three types of coding, namely, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word retention among Thai EFL learners.

3.7.2.3 H_0: The use of L2 ➲ L1 translation coding does not facilitate word retention among Thai EFL learners.

3.7.2.4 H_0: The use of pictorial coding does not facilitate word retention among Thai EFL learners.

3.7.2.5 H_0: The use of simultaneous L2 ➲ L1 translation and pictorial coding does not facilitate word retention among Thai EFL learners.

CHAPTER 4
RESULTS AND DISCUSSION

The purpose of this study was to find out which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, was the most effective in facilitating word recognition and word retention, and to what extent each type of coding facilitated word retention among Thai EFL learners. It further investigated students' opinions towards each type of coding as an enrichment of the statistical values for a more complete picture.

This chapter begins with the results by answering the first five research questions and the five hypotheses with the use of both descriptive and inferential statistics. The main findings for the first two research questions were based on the use of one-way ANOVA and the main findings for the last three questions were based on the use of Paired T-test. The latter sections of this chapter deal with the findings elicited from the sixth research question with the help of the interviews. Finally, the chapter ends with the discussion.

4.1 Results

4.1.1 Research Question 1: Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word recognition among Thai EFL learners?

Three groups of students were studied. Group 1, which underwent the L2 ➲ L1 translation coding, consisted of 22 students; Group 2, which underwent the pictorial coding, consisted of 17 students; and Group 3, which underwent the simultaneous L2 ➲ L1 translation and pictorial coding, consisted of 19 students.

Descriptive statistics (Table 4.1) revealed that word recognition among Thai EFL learners during the immediate posttest was highest among Group 3 students followed by Group 2 and Group 1 students. Out of thirty-six points, the means for Group 3, Group 2 and Group 1 were 9.579, 9.118 and 7.227, respectively, with the SD values ranging from 5.7307, 5.2545 and 5.0326.

Table 4.1

Group Statistics of the Immediate Posttest Scores

	Min. (0)	Max. (36)	Mean	SD
Group 1 (n =22) (L2 ➲ L1 translation coding)	2	18	7.227	5.0326
Group 2 (n =17) (pictorial coding)	3	18	9.118	5.2545
Group 3 (n =19) (simultaneous L2 ➲ L1 translation and pictorial coding)	3	22.5	9.579	5.7307
Total (*N* = 58)			8.552	5.3457

Before using one-way ANOVA to find out the difference among the three groups, the Levene test for equality of variances among the three groups was conducted (Table 4.2). The results confirmed that the data among all the three groups were homogeneous during the immediate posttest with values over 0.05 (.910). An F test of one-way ANOVA could be used to further run the test.

Table 4.2

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Immediate	.095	2	55	.910
Delayed	1.363	2	55	.264

Inferential statistics ANOVA (Table 4.3) failed to reveal any significant difference for word recognition among Thai EFL learners during the immediate posttest among the three groups of students. (F = 1.126, p = .332).

Therefore, the first hypothesis stating that there are no differences among the three groups of coding, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word recognition among Thai EFL learners was accepted.

Table 4.3

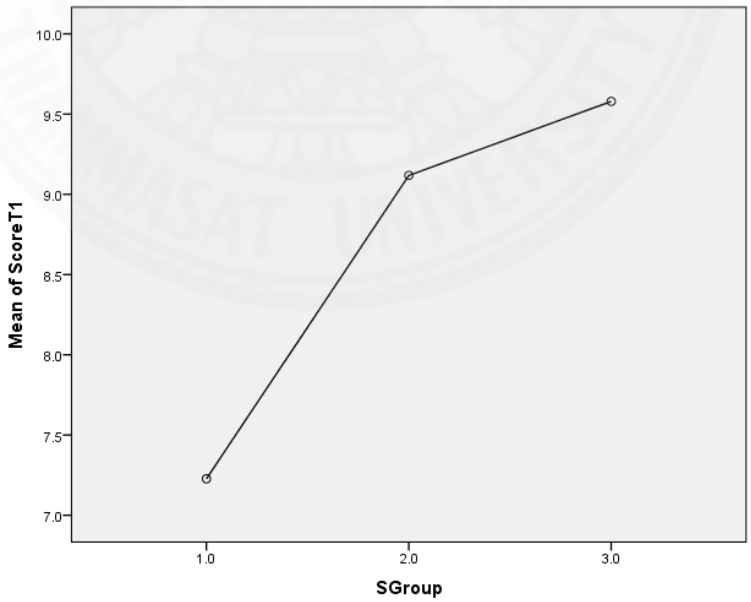
ANOVA Results of the Immediate Posttest Scores

Source of variance	SS	df	MS	F	Sig.
Between groups	64.085	2	32.042	1.126	.332
Within groups	1564.760	55	28.450		

$p < .05$

Figure 4.1

Mean Plots for Immediate Posttest (Word Recognition)



4.1.2 Research Question 2: Which type of coding, namely, L2 ➲ L1 translation, pictorial or simultaneous L2 ➲ L1 translation and pictorial, is the most effective in facilitating word retention among Thai EFL learners?

Three groups of students were studied. Group 1, which underwent the L2 ➲ L1 translation coding, consisted of 22 students; Group 2. which underwent the pictorial coding, consisted of 17 students; and Group 3, which underwent the simultaneous L2 ➲ L1 translation and pictorial coding, consisted of 19 students.

Descriptive statistics (Table 4.4) revealed that word retention among Thai EFL learners during the delayed posttest was highest among Group 3 students followed by Group 2 and Group 1 students. Out of thirty-six points, the means for Group 3, Group 2 and Group 1 were 8.211, 6.529 and 5.364, respectively, with the SD values ranging from 5.6748, 3.5728 and 3.6586.

Table 4.4

Group Statistics of the Delayed Posttest Scores

Group	Min. (0)	Max. (36)	Mean	SD
Group 1 (n = 22) (L2 ➲ L1 translation coding)	2	11	5.364	3.6586
Group 2 (n =17) (pictorial coding)	1	13	6.529	3.5728
Group 3 (n =19) (simultaneous L2 ➲ L1 translation and pictorial coding)	2	23.5	8.211	5.6748
Total (*N* = 58)			6.638	4.4876

Before using one-way ANOVA to find out the difference among the three groups, the Levene test for equality of variances among the three groups was conducted (Table 4.2). The results confirmed that the data among all the three groups

were homogeneous during the delayed posttest with values over 0.05 (.264). An F test of one-way ANOVA could be used to further run the test.

Inferential statistics ANOVA (Table 4.5) failed to reveal any significant difference for word retention among Thai EFL learners during the delayed posttest among the three groups of students. (F = 2.141, p = .127).

Therefore, the second hypothesis stating that there are no differences among the three groups of coding, L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial, in facilitating word retention among Thai EFL learners was accepted.

Table 4.5

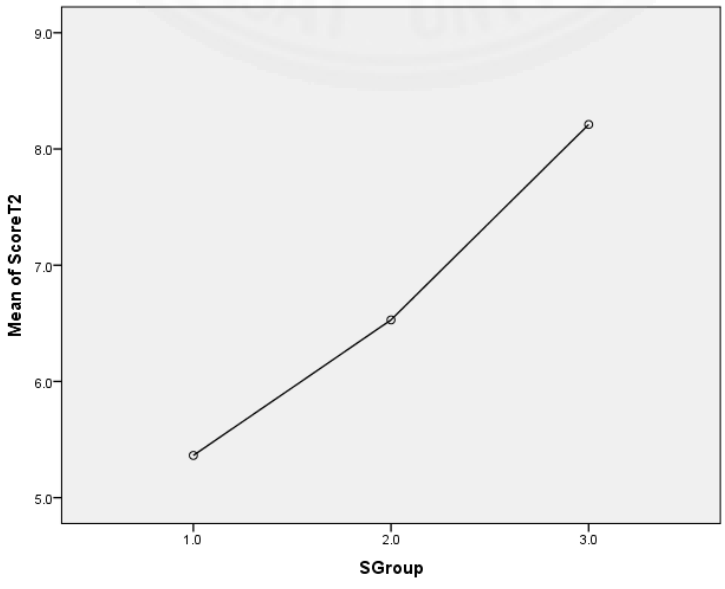
ANOVA Results of the Delayed Posttest Scores

Source of variance	SS	df	MS	F	Sig.
Between groups	82.912	2	41.456	2.141	.127
Within groups	1064.984	55	19.363		

$p < .05$

Figure 4.2

Mean Plots for Delayed Posttest (Word Retention)



4.1.3 Research Question 3: To what extent does L2 ➲ L1 translation coding facilitate word retention among Thai EFL learners?

One group of twenty-two students undergoing the L2 ➲ L1 translation coding was studied. Their scores between immediate and delayed posttests were used for calculation using a Paired T-test to find out the difference.

From Table 4.6, it was observed that the standard deviation for this group during the delayed posttest was at 3.6586, which was lower than during the immediate posttest at 5.0326. A correlation test between the two values was executed

Table 4.6

Paired Samples Statistics

	Mean	SD	SEM	$\bar{D}$	$S\bar{D}D$	t	Sig.
Group 1 (n = 22) (L2 ➲ L1 translation coding)							
Immediate	7.227	5.0326	1.0729				
				1.863	1.5521	5.632	0.000
Delayed	5.364	3.6586	.7800				
Group 2 (n =17) (pictorial coding)							
Immediate	9.118	5.2545	1.2744				
				2.5882	2.1523	4.958	0.000
Delayed	6.529	3.5728	.8665				
Group 3 (n = 19) (simultaneous L2 ➲ L1 translation and pictorial coding)							
Immediate	9.579	5.7307	1.3147				
				1.3684	1.6984	3.512	0.002
Delayed	8.211	5.6748	1.3019				

(Table 4.7) and the result was found to be at 0.986 with a significance level at 0.000, which was less than 0.05. This meant that the two values were significantly correlated. A Paired T-test (Table 4.8) showed that the delayed posttest score decreased significantly from the immediate posttest score ($t = 5.632$, $p < 0.05$)

Table 4.7

Paired Samples Correlation

Group	n	Correlation	Sig.
Group 1 (L2 ➲ L1 translation coding)	22	.986	.000
Group 2 (pictorial coding)	17	.952	.000
Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding)	19	.956	.000

Table 4.8

Paired T-test Scores

	Paired Differences	t	df	Sig. (2-tailed)
	95% Confidence Interval of the Difference			
	Upper			
Group 1 (L2 ➲ L1 translation coding)	2.5518	5.632	21	.000
Group 2 (pictorial coding)	3.6948	4.958	16	.000
Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding)	2.1870	3.512	18	.002

4.1.4 Research Question 4: To what extent does pictorial coding facilitate word retention among Thai EFL learners?

One group of seventeen students undergoing the pictorial coding was studied. Their scores between immediate and delayed posttests were used for calculation using a Paired T-test to find out the difference.

From Table 4.6, it was observed that the standard deviation for this group during the delayed posttest was at 3.5728, which was lower than during the immediate posttest at 5.2545. A correlation test between the two values was executed (Table 4.7) and the result was found to be at 0.952 with the significance level at 0.000, which was less than 0.05. This meant that the two values were significantly correlated. A Paired T-test (Table 4.8) showed that the delayed posttest score decreased significantly from the immediate posttest score ($t = 4.958$, $p < 0.05$)

Therefore, the fourth hypothesis stating that the use of pictorial coding does not facilitate word retention among Thai EFL learners was rejected. This meant pictorial coding facilitated word retention.

4.1.5 Research Question 5: To what extent does simultaneous L2 ➲ L1 translation and pictorial coding facilitate word retention among Thai EFL learners?

One group of nineteen students undergoing the simultaneous L2 ➲ L1 and pictorial coding was studied. Their scores between immediate and delayed posttests were used for calculation using Paired T-test to find out the difference.

From Table 4.6, it was observed that the standard deviation for this group during the delayed posttest was at 5.6748, which was lower than during the immediate posttest at 5.7307. A correlation test between the two values was executed (Table 4.7) and the result was found to be at 0.956 with the significance level at 0.000, which was less than 0.05. This meant that the two values were significantly correlated. A Paired T-test (Table 4.8) showed that the delayed posttest score decreased significantly from the immediate posttest score ($t = 3.512$, $p < 0.05$)

Therefore, the fifth hypothesis stating that the use of simultaneous L2 ➲ L1 translation and pictorial coding does not facilitate word retention among Thai EFL learners was rejected. This meant that simultaneous L2 ➲ L1 translation and picture coding facilitated word retention.

4.1.6 Research question 6: What are students' opinions towards each type of coding: L2 ➲ L1 translation, pictorial and simultaneous L2 ➲ L1 translation and pictorial?

Theme 1: **The size of the presentation during the vocabulary presentation**

Respondents in the study were indifferent about the size of the presentations, mentioning nothing further about their proportions during the three word episodes. Nobody pinpointed any peculiarity of the proportion. When asked this question, students merely said that it was alright and satisfactory. This issue was particularly extended by only one subject, which was Student D from Group 2, who said that it could be applied in his real life.

Theme 2: **The black and white background during the vocabulary presentation**

Respondents in the study were of mixed opinions regarding this question. Some said monochrome was sufficient while some said it would have been more interesting had it been more colorful.

All the three respondents from Group 1 (L2 ➲ L1 translation coding) were in favor of the black and white background presentation. They said that the use of black and white background was sufficient and natural. Student A mentioned that too many colors might obscure the picture. Also, Student E from Group 2 (pictorial coding) mentioned that he could not find any downside to the monochrome background.

In contrast to the opinions above, Student D from Group 2 (pictorial coding) proposed that the pictures should have been more colorful instead of just black and white and that some pictures did not include details of what exactly it was. He gave an example of a bird picture, saying that he could not distinguish what type of bird it was, i.e., a crane or other type of bird. Student I from Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding) also had the same feeling. She thought it would be more attractive if it were more colorful and it might help her remember better.

One student in the study was indecisive about the matter of black and white. Student H from Group 2 (pictorial coding) said the black and white background was not a problem for him, but more colors might help.

To sum up, the overall impression towards the monochrome background was not conclusive among the groups but it was among respondents from Group 1 (L2 ➲ L1 translation coding).

Theme 3: **Culture and experience issues in learning a new word**

Answers from respondents were unidirectional regarding this issue. They agreed that culture and experience played a part in learning a new word and cited different cases as examples.

In terms of culture, Student A from Group 1 (L2 ➲ L1 translation coding) gave the example of the word "garland". She mentioned that garland was prevalent in the Thai society and the word hooked her easily. This was also true for Student F from Group 2 (picture coding) who admitted that he could remember words that were closer to him in terms of use and background better such as the words "ปลาเก๋า" and "ดอกบัว".

In terms of experience, Student B who was also from Group 1 stated that past experience definitely played a part in learning a language. She cited her own experience during her high school years, narrating her life as a class leader who had to serve as a bridge between her Thai classmates and foreign teachers. She was confident that this background truly helped her with her English speaking skill. Student C who was from Group 1 also had the same idea. She mentioned that teachers were influential when learning a language. One very particular answer came from Student D from Group 2 (pictorial coding) who said some words could be seen from outside classroom experience such as from computer games but without a clue, it would have just been "seen", not "learned". Student G from Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding) asserted that he used to study a special lesson in English and it helped him a lot. Also from Group 3, Student H said watching a soccer match definitely helped him learn English.

In sum, students agreed that culture and their past experiences played a part in learning English.

Theme 4: Extra word information preferences like the word's part of speech being included in the vocabulary presentation

Answers to this question were bilateral but unanimous. Students from Group 1 (L2 ➲ L1 translation coding) agreed with adding more information to words shown during the presentation as they thought this could help them remember words better. In contrast, none of the students from Groups 2 and only one student from Group 3 required further information on words stating what they had seen was sufficient.

Group 1 students (L2 ➲ L1 translation coding) especially Students A and B confirmed that they wanted to know more about the words such as their part of speech. This is in contrast to Students from Group 2 (pictorial coding) and Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding). In general, they were in favor of the displayed format. Student D, an audio learner, made an interesting remark to this question in stating that "one picture did it all". However, Student I from Group 3 pointed out that she would like to see how each word was used in a real sentence, which might also help her learn better.

To be precise, students in Group 1 favored the idea of more information on words while students in Groups 2 and 3 in general did not see the benefit of this.

Theme 5: **Word learning strategies application while watching the vocabulary presentation**

Responses towards this issue were numerous ranging from none to multiple strategies applied during the vocabulary presentation regardless of the group students belonged to.

The strategy students mentioned the most was the mnemonic technique. Student A from Group 1 (L2 ➲ L1 translation coding) said she linked the word "แกน" with the English word "garland" while her normal routine was to use a dictionary to find out the meaning of an unknown word and, if available, use audio to check the word's pronunciation. Student B, also from Group 1, applied the mnemonic technique such as sound transfer from L1 ➲ L2 and also what she called the "root" to the words she saw. She said she could remember the word "midgets" by pronouncing

the word in Thai as “แอร์” and then applied that to the translation “แคระ”. Like Students A and B, Students C and D from Group 2 (pictorial coding) also used the acoustic link. Student C said she could remember the word “lavabos” because she had a friend named “Boss”. Accordingly, Student D mentioned that his normal technique when learning new words was through verbal memory or by speaking the word, not spelling. Thus, he could remember a word and its meaning but not its spelling. As an audio learner, he said that he normally liked being “told” or “talked to” and he did not like reading. However, he said that seeing a picture like in this method of verbal learning style was better than having someone talk to or explain to him. Student G from Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding) was among the acoustic link applicators. He could remember the word “yashmac” because he has a Muslim friend named “Yim”, who also wore a hijab. So, he linked the letter “y” of both words together to help him memorize the meaning of the word while in his daily life, he said that he would often try to remember a new word by linking some common word features in the new word with words he already knew. The other mnemonic technique students applied was gesture. Student B could remember the word “mittens” because of the word “ten” which linked to the ten fingers. Student H from Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding) also applied this technique. He said he tried writing in the air or sometimes spelling a word while watching the presentation, which he said he did not do in his daily life. In his everyday life, he would learn English by watching a soccer match or if possible, he liked to remember by looking at pictures several times.

Apart from the acoustic mnemonic techniques mentioned above, some students like Student E from Group 2 (pictorial coding) applied their own orthographic mnemonic techniques. This student said he would match the picture with its first letter, although he himself was not sure if it was successful or not. He added that in his everyday life, he started watching English movies with the soundtrack on about once a week to help him with his new chapter in studying English in the university.

One student, Student F from Group 2 (pictorial coding), was distinct in attacking this issue. He said he did not apply any technique but tried explicitly to remember each L2 words together with the pictures.

Student I from Group 3 (simultaneous L2 ➲ L1 translation and pictorial coding) was the only one who said that she never applied any of the mnemonic techniques, neither during the presentation nor in her real life.

In sum, most of the students applied learning strategies, especially mnemonic techniques, differently during the learning episode.

Theme 6: **The overall impression towards and/or the addition to or exclusion of the vocabulary presentation**

Answers regarding this issue were rich and conforming. All of the respondents were satisfied with the presentations and they were glad to have experienced them. Students were content and willing to share their experience they had during the three vocabulary episodes.

Group 1 students (L2 ➲ L1 translation coding) like Student A said she liked the simplicity of the method and thought she could now remember the word "garland" forever due to simple translation. She mentioned that the words she saw actually reflected the things around her but had never known how to say them in English. She also liked the presentation since it was like a test to her. She mentioned that at first she wondered why she had to watch the presentation but during the second presentation she was more relaxed and had no objection to the study. Student B said she quite liked the method since it was both a brain teaser and a challenge to her. She said she also liked it partly because they were unknown words so that she could add more to her repertoire since L2 ➲ L1 translation was her normal routine. She pinpointed one interesting fact, which was that this method could "save words seen visually into my brain". Her first impression with the presentation was to wonder why there were so many words, but on the second time, she thought it was alright and she was pleased because she could remember some of the words and their meanings. There was also something that she did not like, which was not related to the presentation. She said she was angry at herself for not being able to remember the words and their meanings. Student C's overall impression was good, and she stated that she had no objection to the L2 ➲ L1 translation method, but found that there were too many words that were "weird" and not usable. Some words were too close in meaning like those referring to animals. Nevertheless, she quite liked being exposed to new words she had never seen before and some words were so distinct that

she could remember right away like the words “termite” or “ปลวก” and “teepees” or “กระโจมอินเดียนแดง”. She also added that the word length was not a problem but the length of the translation was quite long. She would also like to see pictures with the translation, stating that they might help her remember better.

Group 2 students’ comments (pictorial coding) were in line with Group 1 students. Student D rated his overall experience towards the picture presentation as “good”. He said that at first he was puzzled to see the pictorial presentation, but as he remembered some words afterwards, he felt better. Student E said that he felt the presentation was a good one, and he said that the pictures helped him but not so much as he mentioned several times that “I didn’t know the word’s meaning even though there was a picture next to it”, and this caused him a lot of frustration. Student F said his perception towards the presentation was quite good and it helped him remember better, citing several times that pictures really helped and also made remembering easy. However, the downside was that L2 words were difficult and they were not in an alphabetical order, which made it difficult to memorize. The pictures shown could give him an idea what the words meant. Thus, not knowing the objective of the study, his suggestion was to run words in alphabetical order and to blind words or pictures for students to guess as a word game.

Group 3 students’ reaction (simultaneous L2 ➲ L1 translation and pictorial coding) was the same as that of Groups 1 and 2 students. All of them felt that seeing both translations and pictures was better than just one. Student G said he truly preferred the application of simultaneous L2 ➲ L1 translation and pictorial coding, saying several times that they were mutually enhancing, and did not interfere with each other. Furthermore, he added that pictures alone helped a lot, but with an L1 translation, it was even better. During the presentation, he found the L2 words to be extraordinary and very difficult to read or spell, and this was his major hindrance. He could not match the meaning with L2, and he was definitely not be able to spell those L2 words due to their readability. Asked if he could amend the method, he said a longer exposure for each word would be better. He would also very much like to apply the technique for use in his real life. Student H was also very positive with regard to the method used. Simultaneous L2 ➲ L1 translation and pictorial coding helped him remember words better. They did not interfere with each other at all. His

overall impression towards the presentation was satisfactory. He felt it was a good opportunity for him to learn more and would have liked to know more about the new words by giving an example of the word "xenopus" or "กบ", which he could remember until the day he was interviewed. Like Student G, the only problem was the difficult spelling of L2 words, which made him quite uncomfortable. Student I was very much the same as her group mates. She said she really liked the simultaneous L2 ➲ L1 translation and pictorial coding, saying that they helped a lot when it came to memorizing. She was very impressed with the technique, stating several times that both translation and pictures helped a low proficiency student such as herself. Seeing both at once definitely helped her recall a word's meaning better than just one coding alone. She gave the example of the word "เปลญวน", for which she could almost recite the English spelling though not quite correctly. She asserted that seeing both coding at once was an "all inclusive package", and to her, they never interfered with each other; on the contrary, they complemented each other. She said that she might apply this technique in her real life since it was very applicable, saying that "just one click and you have both".

All in all, students from all the three groups felt that the presentation method they encountered was favorable. The downside was the difficulty of spelling L2 words and the long L1 translation, but there were no negative feelings toward the method used to present.

4.2 Discussion

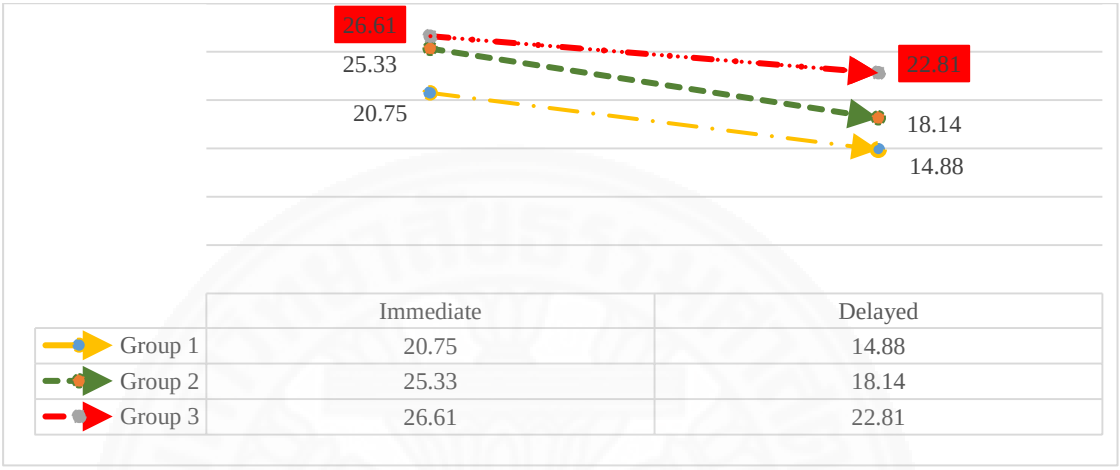
This part discusses three major areas. The first two parts deal with the findings gained from descriptive and inferential statistics and the third part deals with the findings gained from the interview.

4.2.1 Rationalizing Descriptive Statistics

The descriptive statistics shown earlier illustrated the differing power of the three types of coding. As can be seen from the mean scores among the three groups, Group 1 ranked the lowest during both tests, Group 2 was in between and Group 3 scored the highest. It could be said that simultaneous L2 ➲ L1 translation and pictorial coding was valuable for both recognition and retention in itself to a certain degree. Figure 4.3 shows the trend change among the three groups in terms of percentage difference.

Figure 4.3

Percentage Change between Immediate and Delayed Posttests



	Immediate	Delayed
Group 1	20.75	14.88
Group 2	25.33	18.14
Group 3	26.61	22.81

Literally, all the scores for the three groups during the delayed posttest dropped naturally due to time lapse, which is physically inevitable. However, using the percentage decrease formula ($\frac{V1-V2}{V1}\ x\ 100$) to calculate against this deterioration, it was found that the decrease rate for Group 3 was the least among the three groups as shown in Table 4.9.

Evidently, the figures showed that the drop in Group 1 and Group 2 was relatively the same at almost thirty percent (28.29 % and 28.38 % respectively) while Group 3 was much less, as the rate of the decrease was approximately seventeen percent. If the mean score for Group 3 was not substantial enough to support the value of simultaneous L2 ➲ L1 and pictorial coding, this percentage difference certainly was. Though the results between Group 2 and Group 3 were comparable during the immediate posttest, the yield from the delayed posttest was more diversified. The gap was even bigger as seen through percentage change. The virtue of dual coding towards the physical effect of time versus memory was maintained strongly as illustrated next.

Table 4.9

Percentage Decrease

Group	**Mean**
Group 1 (n = 22)	
(L2 ➲ L1 translation coding)	
Immediate	7.227 **(20.75%)**
Delayed	5.364 **(14.88%)**
Percentage decrease	**28.29%**
Group 2 (n =17)	
(pictorial coding)	
Immediate	9.118 **(25.33%)**
Delayed	6.529 **(18.14%)**
Percentage decrease	**28.38%**
Group 3 (n = 19)	
(simultaneous L2 ➲ L1 translation and pictorial coding)	
Immediate	9.579 **(26.61%)**
Delayed	8.211 **(22.81%)**
Percentage decrease	**16.66%**

The present theory also includes specific assumptions concerning the organization of nonverbal and verbal information in episodic storage. These assumptions derive directly from processing spatial and synchronous information whereas the verbal system is specialized for sequential processing. With respect to episodic trace, the nonverbal, visual trace information about a unitary object or an organized scene, whether derived from external objects or imagery-encoding activity, is characterized by its spatial organization and synchronous (simultaneous) availability (Paivio, 1990, p. 142).

4.2.2 Rationalizing Inferential Statistics

Though inferential statistics ANOVA from the results indicated no significant difference among the three types of coding both during immediate and delayed posttests, a force into post-hoc test yielded a different picture. LSD outcomes for the delayed posttest showed that there was a statistically significant difference between Group 3 and Group 1 (p.= 0.044) as shown in Table 4.10 below. Had the number of subjects been greater, the results would have been more interesting in terms of being able to identify the true difference among the three groups. This was a point that supported the value of DCT as shown in several research studies aimed towards multiple sensory effects in the field of foreign language learning (Sombatteerra and Kalyuga 2012, Jalilehvand 2011, Yoshii 2006, Kost, Foss and Lenzini 1999, Plas, Chun, Mayer and Leutner 1998, Mayer and Anderson 1991).

Table 4.10

Fisher's Least Significant Difference (LSD) Multi Comparison Result

Dependent Variable	Group	Group	Mean Difference	SEM	Sig.
LSD	**3**	**1**	**2.8469***	**1.3781**	**.044**

$p < 0.5$

Besides ANOVA, Paired T-test was also executed and the results showed that the difference in the decrease for all three groups was statistically significant. However, the significant decrease among them was not the same. A closer inspection of each pair of the three group's SD scores in the immediate and delayed posttests depicted another angle. It was evident that Group 3 was the one with the most stable rate of maintaining vocabulary repertoire among the students (SD 5.7307 during immediate posttest versus SD 5.6748 during delayed posttest), suggesting that simultaneous L2 ➲ L1 and pictorial coding was a more powerful method than the other two types of coding. The gap differences between Group 1 and Group 2 were wider when compared to that of Group 3. This suggested that in maintaining the vocabulary repertoire among students, simultaneous L2 ➲ L1 and

pictorial coding could help students sustain a better scope of memory than L2 ➲ L1 translation or pictorial coding alone. Thus, it can be concluded that simultaneous L2 ➲ L1 translation and pictorial coding was one of the promising strategies that could be applied to the teaching-learning of vocabulary to EFL beginners without causing harm to them in terms of cognitive load as cautioned earlier.

Table 4.11

Paired Samples Statistics

Group	Mean	**SD**	SEM
Group 1 (n = 22)			
(L2 ➲ L1 translation coding)			
Immediate	7.227	**5.0326**	1.0729
Delayed	5.364	**3.6586**	.7800
Group 2 (n = 17)			
(pictorial coding)			
Immediate	9.118	**5.2545**	1.2744
Delayed	6.529	**3.5728**	.8665
Group 3 (n = 19)			
(simultaneous L2 ➲ L1 translation and pictorial coding)			
Immediate	9.579	**5.7307**	1.3147
Delayed	8.211	**5.6748**	1.3019

4.2.3 Rationalizing Interview Data

4.2.3.1 Interview Data Concerning Three Types of Coding

In order to expand the spectrum of the results, semi-structured interviews were conducted. Superficially, it was found from the interviews that students' opinions towards the first two types of coding, L2 ➲ L1 translation and pictorial, were positive. For the third type of coding, simultaneous L2 ➲ L1 translation and pictorial, respondents were also positive. They said that seeing both types of coding helped them remember difficult words better. For all three types of coding, none of them had objections to the presentation. The black and white

background was not a problem though some of them said it would be better if it were more colorful. Student D from Group 2 revealed an interesting idea about learning styles. He himself was an audio learner but found that this visual method was not bad and even better in some aspects as the picture could describe better and wider in terms of breath (but not depth). This is in line with Ellis (1995) as cited in Read (2000, p. 50), who found that "the pictures triggered recall in a way that the target words by themselves did not." Most of them applied mnemonics during the presentations to help remember better and the most common one was L1 ➲ L2 sound transfer. Some applied the technique of "acoustic link" like Student C from Group 1. The word length in L2 was not a factor, but some disliked reading a long L1 translation.

Interestingly enough, most of the students did not feel that culture was a major factor in learning a new word though language was culturally bound. Read (2000, p.5) states that "Language is sociolinguistic whose most obvious area includes 'natural' or idiomatic expressions, 'cultural references' and 'figures of speech.'" The word "yashmac" was the only word in this experiment that students from all the three groups could match correctly in both immediate and delayed posttests. The overall time presentation was also something that students in general favored. They said it was not too long otherwise they would have lost their attention.

Spelling was one point that students referred to as a hindrance for memorizing. Some of them said words were difficult to remember because they could not spell or pronounce them. This was a problem found not only in English as a Foreign Language learner but also for native speakers themselves, as "Comparison of the spelling of English speakers with speakers of other languages shows that irregularity in the English spelling system creates difficulty for learners as a first language" (Moseley as cited in Nation, 2011, p.45). Students in this experiment were L2 learners whose proficiency was low, so it was not surprising to learn that they encountered such a problem. Nation (2011, p.45) confirms a strong link between spelling and reading.

It was also found that some students might have used gestures or paralinguistic expressions to aid memorizing, which is unstoppable and would have passed unnoticed by the researcher.

Information from subjects above could point toward one captivating fact of valence. The degree of attraction and aversion that one feels towards an object plays a major role in learning a new word in a language class. Valence is heavily connected with both recognition and retention as explained in Chapter 2 concerning working memory and long-term memory. Theoretically and practically, the human learning system is triggered by input received through the sensory channels, which codes the stimulus subjectively due to personal background and experience. If the degree of the input is heavily connected with an individual's schema, one often learns better. This is in line with the school of cognitivism, which sees language learners as machines that process input data in relation to the owner's innate background activity. The output data refers to how each student learns and remembers the information due to both their cognitive processing capacity and their intrinsic elements.

What was mentioned earlier sheds some light on the three types of coding and students' opinions in general. The paragraphs below present more relevant ideas concerning the interview results and findings relating to the theory of dual coding.

4.2.3.2 Interview Data Concerning Dual Coding Theory

To elaborate this part, it is worth mentioning again that the core concept of DCT is based on visual and verbal input. Moreover, its processing concepts are divided into three areas: representative, referential and associative. Representative property refers to how learners understand the input as it was received such as when they see the word face and they can translate what face means. Referential property refers to how learners link input between two systems from verbal to visual or vice versa for their understanding. For example, they can refer the word face to the face of their friend or their friend's face could trigger the word that is spelled f-a-c-e. Associative property refers to how learners connect the input within the system in order to understand. For instance, they relate the word nose with eyes or when the image of nostrils reminds them of the image of lips.

The data gained from the semi-structured interviews were reviewed. The three concepts of DCT mentioned above together with the three main differences make it difficult to generalize the results in L2 contexts. Grabe and

Stoller (2011, p. 35) stress that there are linguistic and processing differences, individual and experiential differences, and socio-cultural and institutional differences, all of which were obviously present in this research.

As for the first difference, linguistic and processing differences, the influence of students' varying language transfer in working with two languages was evident. Students employed their language ability in transferring and interacting between the two languages at different degrees and angles. Some applied this with almost every word they saw for better recognition and retention while some did not pay attention to this factor at all. Nevertheless, the findings showed that most of the students interviewed noticed themselves using this strategy. This is very much in line with the observation of Grabe and Stoller (2011, p. 41) that, "In general, L2 students tend to draw on L1 processing skills when they try to read the L2." Another particular difference shown in this area was the factor of L1 orthographic system. Grabe and Stoller (2011, p. 40) citing Hanley, Tzeng and Huang (1999) and Koda (2005) wrote that "readers of Chinese and Japanese make greater use of visual processing than do readers of English because of L1 orthography." In contrast to the above study by Hanley, Tzeng and Huang and Koda, the present study was done with Thai students whose writing system is very much like that of the English language in terms of having a letter-sound relationship. Thus, unlike Chinese and Japanese students, Thai students might have used less visual processing in transferring languages back and forth. This dimension is expanded on below.

> Foreign learners too experience phonological difficulties related to phonemes, combinations of phonemes and suprasegmental features. What makes some words phonologically more difficult than others is very much determined by the learner's L1 system (Schmitt & McCarthy, 1997, p.142).

What they put forth is very relevant to this research "Familiarity with phonological features and a word's phonotactic regularity (its

familiar combinations of features) were shown to affect accuracy in perceiving , saying and remembering the word" (Schmitt & McCarthy, 1997, p.143).

Schmitt and McCarthy (1997, p.143) cite the work of Ellis and Beaton showing that English-speaking learners of German showed better long-term memorization of words. Again, Schmitt and McCarthy (1997, p. 146) state that "The learner's ability to decompose a word into its morphemes can facilitate the recognition of a new word and its subsequent production". Henning (cited in Read, 2004, p. 40) supports this in light of this study done with low proficiency students, which found that "Learners at a low level of language learning store vocabulary according to the sound of words, whereas at more advanced levels words are stored according to meaning." Low proficiency students in this experiment experienced the problem but some of them tackled it adroitly by employing the strategy of transfer both acoustically and semantically. Grabe and Stoller (2011, p. 45) define transfer as "the idea that L2 readers will use their L1 knowledge and experiences to help them carry out L2 tasks." Thus, for those who did use the factor of transfer, they might have used it either deliberately or subconsciously.

What has been said so far relates to the dual coding processing concepts. Data supporting this property was mainly from Group 1 students since they were the only group under the "within" and "non-dual" property. Student C from Group 1 exemplified this idea. She learned the L2 word "termite" as "ปลวก" without cross-referencing to either the picture or other words. She simply learned new words verbally by transferring the meaning of L2 into her L1. This stressed the basic idea of representation in DCT as things are learned and perceived the way they are. The second concept is the referential property. Two students were the best examples for this category. While learning the new word "lavabos", Student C from Group 1 was thinking about her friend whose name was "Boss" to help her remember the meaning. Student G from Group 3 also displayed this property. He linked the word "yashmac" with his Muslim friend whose name was "Yim" and also wore a hijab. This illustrated the between systems connectivity of dual coding processing level. What was received through the verbal channel could be sent across to the visual channel for better understanding. The third concept is the associative property. Student B from Group 1 exhibited this element. She learned the L2 word "mittens" by connecting it

with the word “ten”. This direct activation was said to be “within system” when verbal input is connected with another verbal input or when visual input is connected with another visual input. This was confirmation that linguistic and individual differences intertwined with the elementary concept of representation in DCT truly play a role in language learning.

The second area is individual and experiential differences. As individuals, students and teachers vary in their subjectivism. This very much relates to Krashen’s hypotheses. One of his hypotheses that should be given special attention here is the affective filter hypothesis. Krashen states that the elements under this type of hypothesis can be triggered by four main inputs, which are anxiety, self-confidence, motivation and stress. One of the respondents (Student B from Group 1) was an exemplar of this topic. During the study, she was quite confident in her English ability. She was more relaxed and calm when compared to Student E from Group 2 whose stress was high due to his frustration of not knowing the meaning of difficult words. The findings from the interview with this pair of students were a hard piece of evidence pertaining to this point. Up to this point, the two main differences, which might undermine the generalization of the results discussed, were due to physical and mental modes inside each student.

As for the third difference, which was the socio-cultural and institutional differences, what Grabe and Stoller mean by this is that parents, the environment, and/or social and economic status are also responsible for the disparities among students when it comes to the world of literacy. Student A from Group 1 could remember the word “garland” not just because of L1 ➲ L2 sound transfer but partly because of the Thai environment where garlands are omnipresent. The raw data showed that during the immediate posttest, the word “garland” could be recognized by as many as 25 students. This was approximately half the total number of participants who could recognize the meaning and this word was number three on the list of words that students could recognize the most. The top two were scallop with a recognition rate of 34 students while number one on the list was the word “yashmac”. Up to 42 students were able to recognize the meaning of this word. During the delayed posttest, 20 students could still retain the meaning of the word “garland”, making this word number four on the best retained list. Number one, two

and three were “yashmac”, “scallop” and “midgets”, with the retention rates of 42, 33 and 24 students, respectively. Student F from Group 2 was also a good example of how social and environment play a part in language learning. He mentioned that he could remember the word “ปลาเก๋า” and “ดอกบัว” because these two words are very common in the society. With respect to socioeconomic status and the theory of DCT, Paivio (1990, p. 22) once observed that “some representational processes are biologically determined and others are culturally determined”.

The generalizations of the present study relating to the three differences stated by Grabe and Stoller together with the three basic properties of DCT have been discussed. This discussion section would not be complete without referring to the second issue present among students in this study. This was the dimension of memory strategy, which relates directly to DCT as seen from Table 2.2 in Chapter 2.

4.2.3.3 Interview Data Concerning Memory Strategy

MEM or memory strategy, or traditionally known as mnemonics, is one of the strategies often used most by L2 learners. This technique is one of the most effective methods among learners of language both native and foreign, and “In the case of vocabulary, the goal of both (memory strategy and cognitive strategy) is to assist recall of words through some forms of language manipulation” (Schmitt & McCarthy, 1997, p. 205). Hundreds or even thousands of memory strategies have been proposed but the most systematic one was the one proposed by Rebecca Oxford (1990). Regarding the issue of language learning strategies, Oxford clarified memory strategies as a direct method that are further classified into 1) creating mental linkages 2) applying images and sounds 3) reviewing well, and 4) employing action. The first two issues were observed in this research and, when combined, were very much the same as the theme of DCT. Another set of memory strategies was proposed by Purpura, as cited in Schmitt and McCarthy (1997). Purpura divides memory strategies into six areas: 1) repeating 2) using mechanical means 3) associating 4) linking with prior knowledge 5) using imagery, and 6) summarizing. Two interrelated points between Oxford and Purpura are Oxford’s creating mental linkage and Purpura’s using imagery. Both items share the foundation of DCT as part of the learning process as Paivio once put “an

interactive relation between the imagined element is important to recall" (Paivio, 1990, p. 21). Imagery is very effective when used to recall since it can be encoded directly and holistically, and this is why people subconsciously resort to this technique frequently. In simpler terms, "dual coding posits that the associations to concrete nouns are mediated partly by referent images common to the translation equivalents in each verbal system" (Pavio, 1990, p.246). Findings from the interviews showed that students made use of one or two of the strategies frequently. Paivio cited the work of several researchers and put it this way "individuals differ in their preferred strategies and abilities, so that some individuals may rely on spatial imagery to solve such problems, whereas others use a linguistic strategy" (Paivio, 1990, p. 206). When triangulated with the numerical data, it was not surprising to see that the Group 3 students who were shown the coding of simultaneous L2 ➲ L1 translation and pictures were the ones with the best scores in both tests. Their recognition score after the immediate posttest and their retention score after the delayed posttest, though not significantly different, were higher than those of the other two groups. The gap between Group 1 and Group 3 was very obvious. This is in line with the work of Thompson as cited in Schmitt and McCarthy (1997, p. 211), which determined that "…mnemonics work by utilizing some well-known principles of psychology; a retrieval plan is developed during encoding, and mental imagery, both visual and verbal, is used."

This study might provide some evidence showing that DCT works to a favorable degree. Some students said that they enjoyed seeing both the translation and the pictures at the same time, which supports the idea of DCT that visual and verbal did not counteract and instead support each other. Schmitt (2010, p. 244), citing Clark and Paivio's work in 1995 referring to DCT, states that "Learning foreign vocabulary…involves successive verbal and nonverbal representations that are activated during initial study of the word pairs and during later efforts to retrieve the translation". Deliberately or not, most of the students employed this technique during the study. However, it should be noted that there might be some factors that undermined the results and findings such as the environment the students encountered outside of the research context.

Before this section of the discussion ends, Paivio, the originator of the theory himself, had very strong words regarding the theory of dual coding towards second language learning.

> A major implication is that it is especially important to learn the second language (L2) in direct association with appropriate nonverbal referents because such referents (objects, events, behaviors, emotions), cognitively represented, constitute to the knowledge of the world that L2 must tap as it is to be used meaningfully (Paivio, 1990, p. 252)

To sum up, it could be said that descriptive and inferential statistics together with the answers from students during the interview sessions complemented each other in shedding more light on vocabulary teaching and learning among Thai EFL learners in different aspects. Superficially, there was no significant difference among the three types of coding for both word recognition and retention. Nevertheless, digging deeper into the data, a marginal difference was discovered. Simultaneous L2 ➲ L1 translation and pictorial coding is more promising than the other two when looking at numerical data. Also, though each type of coding was powerful in itself, one of them, simultaneous L2 ➲ L1 translation, has more tangible value compared to the other two types somewhat notably. The degree of retention as seen from the average score (see Table 4.11) was better than the other two types of coding. Apart from the numerical data, interviews with students confirmed that the idea of double sensory inputs or dual coding helped them while experiencing new words in English without interfering or interrupting their mind during word sighting. Students presented with this kind of coding favored the presentation during the experiment without complaining about the redundancy of both visual and verbal inputs.

All in all, the proposition of DCT manifested itself in this experiment thoroughly. Its three processing levels of representative, referential or associative were visible between verbal and nonverbal systems, which are the two primary sensory modalities people use for memory, throughout the course. Moreover, the results gained from both numerical and interview data support the idea of DCT, which

maintains that the activation in either the verbal or the nonverbal systems triggers the other. However, DCT alone could not accomplish all the work without the help of the surrounding environment. It should be emphasized here that teachers should keep in mind Paivio's view that "Finally, individual differences in imagery and verbal abilities and strategy preferences affect the nature of processing during comprehension" (Paivio, 1990, p. 222); and also Nation's that "Learners may favor certain styles of learning" (2001, p. 383).

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The data from this study pointed to the value of the simultaneous L2 ➲ L1 translation and pictorial coding in both word recognition and word retention among Thai EFL learners. Descriptively, it yielded a slightly better result when compared to the application of pictures alone and it was obviously better when compared to the application of L2 ➲ L1 translation coding. Inferentially, there were no significant differences among the three types of coding in terms of both the recognition and retention rate of students.

The reason why simultaneous L2 ➲ L1 translation and pictorial coding was better than the other two types of coding can of course be attributed to DCT. This proved that employing two sensory modals at once did no harm to the memory or learning effects of the learners even though the impact was not very great, which might be due to the small sample size. Had the number of students in the study been higher, the results may have been much more conclusive. The idea of DCT posits that two systems of input, which can be either verbal or non-verbal, enhance the activity of the other and this study showed that this was true. This theory is in contrast to the idea of the single coding, which says that one channel of input is better as otherwise students will be bombarded by too many things during their learning session. Instead of confusing learners with double channels of input, the use of both verbal and non-verbal modals does not interfere learners during their learning period as shown by their higher rate of word recognition and also helps them to have a better retention rate. Paivio (1990, p. 235) stresses this point in writing that **"**dual coding enhances the probability of finding a common ground, that is, a connection between topic and vehicle, in long-term memory; the synchronous or integrated nature of imagery enables large amounts of potentially relevant information to become available quickly".

In sum, the essence of DCT incorporated with the concept of spaced repetition for at least three times while learning new seven-letter words of low frequency among

low EFL proficiency students at the tertiary level, at least, proved promising in regard to both the recognition and retention rates.

5.2 Pedagogical Implications

This study might give more confidence to vocabulary teachers who used to think that "too many cooks spoil the broth", and who often clang to only one channel of either L1 - L2 translation or picture coding. Their technique was not incorrect, but it could be enhanced by the use of both when applicable. In fact, DCT did not overwhelm students with two pieces of incoming data, rather it blended the information into one, which helped students learn new items in the world of vocabulary better. Augmenting simple verbal information with visual (still) images proved feasible at a favorable degree with teaching words among EFL beginner students at the chosen university. Moreover, teachers and students who are skeptical about the use of flashcards and believe they may be an obsolete way of learning a new vocabulary item can feel more confident regarding the application of this method as it is still viable and effective to this date. Applying both L1 translation and picture to a new word on either a piece of card or on an electronic device like a cell phone is not at all demanding. That in the age of the communicative approach there are teachers who fear this technique is not very promising since learning a new word with a very small amount of data seemed unrealistic or there was not enough information of word for the sake of learning. Grabe (2012) argues that first encounters with words may leave a minor impressions and it is impossible to learn new words with their complete information immediately. Furthermore, learning a word should be regarded as a developmental and incremental process.

Consequently, as language teachers teach low proficiency students whose capacity of vocabulary is still limited, they might feel encouraged by inserting little pieces of information bit by bit and later using bigger pieces of data as a means of building vocabulary for their elementary level students. On top of that, the importance of repetition must not be forgotten.

> Amassing a fully-functioning vocabulary is essentially a memory task, and techniques to help in the memorizing of words can be usefully taught, too. It also helps to provide learners with repeated encounters with new words, e.g.

through the re-reading of texts, or by reading several texts about the same topic" (Thornbury, 2006, pp. 240-1).

Thus, as for the pedagogical implications, it is strongly believed that the idea of giving minor information of an L1 translation together with a picture in a non-contextual fashion for students to learn a new item is not discouraging. Carter (2012) once quoted Samuel Johnson, who views that "The value of a work must be estimated by its use: It is not enough that a dictionary delights a critic, unless at the same time it instructs the learner". Language teachers in Thailand know that their students do not have enough exposure in print to be able to recognize vocabulary, let alone retain meanings like native speakers when studying a language. Thus, the job of language teachers is to focus on equipping students with a practical strategy to learn new words in order to expand their vocabulary size. This is especially true for low proficiency level students whose L2 competence has not been established and whose strategies in learning are still unfocused. Based on the results of this study, many of the teachers who find the method of coding L2 words with simultaneous L1 translation and pictorial too explicit and intentional might feel better learning that "Short-term representation and rehearsal allows the eventual establishment of long-term sequence information for language." (Schmitt & McCarthy, 1997, p. 139). Moreover, this piece of research is one confirmation to vocabulary teachers in Thailand that spaced repetition of new words equipped with the coding of simultaneous L2 ➲ L1 translation and pictorial can help low proficiency students recognize and retain the meaning of new words better than the other types of coding administered over a period of more than a month. For teachers who favor the use of L2 translation, a remark from Grabe and Stoller (2011, p.47) might help them feel more comfortable when using an L1 translation: "In the right circumstances, many aspects of L1 reading abilities support L2 comprehension". It is not surprising that during this research no students ever complained about the use of L1. Their only remark was that some words or phrases were quite long, which was a matter of speed pertaining to reading, not a learning hindrance. It is certain that in their real life, students can adjust the translation, the speed and the picture to their liking. Therefore, what is more important is the fact that students will find that this method affords them opportunities

for storing more words in their repertoire under any circumstance they are in. Schmitt and McCarthy (1997) confirm that word cards are very functional as they can be carried around and can be used wherever students prefer both inside and outside classroom or in their "idle moments" , and whenever they want either at the initial stage of encountering a word or for a word record at a later stage for word revision. It is also very flexible with students of all proficiency levels. Teachers who fear that it is too trivial for learning new words should not be intimidated by its lack of sophistication if applied properly. Read (2004, p. 41) confirms that "systematic learning of individual words can provide a good foundation for vocabulary development, especially in foreign language environments where learners have limited exposure to the language outside of the classroom." This kind of application should be regarded as an alternative method for anyone learning a foreign language no matter what level they are at. Besides the use of single coding of either L2 ➲ L1 translation or pictorial, the application of simultaneous L2 ➲ L1 translation and pictorial coding seems to be valuable than the previous two as reflected in the discussion part in Chapter 4. The hard evidence was evident during the interviews of Group 3 students, as it was revealed to have enhanced both recognition and retention among students. Paivio (1990, pp. 252-3) indicates that

> A major implication is that it is especially important to learn the second language (L2) in direct association with appropriate nonverbal referents because such referents (objects, event, behaviors, emotions), cognitively represented, constitute the knowledge of the world that L2 must tap if it is to be used meaningfully. The richer and more direct the referential interconnections, the more efficient L2 use will be.

All in all, the successful learning of words is dependent on many factors and there has never been a one-size-fits-all strategy. Mixing and matching is the key especially in the field of vocabulary learning. Nagy and Townsend (2012, p. 97), citing Graves (2000), write that there were "four components of a vocabulary curriculum: wide reading, promoting word consciousness, teaching word learning strategies and teaching individual words." The goal for students is being able to

recognize and retain the word's meaning. Teachers, on the other hand, have to find ways to help students memorize words better. Teachers and students should be encouraged to explore and use different strategies to help increase their vocabulary repertoire. The focal point of this study was to find ways for teachers to steer EFL learners with low vocabulary learning strategy toward better achievement. A verse from the two thousand year old Bhagavad Gita reinforces this: "The goal of knowledge and the goal of service are the same, those who fail to see this are blind."

Paivio's words (1990, p. 257) may be used as a fitting conclusion for this research: "In particular, the theory (DCT) suggests that language-learning strategies based on the systematic use of referent objects, pictures, activities, and mental imagery would be especially effective in promoting learning."

5.3 Recommendations for Further Study

Based on the current platform, there are several factors that can be tested further to make the research more dynamic. There are five points to be investigated further.

The first suggestion is to try a comparison of both the recognition and retention rate between high and low proficiency students using the same set of unknown words. This could provide proof of whether these two groups of students have different types of strategies when encountering new words or not.

The next suggestion is the reduction of the vocabulary presentation time from seconds to milliseconds but this should take student's readability into consideration. This could indicate the extent to which DCT can facilitate the L2 vocabulary learning process. Also, a more restricted word count for L1 translation should be employed. Even though all of the Thai translations were limited to no more than seven head nouns and all of them fit perfectly within each frame, their physical appearance was perceived as imbalanced. The presentation would have looked more symmetrical and it might have made this variable less confounding.

The third suggestion is to conduct a study between two groups of students at the same proficiency level undergoing the same set of unknown words but with different types of pictures with the first group using static pictures and the second group using dynamic pictures.

The fourth recommendation is the application of a computerized test for both the immediate and delayed posttests. Group 3 students did both tests in a slightly different pattern from what they saw during the presentation. This method would have eradicated this factor, which might have been a confounding variable.

For the third and fourth recommendations, there is one crucial suggestion regarding the application of the immediate posttest at the end of each presentation, which would better in terms of data management.

The last recommendation is to conduct a case study of a student whose learning style is neither visual nor verbal. Again, it would be interesting to see the impact of DCT toward a learner who is outside its parameter.

REFERENCES

Acha, J. (2009). The effectiveness of multimedia programmes in children's vocabulary learning. British Journal of Educational Technology, 40: 23–31. doi:10.1111/j.1467-8535.2007.00800.x

Adelson-Goldstein, J., & Shapiro, N. (2009). *Oxford picture dictionary*. New York: Oxford University Press.

Adulseranee, R. & Lockard, P.J. (2007). The Effects of Using Different Types of Multimedia Presentations on Thai Seventh-grade Learners' Understanding of a Social Studies Text. In T. Bastiaens & S. Carliner (Eds.), *Proceedings of E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2007* (pp. 2283-2288). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/p/26697.

A'Echevarria, A., & Patience, I. (2008). *Teaching thinking pocketbook.* Alresford: Teachers' Pocketbooks.

Al-Seghayer, K. (2001). The effect of multimedia annotation modes on L2 vocabulary acquisition: A comparative study. *Language Learning & Technology*,*5*(1), 202-232. Retrieved from http://www.llt.msu.edu/vol15num1/alseghayer/default.htm

Akbulut, Y. (2007). Effects of multimedia annotations on incidental vocabulary learning and reading comprehension of advanced learners of English as a foreign language. *Instructional Science*, *35*(6), 499-517. DOI: 10.1007/s11251-007-9016-7

Atchara Simlee. (2012) *The effect of vocabulary learning strategy training on Mathayomsuksa five EFL students in Ubon Ratchathani province.* (Master of Arts Thesis, Thammasat University)

Bachman, L. F., & Palmer, A. S. (2010). *Language assessment in practice: Developing language assessments and justifying their use in the real world*. Oxford: Oxford University Press.

Baleghizadeh, S., & Ashoori, A. (2011). The impact of two instructional techniques on EFL learners' vocabulary knowledge: flash cards versus word lists. *Mextesol Journal*, *35*(2), 1-9. Retrieved from

http://search.proquest.com/openview/5fb90b6789b6013fa06f244cd7bf223e/1?pq-rigsite=gscholarhttp://mextesol.net/journal/index.php?page=journal&id_article=71

Barber, H. A., Otten, L. J., Kousta, S. T., & Vigliocco, G. (2013). Concreteness in word processing: ERP and behavioral effects in a lexical decision task. *Brain and language*, *125*(1), 47-53. http://dx.doi.org/10.1016/j.bandl.2013.01.005

Barwood, T. (2005). *Learning to learn pocketbook.* Alresford: Teachers' Pocketbooks.

Basoglu, E. B., & Akdemir, Ö. (2010). A comparison of undergraduate students' English vocabulary learning: Using mobile phones and flash cards. *TOJET: The Turkish Online Journal of Educational Technology*, *9*(3). Retrieved from http://search.proquest.com/openview/5fb90b6789b6013fa06f244cd7bf223e/1?pq-origsite=gscholar

Best, B. (2011). *Accelerated learning pocketbook.* Alresford: Teachers' Pocketbooks.

Bilbrough, N., & Thornbury, S. (2011). *Memory activities for language learning*. Cambridge: Cambridge University Press.

Binder, J. R., Westbury, C. F., McKiernan, K. A., Possing, E. T., & Medler, D. A. (2005). Distinct brain systems for processing concrete and abstract concepts. *Journal of cognitive neuroscience*, *17*(6), 905-917. DOI: 10.1162/0898929054021102

Blackwell, A. F. (1997). Correction: A picture is worth 84.1 words. In *Proceedings of the First ESP Student Workshop* (pp. 15-22). Retrieved from https://www.cl.cam.ac.uk/~afb21/publications/Student-ESP.html

Brown, J. D. (2005). *Testing in language programs: A comprehensive guide to English language assessment*. Upper Saddle River, N.J: Prentice Hall Regents.

Brown, H. D., & Abeywickrama, P. (2010). *Language assessment: Principles and classroom practices*. White Plains, NY: Pearson Education.

Canning-Wilson, C. (2001). Visuals and language learning: Is there a connection. Retrieved from http://www.eltnewsletter.com/back/October2000/art352000.htm

Carpenter, S. K., & Olson, K. M. (2012). Are pictures good for learning new vocabulary in a foreign language? Only if you think they are not. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *38*(1), 92. DOI: 10.1037/a0024828

Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H., & Pashler, H. (2012). Using spacing to enhance diverse forms of learning: Review of recent research and implications for instruction. *Educational Psychology Review*, *24*(3), 369-378. DOI: 10.1007/s10648-012-9205-z

Carr, N. T. (2011). *Designing and analyzing language tests*. Oxford: Oxford University Press.

Carter, R. (2012). *Vocabulary: Applied linguistic perspectives*. London: Routledge.

Chacón, B. R., Abello-Contesse, C., & Torreblanca-López, M. M. (2010). *Insights into non-native vocabulary teaching and learning*. Bristol: Multilingual Matters.

Chan, M. S., & Black, J. B. (2006). Learning Newtonian mechanics with an animation game: The role of presentation format on mental model acquisition. In *Annual Meeting of the American Educational Research Association (AERA), San Francisco* (pp. 2-35). DOI: 10.1.1.169.3864&rep=vep1&type=pdf

Chen, C., & Truscott, J. (2010). The effects of repetition and L1 lexicalization on incidental vocabulary acquisition. *Applied Linguistics*, amq031. DOI: 10.1093/applin/amq031

Chen, N. S., Hsieh, S. W., & Kinshuk, A. (2008). Effects of short-term memory and content representation type on mobile language learning. *Language learning & technology*, *12*(3), 93-113. Retrieved from: http://espace.library.uq.edu.au/view/UQ:182128/UQ182128_OA.pdf

Churches, R. (2010). *Effective classroom communication pocketbook*. Alresford: Teachers' Pocketbooks.

Common European Framework of Reference for Languages: Learning, Teaching, Assessment. Strarsbourg. Language Policy Unit. Retrieved from http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory?. *Progress in brain research*, *169*, 323-338. DOI: 10.1016/S0079-6123(07)00020-9

Creswell, J. W., & Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches*. Los Angeles: SAGE Publications.

Crooks, R., Lankow, J., & Ritchie, J. (2012). *Infographics: The power of visual storytelling*. Hoboken, NJ: Wiley.

Crystal, D. (2012). *The story of English in 100 words*. New York: St. Martin's Press.

De Groot, A. M. B. (2006), Effects of Stimulus Characteristics and Background Music on Foreign Language Vocabulary Learning and Forgetting. Language Learning, 56: 463–506. doi:10.1111/j.1467-9922.2006.00374.x

De Groot, A., & Keijzer, R. (2000). What is hard to learn is easy to forget: The roles of word concreteness, cognate status, and word frequency in foreign-language vocabulary learning and forgetting. *Language Learning*, *50*(1), 1-56. DOI: 10.1111/0023-8333.00110

De Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional science*, *38*(2), 105-134. DOI: 10.1007/s11251-009-9110-0

Derakshan, N., & Koster, E. H. (2012). Information processing, affect, and psychopathology: A Festschrift for Michael W. Eysenck. *Journal of Cognitive Psychology*, *24*(1), 1-5. http://dx.doi.org/10.1080/20445911.2011.637489

Dommett, E. (2011). *Learning & the brain pocketbook*. Alresford: Management Pocketbooks.

Dong, Q., Mei, L., Xue, G., Chen, C., Li, T., Xue, F., & Huang, S. (2008). Sex-dependent neurofunctional predictors of long-term maintenance of visual word learning. *Neuroscience Letters*, *430*(2), 87-91. DOI: 10.1016/j.neulet.2007.09.078

Dörnyei, Z. (2003). *Questionnaires in second language research: Construction, administration, and processing*. Mahwah, N.J: Lawrence Erlbaum Associates.

Dörnyei, Z. (2011). *Research methods in applied linguistics: Quantitative, qualitative, and mixed methodologies*. Oxford: Oxford University Press.

Draper, J. (2012). Reconsidering compulsory English in developing countries in Asia: English in a community of Northeast Thailand. *Tesol quarterly*, *46*(4), 777-811. DOI: 10.1002/tesq.50

Dubois, M., & Vial, I. (2000). Multimedia design: the effects of relating multimodal information. *Journal of Computer Assisted Learning*, *16*(2), 157-165. DOI: 10.1046/j.1365-2729.2000.00127.x

Dzulkifli, M. A., & Mustafar, M. F. (2013). The influence of colour on memory performance: a review. *The Malaysian journal of medical sciences: MJMS*,*20*(2), 3. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3743993/

Endress, A. D., & Potter, M. C. (2014). Something from (almost) nothing: Buildup of object memory from forgettable single fixations. *Attention, Perception, & Psychophysics*, *76*(8), 2413-2423. DOI:10.3758/s13414-014-076-3

Education Policy Research Series Discussion Document No.5: Education Systems in ASEAN+6 Countries: A Comparative Analysis of Selected Educational Issues. Bangkok. Education Policy and Reform Unit

Fadel, C., & Lemke, C. (2008). Multimodal learning through media: What the research says. *San Jose, CA: Cisco Systems,* 1-24. Retrieved from www.cisco.com/web/strategy/docs/education/Multimodal-Learning-Through-Media.pdf

Farías, M., Obilinovic, K., Orrego, R., & Gregersen, T. (2014). Evaluating types and combinations of multimodal presentations in the retention and transfer of concrete vocabulary in EFL learning. *Revista Signos*, *47*(84), 21. Retrieved from http://search.proquest.com/openview/2ecad7743f464564419dd9d4c813be85/1?pq-origsite=gscholar

Forman, R. (2008). Using notions of scaffolding and intertextuality to understand the bilingual teaching of English in Thailand. *Linguistics and Education*, *19*(4), 319-332. DOI: 10.1016/j.linged.2008.07.001

Godwin-Jones, R. (2010). Emerging technologies from memory palaces to spacing algorithms: approaches to second language vocabulary learning. *Language, Learning & Technology*, *14*(2), 4-11. Retrieved from http://llt.msu.edu/vol14num2/emerging.pdf

Grabe, W. P., & Stoller, F. L. (2011). *Teaching and researching: Reading*. Longman.

Grabe, W. (2012). *Reading in a second language: Moving from theory to practice*. Cambridge University Press.

Grambs, D., & Levine, E. S. (2011). *So you think you can spell?: Killer quizzes for the incurably competitive and overly confident*. London: A. & C. Black.

Gulotta, C. (2009). *One thousand words that you must know for standardized tests, high school, university and life!* USA: Mostly Bright Ideas

Hartas, D. (2011). Families' social backgrounds matter: socio-economic factors, home learning and young children's language, literacy and social outcomes. *British Educational Research Journal, 37*(6), 893-914. DOI:10.1080/01411926.2010.506945

Hauptmann, B., & Karni, A. (2002). From primed to learn: the saturation of repetition priming and the induction of long-term memory. *Cognitive Brain Research, 13*(3), 313-322. Retrieved from http://www.sciencedirect.com/science/article/pii/S0926641001001240

Heidari-Shahreza, M. A., & Tavakoli, M. (2016). The effects of repetition and L1 lexicalization on incidental vocabulary acquisition by Iranian EFL Learners. *The Language Learning Journal, 44*(1), 17-32. DOI: 10.1080/095721736.2012.708051

Hintzman, D. L. (2010). How does repetition affect memory? Evidence from judgments of recency. *Memory & Cognition, 38*(1), 102-115. DOI: 10.3758/MC.38.1.102

Horton, C. & Taylor, C. (2015) *ASEAN+3*. Singapore: Produced by Kasikorn Bank Public Company Limited in collaboration with the publisher, Editions Didier Millet.

Huchendorf, L. (2007). The effects of color on memory. *UW-L Journal of Undergraduate Research X*, 1-4. Retrieved from www.uwlax.edu/urc/JUR-online/PDF/2007/huchendorf.pdf

Hughes, A. (2011). *Testing for language teachers*. Cambridge: Cambridge University Press.

Hummel, K. M. (2010). Translation and short-term L2 vocabulary retention: Hindrance or help?. *Language Teaching Research, 14*(1), 61-74. DOI: 10.1177/1362168809346497

Isaac, S., & Michael, W. B. (1981). *Handbook in research and evaluation: A collection of principles, methods, and strategies useful in the planning, design, and evaluation of studies in education and the behavioral sciences*. San Diego, Calif: EDITS Publishers.

Jalilehvand, M. (2012). The effects of text length and picture on reading comprehension of Iranian EFL students. *Asian Social Science*, *8*(3), 329. DOI:10.5539/ass.v8n3p329

Jared, D., Poh, R. P. Y., & Paivio, A. (2013). L1 and L2 picture naming in Mandarin–English bilinguals: A test of bilingual dual coding theory. *Bilingualism: Language and Cognition*, *16*(02), 383-396. DOI: 10.1017/S1366728912000685

Jenkins, J. (2009). *World Englishes: A resource book for students*. London: Routledge.

Jensen, E., & Jensen, E. (2008). *Brain-based learning: The new paradigm of teaching*. Thousand Oaks, CA: Corwin Press.

Jessen, F., Heun, R., Erb, M., Granath, D. O., Klose, U., Papassotiropoulos, A., & Grodd, W. (2000). The concreteness effect: Evidence for dual coding and context availability. *Brain and language*, *74*(1), 103-112. DOI: 10.1006/brln.2000.2340

Jukes, I., McCain, T. D. E., & Crockett, L. (2010). *Understanding the digital generation: Teaching and learning in the new digital landscape*. Kelowna, C.-B: 21st Century Fluency Project.

Jurkovic, A., Anderson, C., Myklejord, D., Levin, C., & Lotz, A. (2013). The effect of music tempo on memory retention. Retrieved from http://jass.neuro.wisc.edu/2013/01/602%2012%20The%20Effect%20of%20Music%20Tempo%20On%20Memory%20Retention1.pdf

Kalyuga, S. Cognitive Load Factors Moderating the Redundancy Effect in Multimedia Learning. Retrieved from http://www.nectec.or.th/icce2011/program/proceedings/pdf/C6_S1_10S.pdf

Kano, F., & Hirata, S. (2015). Great apes make anticipatory looks based on long-term memory of single events. *Current Biology*, *25*(19), 2513-2517. http://dx.doi.org/10.1016/j.cub.2015.08.004

Karpicke, J. D., & Roediger, H. L. (2008). The critical importance of retrieval for learning. *science*, *319*(5865), 966-968. DOI:10.1126/science.1152408

Khoii, R., & Sharififar, S. (2013). Memorization versus semantic mapping in L2 vocabulary acquisition. *ELT journal*, *67*(2), 199-209.

Kim, D., & Gilman, D. A. (2008). Effects of Text, Audio, and Graphic Aids in Multimedia Instruction for Vocabulary Learning. *Educational Technology & Society*, *11*(3), 114-126. Retrieved from: http://www.jstor.org/stable/jeductechsoci.11.3.114

Koenig, C., Seligson, P. & Oxenden, C. (2012). *English file elementary student's book*. Oxford: Oxford University Press.

Komol, T., & Sripetpun, W. (2011). Vocabulary learning strategies employed by undergraduate students and its relationship to their vocabulary knowledge. In *Proceedings of the 3rd International Conference on Humanities and Social Sciences*. Retrieved from http://fs.libarts.psu.ac.th/research/conference/proceedings-3/2pdf/008.pdf

Korat, O., Levin, I., Atishkin, S., & Turgeman, M. (2014). E-book as facilitator of vocabulary acquisition: support of adults, dynamic dictionary and static dictionary. *Reading and Writing*, *27*(4), 613-629. DOI: 10.1007/s11145-013-9474-z

Kost, C. R., Foss, P., & Lenzini, J. J. (1999). Textual and pictorial glosses: Effectiveness on incidental vocabulary growth when reading in a foreign language. *Foreign Language Annals*, *32*(1), 89-97. DOI: 10.1111/j.1944-9720.1999.tb02378.x

Kousta, S. T., Vigliocco, G., Vinson, D. P., Andrews, M., & Del Campo, E. (2011). The representation of abstract words: why emotion matters. *Journal of Experimental Psychology: General*, *140*(1), 14. DOI: 10.1037/a0021446

Kuo, M. L. A., & Hooper, S. (2004). The effects of visual and verbal coding mnemonics on learning Chinese characters in computer-based instruction. *Educational technology research and development*, *52*(3), 23-34. DOI: doi:10.1007/BF02504673

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design*. Upper Saddle River, N.J: Prentice Hall.

Lew, R., & Doroszewska, J. (2009). Electronic dictionary entries with animated pictures: Lookup preferences and word retention. *International Journal of Lexicography*, *22*(3), 239-257. DOI: 10.1093/ijl/ecp022

Lin, C. C., & Hsiao, H. S. (2011, December). The effects of multimedia annotations via PDA on EFL learners' vocabulary learning. In *Proceedings of the 19th International Conference on Computers in Education*. Retrieved from http://www.nectec.or.th/icce2011/program/proceedings/pdf/C6_F7_218F.pdf

Liu, J. (2008). L1 use in L2 vocabulary learning: Facilitator or barrier. *International Education Studies*, *1*(2), 65. http://dx.doi.org/10.5539/ies.v1n2p65

Logan, J. M., Thompson, A. J., & Marshak, D. W. (2011). Testing to enhance retention in human anatomy. *Anatomical sciences education*, *4*(5), 243-248. DOI: 10.1002/ase.250

Lotto, L. and de Groot, A. M. B. (1998). Effects of Learning Method and Word Type on Acquiring Vocabulary in an Unfamiliar Language. *Language Learning*, 48: 31–69. DOI:10.1111/1467-9922.00032

Lujan, H. L., & DiCarlo, S. E. (2006). First-year medical students prefer multiple learning styles. *Advances in Physiology Education*, *30*(1), 13-16. DOI:10.1152/advan.00045.2005

Lwin, M., Morrin, M., & Krishna, A. (2010). Exploring the superadditive effects of scent and pictures on verbal recall: An extension of dual coding theory.*Journal of Consumer Psychology*, *20*, 317-326. DOI: 10.1016/j/jcps.2010.04.001

Markham, P., Peter, L. A., & McCarthy, T. J. (2001). The effects of native language vs. target language captions on foreign language students' DVD video comprehension. *Foreign language annals*, *34*(5), 439-445. DOI: 10.1111/j.1944-9720.2001.tb02083.x

Mart, Ç. T. (2013). The facilitating role of L1 in ESL classes. *International Journal of Academic Research in Business and Social Sciences*, *3*(1), 9. Retrieved from http://www.hrmars.com/admin/pics/1400.pdf

Mayer, R. E., & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of educational psychology*, *83*(4), 484. Retrieved from http://psycnet.apa.org/doi/10.1037/0022-0663.83.4.484

McCrostie, J. (2007). Examining learner vocabulary notebooks. *ELT journal*,*61*(3), 246-255. DOI: 10.1093/elt/ccm032

McDermott, K. B., & Chan, J. C. (2006). Effects of repetition on memory for pragmatic inferences. *Memory & Cognition*, *34*(6), 1273-1284. doi: 10.3758 BF03193271Mackey, Alison, & Gass, Susan M. (2005). *Second language research: methodology and design*. (Mackey, Alison and Gass, Susan M. (2005) Second language research: methodology and design. Lawrence Erlbaum Associates.

McDonough, J., & McDonough, S. H. (1997). *Research methods for English language teachers*. London: Arnold.

Meara, P. M., Fitzpatrick, T., & Barfield, A. (2009). *Lexical processing in second language learners: Papers and perspectives in honour of Paul Meara*. Bristol, UK: Multilingual Matters.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks: Sage Publications.

Mohsen, M. A., & Balakumar, M. (2011). A review of multimedia glosses and their effects on L2 vocabulary acquisition in CALL literature. *ReCALL*, *23*(02), 135-159. DOI: 10.1017/S095834401100005X

Munier, E. (2014). *Modality Effects in Short-term Memory versus Long-term Memory within the Deese, Roediger and McDermott Paradigm* (Doctoral dissertation). Retrieved from https://deepblue.lib.umich.edu/bitstream/handle/2027.42/107760/ecmuni.pdf?sequence=1&isAllowed=y

Nagy, W., & Townsend, D. (2012). Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly*, *47*(1), 91-108. DOI: 10.1002/RRQ.011

Nation, I. S. P. (2008). *Teaching vocabulary: Strategies and techniques*. Boston, MA: Heinle.

Nation, I. S. P., & Webb, S. A. (2011). *Researching and analyzing vocabulary*. Boston, MA: Heinle, Cengage Learning.

Nation, I. S. (2011). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Nugroho, Y. S. (2012). Improving students' vocabulary mastery using flashcards (Doctoral dissertation, Sebelas Maret University). Retrieved from https://eprints.uns.ac.id/id/eprint/13244

Nunan, D., & Bailey, K. M. (2009). *Exploring second language classroom research: A comprehensive guide*. Boston, MA: Heinle, Cengage Learning.

Nutsareeya Sangpan (2009). *A study of Thai EFL teachers' use of media in reading instruction*. (Ph.D. Thesis, Chulalongkorn University)

O'Keeffe, A., McCarthy, M., & Carter, R. (2007). *From corpus to classroom: Language use and language teaching*. Cambridge: Cambridge University

O'Malley, J. M., & Pierce, L. V. (1996). *Authentic assessment for English language learners: Practical approaches for teachers*. Reading, Mass: Addison-Wesley Pub. Co.

Oxford, R. L. (1990). *Language learning strategies* (Vol. 210). New York: Newbury House.

Pakzadian, M. (2012). The Effect of L1 on Learning New L2 Vocabulary among Intermediate Proficiency Level Students. *Theory and Practice in Language Studies*, *2*(6), 1147. DOI: 10.4304/tpls.2.6.1147-1152

Parker, S. (2009). *The concise human body book*. London: Dorling Kindersley.

Paivio, A. (1990). *Mental representations: A dual coding approach*. New York: Oxford University Press.

Plass, J. L., Chun, D. M., Mayer, R. E., & Leutner, D. (1998). Supporting visual and verbal learning preferences in a second-language multimedia learning environment. *Journal of educational psychology*, *90*(1), 25. DOI: 10.1037/0022-0663.90.1.25

Plowright, D. (2011). *Using mixed methods: Frameworks for an integrated methodology*. London: SAGE.

Read, J. A. (2004). *Assessing vocabulary*. Cambridge: Cambridge University Press.

Rodriguez, M., & Sadoski, M. (2000). Effects of rote, context, keyword, and context/keyword methods on retention of vocabulary in EFL classrooms. *Language learning*, *50*(2), 385-412. DOI: 10.1111/0023-8333.00121

Ruchkin, D. S., Grafman, J., Cameron, K., & Berndt, R. S. (2003). Working memory retention systems: A state of activated long-term memory. *Behavioral and Brain Sciences, 26*(06), 709-728. DOI: http://dx.doi.org/10.1017/S0140525X03000165

Ryder, M. (2003). Instructional design models. Retrieved from: http://thingsorganic.tripod.com/Instructional_Design_Models.htm

Sadoski, M. (2005). A dual coding view of vocabulary learning. *Reading & Writing Quarterly, 21*(3), 221-238. DOI: 10.1080/10573560590949359

Sadoski, M., & Paivio, A. (2013). *Imagery and text: A dual coding theory of reading and writing.* New York: Routledge.

Schmitt, N. (2010). *Researching vocabulary: A vocabulary research manual*. Basingstoke: Palgrave McMillan.

Schmitt, N., & McCarthy, M. (2011). *Vocabulary: Description, acquisition and pedagogy*. Cambridge: Cambridge University Press.

Schnotz, W., & Bannert, M. (2003). Construction and interference in learning from multiple representation. *Learning and instruction, 13*(2), 141-156. DOI: 10.1016/S0959-4752(02)00017-8

Seliger, H. W., Shohamy, E. G., & Shohamy, E. (2003). *Second language research methods*. Oxford: Oxford University Press.

Seth, A. (2014). *30-second brain: the 50 most mind-blowing ideas in neuroscience, each explained in half a minute*. London: Ivy Press.

Shahrokni, S. A. (2009). Second Language Incidental Vocabulary Learning: The Effect of Online Textual, Pictorial, and Textual Pictorial Glosses. *TESL-EJ, 13*(3), n3. Retrieved from : http://files.eric.ed.gov/fulltext/EJ898202.pdf

Shapiro, A. M., & Waters, D. L. (2005). An investigation of the cognitive processes underlying the keyword method of foreign vocabulary learning. *Language teaching research, 9*(2), 129-146. DOI: 10.1191/1362168805lr151oa

Silverman, D. (2004). *Qualitative research: Theory, method and practice*. London: Sage Publications.

Silverman, R., & Hines, S. (2009). The effects of multimedia-enhanced instruction on the vocabulary of English-language learners and non-English-language learners in pre-kindergarten through second grade. *Journal of Educational*

Psychology, *101*(2), 305. Retrieved from: http://psycnet.apa.org/doi/10.1037/a0014217

Smith, I. (2007). *Assessment & learning pocketbook*. Alresford, Hampshire: Teachers' Pocketbooks.

Sombatteera, S., & Kalyuga, S. (2012). When Dual Sensory Mode with Limited Text Presentation Enhance Learning. *Procedia-Social and Behavioral Sciences, 69*, 2022-2026. DOI: 10.1016/j.sbspro.2012.12.160

Tavakoli, M., & Gerami, E. (2013). *The effect of keyword and pictorial methods on EFL learner's vocabulary learning and retention*. Retrieved from http://www.ugr.es/~portalin/articulos/PL_numero19/18%20%20Mansoor.pdf

Tileston, D. W. (2004). *What every teacher should know about learning, memory, and the brain*. Thousand Oaks, Calif: Corwin Press.

Thornbury, S. (2006). *An A-Z of ELT: A dictionary of terms and concepts*. Oxford: Macmillan Education.

Trow, W. C. (1928). Recall vs. repetition in the learning of rote and meaningful material. *The American Journal of Psychology*, 112-116. Retrieved from http://www.jstor.org/stable/1415313

Ur, P. (2012). *Vocabulary activities*. Cambridge: Cambridge University Press.

Vocabulary. (n.d.) In *Oxford Dictionary*. Retrieved from https://en.oxforddictionarires.com/vocabulary

Washbourne, A., & Hailstone, P. (2011). *EAL pocketbook*. Alresford: Teachers' Pocketbooks.

Webb, S. (2007). The effects of repetition on vocabulary knowledge. *Applied linguistics*, *28*(1), 46-65. DOI: 10.1093/applin/aml048

Webb, S. (2007). Learning word pairs and glossed sentences: The effects of a single context on vocabulary knowledge. *Language teaching research*, *11*(1), 63-81. DOI: 10.1177/1362168806072463

Webster's new explorer crossword puzzle dictionary. (2011). Springfield, MA: Federal Street Press.

Wiener, H. S., & Bazerman, C. (1999). *A reader's guide*. Boston: Houghton Mifflin.

Wiggins, B. E. (2012). E-learning design and intercultural challenges. Retrieved from http://www.cmdconf.net/2012/makale/33.pdf

Whitfield, J. S. (1997). *Webster's New World crossword puzzle dictionary, 2nd Edition*. New York: Hungry Minds.

Yeh, Y., & Wang, C. W. (2003). Effects of multimedia vocabulary annotations and learning styles on vocabulary learning. *Calico Journal*, 131-144. Retrieved from http://www.jstor.org/stable/24149484

Yoshii, M. (2006). L1 and L2 glosses: Their effects on incidental vocabulary learning. *Language Learning & Technology, 10*(3), 85-101. Retrieved from: http://llt.msu.edu.vol10num3/yoshii/

Yoshii, Makoto, and Jeffra Flaitz. (2002) Second language incidental vocabulary retention: The effect of text and picture annotation types. *CALICO Journal , 20(1)*, 33-58. Retrieved from: http://www.jstor.org/stable/24149608

Zarei, A. A. (2009). The effect of bimodal, standard, and reversed subtitling on L2 vocabulary recognition and recall. *Pazhuhesh-e Zabanha-ye Khareji, 49*(1), 65-85. Retrieved from: http://www.ikiu.ac.ir/public_files/profiles/items/1310286471.pdf

Zimmerman, C. B. (2009). *Word knowledge: A vocabulary teacher's handbook.* Oxford: Oxford University Press.

เอกสารภาษาไทย

แผนพัฒนาการศึกษาแห่งชาติฉบับที่๑๑ (พ.ศ.๒๕๕๕-๒๕๕๙). กรุงเทพฯ: สำนักงานปลัดกระทรวงศึกษาธิการ Retrieved from www.moe.go.th

(the Eleventh National Educational Development Plan 2012-2016 of the Ministry of Education)

แผนยุทธศาสตร์ปฏิรูปการเรียนการสอนภาษาอังกฤษเพื่อเพิ่มขีดความสามารถในการแข่งขันของประเทศ (พ.ศ. ๒๕๔๙-๒๕๕๓) Retrieved from www.moe.go.th

(the strategic plan for the reformation of English language teaching and learning to improve the country's competency level of the Ministry of Education of Thailand 2006-2010)

เอกสารประกอบการเรียนวิชา สษ.๑๗๑ ปีการศึกษา ๒๕๕๗ [ม.ป.ท.]. สถาบันภาษา มหาวิทยาลัยธรรมศาสตร์

(EL 171 Textbook)

Electronic Media

www.ef.edu
http://www.moe.go.th
http://www.niets.or.th
https:// www.pinterest.com
http://www.worksheetfun.com

APPENDICES

APPENDIX A

Inceptive Selection of Words with Seven Letters

(after EL 171 textbook verification)

bacalao	balcony	bandana	banquet	bassoon
bellhop	bladder	blender	blister	butcher
buttock	brisket	cabbage	cabinet	canteen
caverns	chisels	console	courier	curtain
dasyure	daysman	dendron	denture	dervish
devilry	dewclaw	dimples	dogwood	dracena
drosera	droshky	dungeon	dwarves	falafel
faucets	feather	felwort	fiction	figwort
filaree	fleeces	flipper	florist	foliage
forceps	freckle	freesia	frigate	garoupa
garland	gazebos	gazelle	garnish	garpike
genoise	gesture	ghettos	gizzard	glacier
gliders	gnocchi	gobbler	goggles	grackle
griddle	grinder	grocery	grottos	haddock
halibut	hallway	hammock	harbour	haricot
harpoon	hassock	hatchet	hornets	humidor
hydrant	jabirus	janitor	jasmine	javelin
juniper	kestrel	kithara	kantele	knuckle
kumquat	ladybug	lantern	lanyard	lavabos
legumes	lentigo	lentils	leprosy	lettuce
loafers	lobster	locusts	lovebug	lozenge
machete	mahjong	mahouts	mallard	manteau
marabou	markhor	marshal	mastiff	mattock
measles	meteors	meerkat	midgets	mittens
mojarra	mollusk	mongrel	monocle	mortars
mosques	mudflap	muscats	muffler	mussels
nacelle	napkins	nappies	nelumbo	nostril
nougats	nozzles	nutmegs	pajamas	panther
parsley	pasture	peacock	pigeons	platter
plumber	plunger	quamash	quetzal	quokkas
rampart	rancher	rappini	rasbora	remudas
reptile	rhamnus	rhombus	rhubarb	ricotta
risotto	roaches	romaine	rooster	roselle
rosette	rostrum	rotunda	roulade	scallop
scholar	scraper	shelter	sheriff	shutter
spatula	storage	surgeon	tadpole	termite
thimble	toddler	tortoise	trailer	teepees
valises	velours	veloute	vendace	veranda

APPENDIX A (Continued)

verbena	vermuth	vernier	veteran	viaduct
viceroy	villain	vinegar	vintner	volcano
vulture	wagtail	wallaby	wantons	wapitis
warbler	waxbill	weasels	whippet	whipray
whisker	whistle	widgeon	winesap	wontons
wryneck	xenopus	yarrows	yashmac	yatagan
zanders	zelkova	zeppole	zithers	zodiacs

APPENDIX B

Vocabulary Screening Test

ชื่อ _____

เลขทะเบียน _____

Section _____

จงแปลความหมายของคำภาษาอังกฤษต่อไปนี้เป็นภาษาไทย

bacalao:	feather:	kantele:
balcony:	forceps:	kumquat:
bandana:	garoupa:	lantern:
bassoon:	garland:	lavabos:
bellhop:	goggles:	legumes:
cabinet:	hammock:	loafers:
chisels:	harbor:	lobster:
[redacted]	hatchet:	locusts:
courier:	hornets:	machete:
faucets:	jaribus:	mahjong:
mallard:	pajamas:	scallop:
markhor:	panther:	termite:
mastiff:	peacock:	tortoise:
mattock:	quokkas:	teepees:
meerkat:	remudas:	volcano:
midgets:	rhombus:	wallaby:
mittens:	ricotta:	whistle:
mortars:	rooster:	winesap:
nappies:	rosette:	xenopus:
nelumbo:	rostrum:	yashmac:

APPENDIX C

Order of Presentations

First Presentation

1. mittens	10. midgets	19. bacalao	28. scallop
2. bandana	11. ricotta	20. mattocks	29. rosette
3. rhombus	12. winesap	21. lavobos	30. termite
4. hammock	13. teepees	22. machete	31. hatchet
5. bellhop	14. remudas	23. chisels	32. rostrum
6. mortars	15. xenopus	24. wallaby	33. yashmac
7. nelumbo	16. mallard	25. kantele	34. faucets
8. mastiff	17. garland	26. jaribus	35. kumquat
9. loafers	18. markhor	27. garoupa	36. locusts

Second Presentation

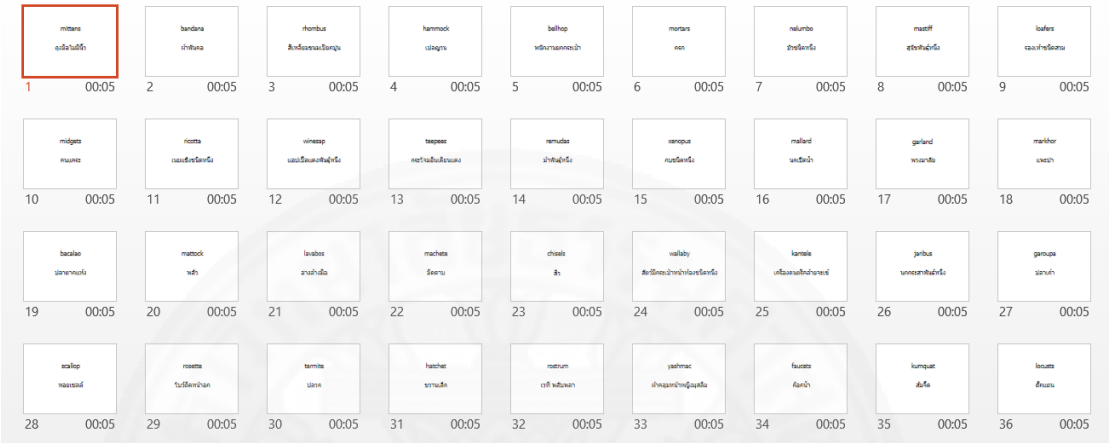
1. kumquat	10. mattock	19. bacalao	28. mallard
2. lavabos	11. xenopus	20. chisels	29. markhor
3. yashmac	12. garoupa	21. loafers	30. remudas
4. faucets	13. wallaby	22. mortars	31. ricotta
5. scallop	14. rostrum	23. midgets	32. jaribus
6. hammock	15. bandana	24. locusts	33. machete
7. teepees	16. termite	25. rosette	34. mastiff
8. nelumbo	17. winesap	26. mittens	35. garland
9. rhombus	18. kantele	27. bellhop	36. hatchet

Third Presentation

1. loafers	10. faucets	19. hatchet	28. jaribus
2. remudas	11. rhombus	20. mattock	29. kumquat
3. mastiff	12. lavabos	21. termite	30. locusts
4. hammock	13. rosette	22. bacalao	31. wallaby
5. bellhop	14. machete	23. teepees	32. chisels
6. yashmac	15. ricotta	24. winesap	33. mittens
7. bandana	16. garland	25. xenopus	34. garoupa
8. markhor	17. mortars	26. midgets	35. nelumbo
9. mallard	18. scallop	27. kantele	36. rostrum

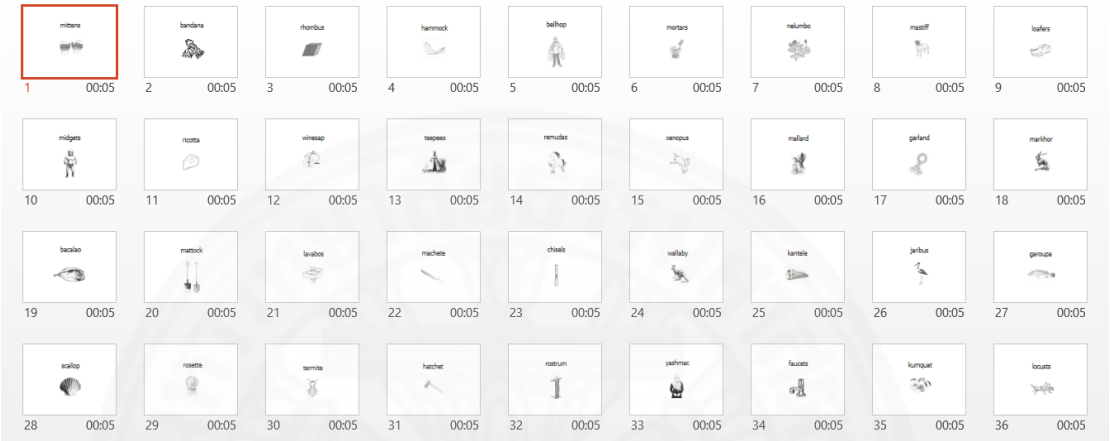
APPENDIX D

Word Presentation Sample



APPENDIX E

Picture Presentation Sample



APPENDIX F

Immediate Posttest for Group 1 and Group 3

ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับคำแปลภาษาไทย

_____	mittens	1. มีดดาบ
_____	hatchet	2. แพะป่า
_____	chisels	3. ผ้าคลุมหน้าหญิงมุสลิม
_____	mastiff	4. หอยเชลล์
_____	markhor	5. ปลาตากแห้ง
_____	mortars	6. นกเป็ดน้ำ
_____	locusts	7. ครก
_____	nelumbo	8. ปลาเก๋า
_____	rostrum	9. บัวชนิดหนึ่ง
_____	lavabos	10. ส้มจี๊ด
_____	ricotta	11. เปลญวณ
_____	bacalao	12. ถุงมือไม่มีนิ้ว
_____	xenopus	13. แอปเปิ้ลแดงพันธุ์หนึ่ง
_____	termite	14. เวที พลับพลา
_____	kumquat	15. ก๊อกน้ำ
_____	garoupa	16. โบว์ติดหน้าอก
_____	garland	17. อ่างล้างมือ
_____	hammock	18. กบชนิดหนึ่ง
_____	scallop	19. ปลวก
_____	mallard	20. ขวานเล็ก
_____	jaribus	21. พวงมาลัย
_____	yashmac	22. พลั่ว
_____	loafers	23. คนแคระ
_____	faucets	24. ผ้าพันคอ

APPENDIX F (Continued)

_____	remudas	25. เครื่องดนตรีคล้ายจะเข้
_____	kantele	26. เนยแข็งชนิดหนึ่ง
_____	teepees	27. พนักงานยกกระเป๋า
_____	machete	28. สี่เหลี่ยมขนมเปียกปูน
_____	winesap	29. รองเท้าชนิดสวม
_____	rosette	30. สิ่ว
_____	rhombus	31. นกกระสาพันธุ์หนึ่ง
_____	midgets	32. กระโจมอินเดียนแดง
_____	bandana	33. ตั๊กแตน
_____	bellhop	34. ม้าพันธุ์หนึ่ง
_____	mattock	35. สัตว์มีกระเป๋าหน้าท้องชนิดหนึ่ง
_____	wallaby	36. สุนัขพันธุ์หนึ่ง

APPENDIX G

Immediate Posttest for Group 2 and Group 3

ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับรูปภาพ เขียนเฉพาะตัวเลขใต้รูปภาพแต่ละรูป

1. mittens	10. lavabos	19. scallop	28. machete
2. hatchet	11. ricotta	20. mallard	29. winesap
3. chisels	12. bacalao	21. jaribus	30. rosettes
4. mastiff	13. xenopus	22. yashmac	31. rhombus
5. markhor	14. termite	23. loafers	32. midgets
6. mortars	15. kumquat	24. faucets	33. bandana
7. locusts	16. garoupa	25. remudas	34. bellhop
8. nelumbo	17. garland	26. kantele	35. mattock
9. rostrum	18. hammock	27. teepees	36. wallaby

APPENDIX H

Immediate Posttest for Group 2 and Group 3 (pictures)

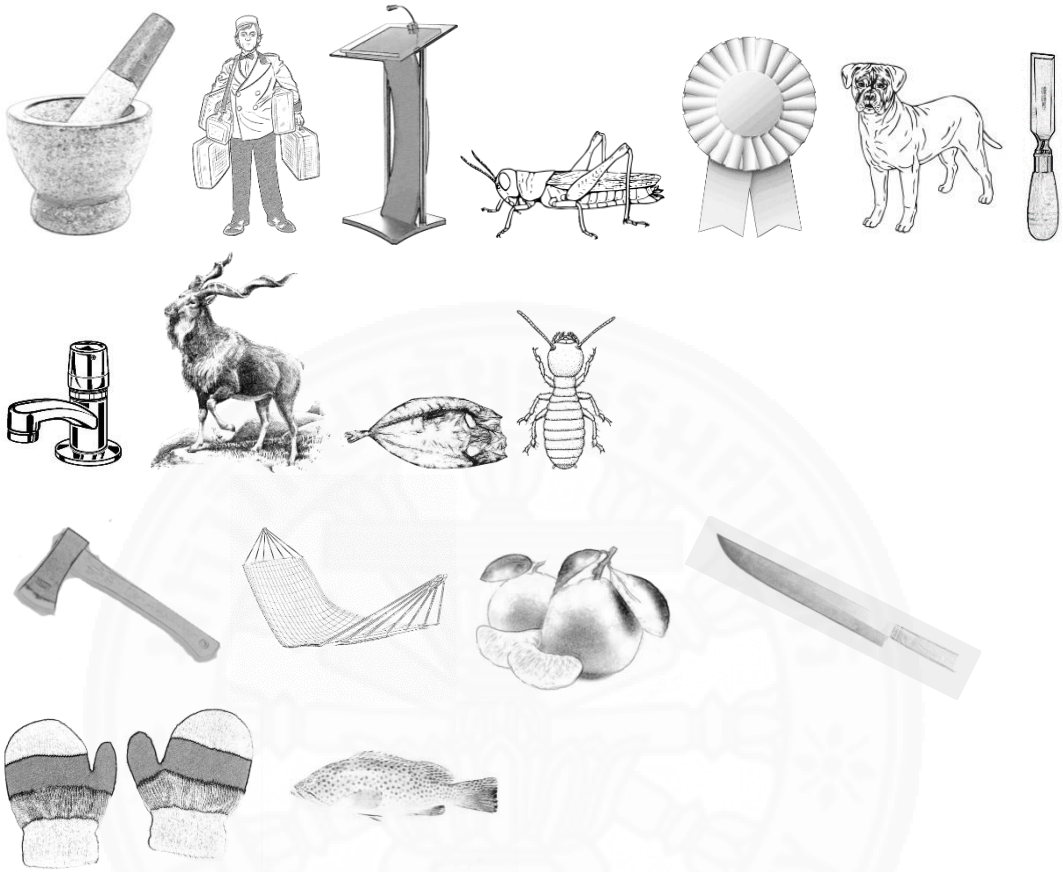
ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับรูปภาพ เขียนเฉพาะตัวเลขใต้รูปภาพแต่ละรูป

APPENDIX H (Continued)



APPENDIX I

Delayed Posttest for Group 1 and Group 3

ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับคำแปลภาษาไทย

_____	rosette	1. กบชนิดหนึ่ง
_____	rhombus	2. รองเท้าชนิดสวม
_____	lavabos	3. ครก
_____	chisels	4. เวที พลับพลา
_____	garoupa	5. ผ้าพันคอ
_____	winesap	6. เครื่องดนตรีคล้ายจะเข้
_____	wallaby	7. พลั่ว
_____	rostrum	8. ก๊อกน้ำ
_____	yashmac	9. กระโจมอินเดียนแดง
_____	teepees	10. สี่เหลี่ยมขนมเปียกปูน
_____	jaribus	11. แพะป่า
_____	bellhop	12. คนแคระ
_____	mittens	13. ส้มจี๊ด
_____	mallard	14. พนักงานยกกระเป๋า
_____	ricotta	15. ปลาเก๋า
_____	faucets	16. บัวชนิดหนึ่ง
_____	xenopus	17. แอปเปิ้ลแดงพันธุ์หนึ่ง
_____	loafers	18. เนยแข็งชนิดหนึ่ง
_____	mortars	19. ปลวก
_____	hatchet	20. ปลาตากแห้ง
_____	mattock	21. นกเป็ดน้ำ
_____	garland	22. เปลญวณ
_____	kentele	23. สิ่ว

APPENDIX I (Continued)

_____	midgets	24. ถุงมือไม่มีนิ้ว
_____	hammock	25. สุนัขพันธุ์หนึ่ง
_____	bandana	26. มีดดาบ
_____	bacalao	27. ตั๊กแตน
_____	machete	28. นกกระสาพันธุ์หนึ่ง
_____	remudas	29. ผ้าคลุมหน้าหญิงมุสลิม
_____	nelumbo	30. พวงมาลัย
_____	scallop	31. ขวานเล็ก
_____	locusts	32. โบว์ติดหน้าอก
_____	mastiff	33. ม้าพันธุ์หนึ่ง
_____	termite	34. สัตว์มีกระเป๋าหน้าท้องชนิดหนึ่ง
_____	markhor	35. อ่างล้างมือ
_____	kumquat	36. หอยเชลล์

APPENDIX J

Delayed Posttest for Group 2 and Group 3

ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับรูปภาพ เขียนเฉพาะตัวเลขใต้รูปภาพแต่ละรูป

1. rosette	10. teepees	19. mortars	28. machete
2. rhombus	11. jaribus	20. hatchet	29. remudas
3. lavabos	12. bellhop	21. mattock	30. nelumbo
4. chisels	13. mittens	22. garland	31. scallop
5. garoupa	14. mallard	23. kantele	32. locusts
6. winesap	15. ricotta	24. midgets	33. mastiff
7. wallaby	16. faucets	25. hammock	34. termite
8. rostrum	17. xenopus	26. bandana	35. markhor
9. yashmac	18. loafers	27. bacalao	36. kumquat

APPENDIX K

Delayed Posttest for Group 2 and Group 3 (pictures)

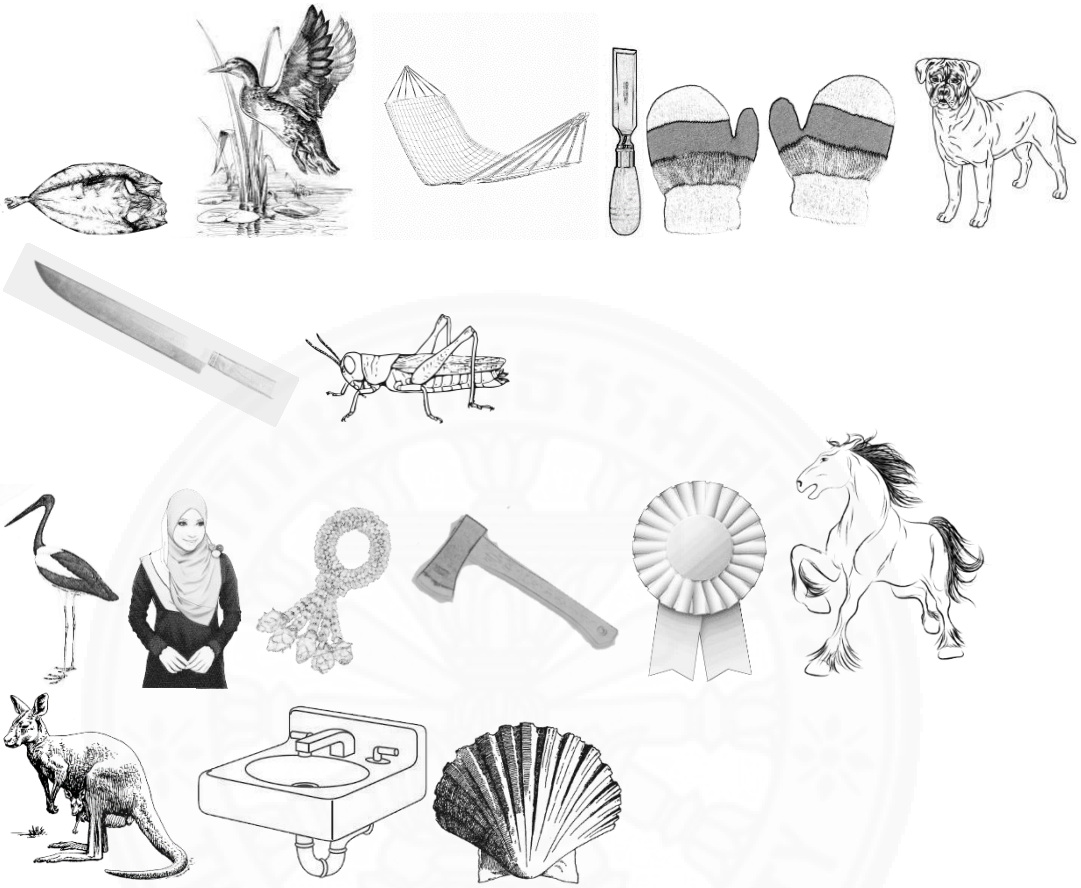
ชื่อ _____

เลขทะเบียน _____

Section _____

จงจับคู่คำศัพท์ภาษาอังกฤษกับรูปภาพ เขียนเฉพาะตัวเลขใต้รูปภาพแต่ละรูป

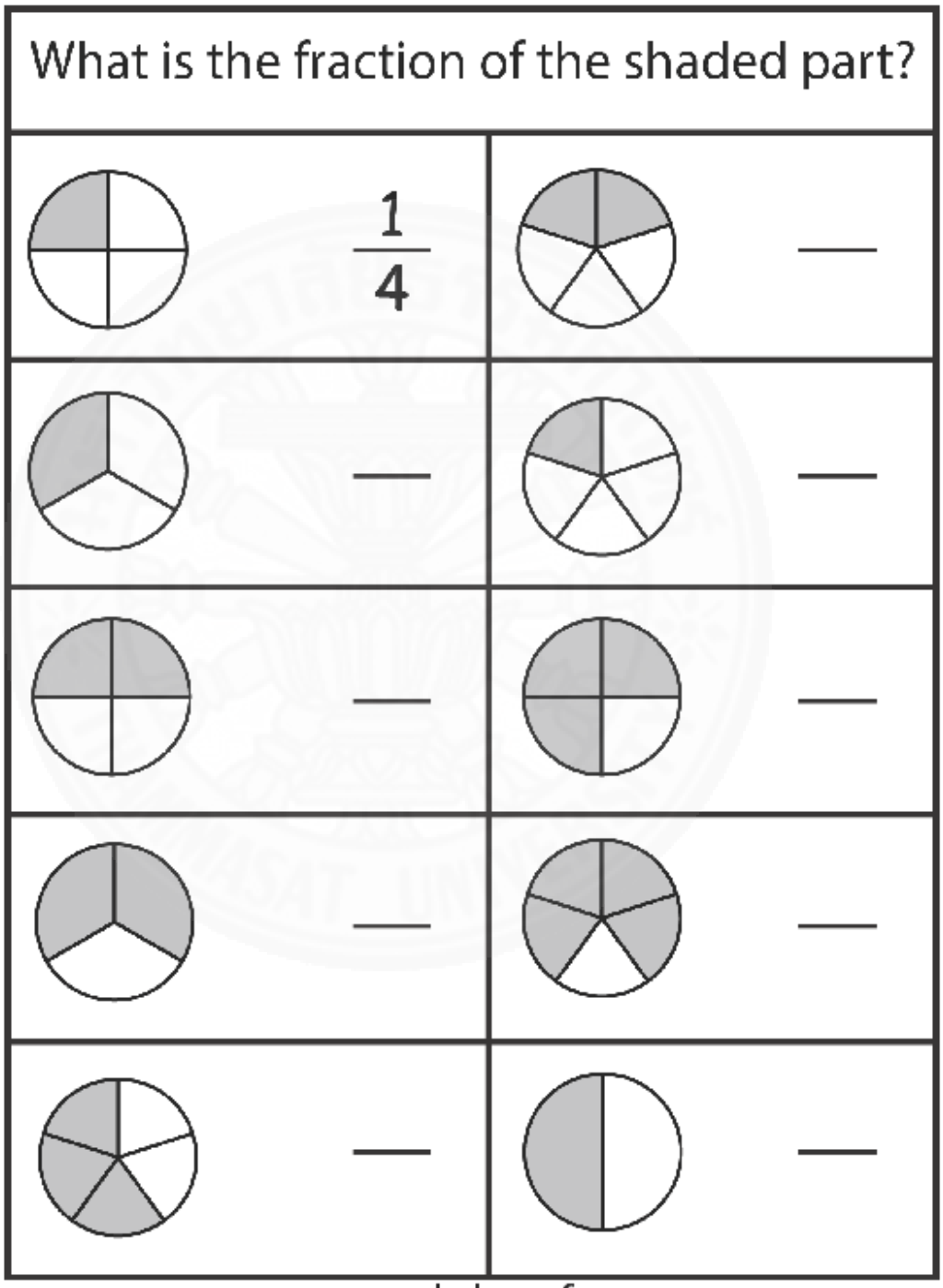
APPENDIX K (Continued)



APPENDIX L

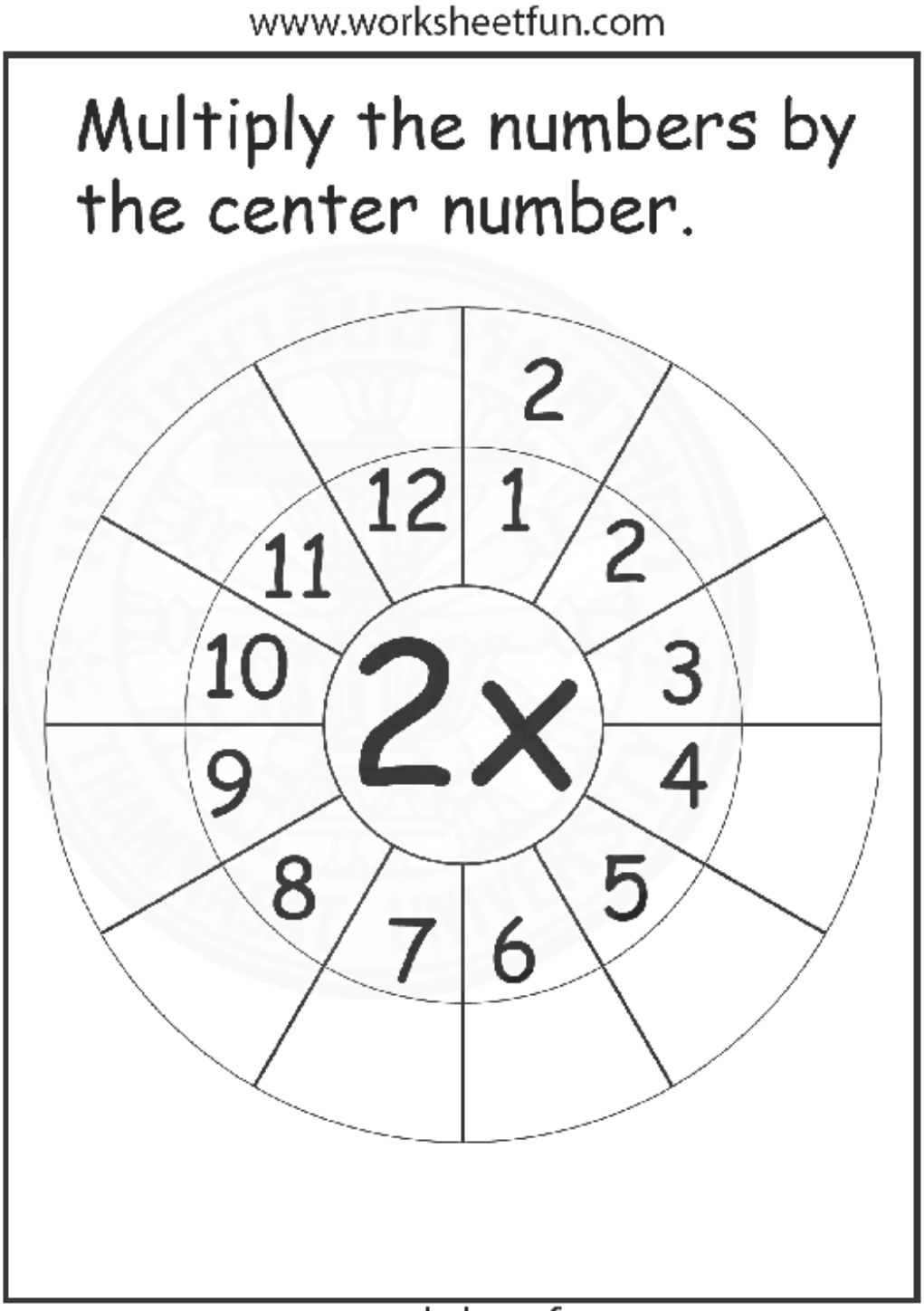
Simple Math Refreshing Exercise for Group 3 (Immediate Posttest)

www.worksheetfun.com



APPENDIX M

Simple Math Refreshing Exercise for Group 3 (Delayed Posttest)



APPENDIX N

Interview Questions

Part I: General Questions

1. What is your first name and last name?
2. Please reconfirm your English study section.
3. Where did you go to high school?
4. What do you do in your spare time?

Part II: Specific Questions

1. What do you think about the size of the presentation during the vocabulary presentation?
2. What do you think about the black and white background during the vocabulary presentation?
3. Do you think culture and experience play a part in learning a new word?
4. Would it be better to put extra information like the word's part of speech into the vocabulary presentation?
5. Did you use any other word learning strategies while watching the three vocabulary presentation?
6. How do you like the three vocabulary presentation and what do you think you want to add more to it?

APPENDIX O

ANOVA Results

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
ScoreT1	1. 0	22	7. 227	5. 0326	1. 0729	4. 996	9. 459	1. 0	18. 0
	2. 0	17	9. 118	5. 2545	1. 2744	6. 416	11. 819	1. 0	19. 0
	3. 0	19	9. 579	5. 7307	1. 3147	6. 817	12. 341	3. 0	22. 5
	Total	58	8. 552	5. 3457	. 7019	7. 146	9. 957	1. 0	22. 5
ScoreT2	1. 0	22	5. 364	3. 6586	. 7800	3. 742	6. 986	. 0	13. 0
	2. 0	17	6. 529	3. 5728	. 8665	4. 692	8. 366	1. 0	14. 0
	3. 0	19	8. 211	5. 6748	1. 3019	5. 475	10. 946	2. 0	23. 5
	Total	58	6. 638	4. 4876	. 5893	5. 458	7. 818	. 0	23. 5

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
ScoreT1	Between Groups	64. 085	2	32. 042	1. 126	. 332
	Within Groups	1564. 760	55	28. 450		
	Total	1628. 845	57			
ScoreT2	Between Groups	82. 912	2	41. 456	2. 141	. 127
	Within Groups	1064. 984	55	19. 363		
	Total	1147. 897	57			

APPENDIX O (Continued)

Multiple Comparisons

Dependent Variable		(I) SGroup	(J) SGroup	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
ScoreT1	LSD	1. 0	2. 0	-1. 8904	1. 7224	. 277	-5. 342	1. 561
			3. 0	-2. 3517	1. 6705	. 165	-5. 699	. 996
		2. 0	1. 0	1. 8904	1. 7224	. 277	-1. 561	5. 342
			3. 0	-. 4613	1. 7807	. 797	-4. 030	3. 107
		3. 0	1. 0	2. 3517	1. 6705	. 165	-. 996	5. 699
			2. 0	. 4613	1. 7807	. 797	-3. 107	4. 030
	Tamhane	1. 0	2. 0	-1. 8904	1. 6659	. 602	-6. 075	2. 294
			3. 0	-2. 3517	1. 6970	. 437	-6. 600	1. 896
		2. 0	1. 0	1. 8904	1. 6659	. 602	-2. 294	6. 075
			3. 0	-. 4613	1. 8310	. 992	-5. 059	4. 137
		3. 0	1. 0	2. 3517	1. 6970	. 437	-1. 896	6. 600
			2. 0	. 4613	1. 8310	. 992	-4. 137	5. 059
ScoreT2	LSD	1. 0	2. 0	-1. 1658	1. 4210	. 416	-4. 013	1. 682
			3. 0	-2. 8469*	1. 3781	. 044	-5. 609	-. 085
		2. 0	1. 0	1. 1658	1. 4210	. 416	-1. 682	4. 013
			3. 0	-1. 6811	1. 4691	. 257	-4. 625	1. 263
		3. 0	1. 0	2. 8469*	1. 3781	. 044	. 085	5. 609
			2. 0	1. 6811	1. 4691	. 257	-1. 263	4. 625
	Tamhane	1. 0	2. 0	-1. 1658	1. 1659	. 691	-4. 089	1. 758
			3. 0	-2. 8469	1. 5177	. 197	-6. 685	. 991
		2. 0	1. 0	1. 1658	1. 1659	. 691	-1. 758	4. 089
			3. 0	-1. 6811	1. 5639	. 643	-5. 630	2. 268
		3. 0	1. 0	2. 8469	1. 5177	. 197	-. 991	6. 685
			2. 0	1. 6811	1. 5639	. 643	-2. 268	5. 630

*The mean difference is significant at the 0. 05 level.

APPENDIX P

Paired T-test Results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	G1 Def1	7. 227	22	5. 0326	1. 0729
	G1 Def2	5. 364	22	3. 6586	. 7800
Pair 2	G2 Pic1	9. 118	17	5. 2545	1. 2744
	G2 Pic2	6. 529	17	3. 5728	. 8665
Pair 3	G3 DP1	9. 579	19	5. 7307	1. 3147
	G3 DP2	8. 211	19	5. 6748	1. 3019

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	G1 Def1 & G1 Def2	22	. 986	. 000
Pair 2	G2 Pic1 & G2 Pic2	17	. 952	. 000
Pair 3	G3 DP1 & G3 DP2	19	. 956	. 000

APPENDIX P (Continued)

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	G1 Def1 - G1 Def2	1. 8636	1. 5521	. 3309	1. 1755
Pair 2	G2 Pic1 - G2 Pic2	2. 5882	2. 1523	. 5220	1. 4816
Pair 3	G3 DP1 - G3 DP2	1. 3684	1. 6984	. 3896	. 5498

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	G1 Def1 - G1 Def2	2. 5518	5. 632	21	. 000
Pair 2	G2 Pic1 - G2 Pic2	3. 6948	4. 958	16	. 000
Pair 3	G3 DP1 - G3 DP2	2. 1870	3. 512	18	. 002

APPENDIX Q

Demographic Data

Statistics

		Group No	Sex	Age	Section	Faculty	ONET	GPA
N	Valid	58	58	54	54	54	54	54
	Missing	0	0	4	4	4	4	4

Statistics

		Reg/Voca	Eng_Yr	Expr	Int_EL171	ScrT	Screened
N	Valid	54	54	54	54	57	57
	Missing	4	4	4	4	1	1

Frequency Table

Group No

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1. 0	22	37. 9	37. 9	37. 9
	2. 0	17	29. 3	29. 3	67. 2
	3. 0	19	32. 8	32. 8	100. 0
	Total	58	100. 0	100. 0	

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1. 0	22	37. 9	37. 9	37. 9
	2. 0	36	62. 1	62. 1	100. 0
	Total	58	100. 0	100. 0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1. 0	41	70. 7	75. 9	75. 9
	2. 0	12	20. 7	22. 2	98. 1
	5. 0	1	1. 7	1. 9	100. 0
	Total	54	93. 1	100. 0	
Missing	System	4	6. 9		
Total		58	100. 0		

APPENDIX Q (Continued)

Section

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1. 0	10	17. 2	18. 5	18. 5
	2. 0	11	19. 0	20. 4	38. 9
	3. 0	17	29. 3	31. 5	70. 4
	4. 0	16	27. 6	29. 6	100. 0
	Total	54	93. 1	100. 0	
Missing	System	4	6. 9		
Total		58	100. 0		

Faculty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1. 0	5	8. 6	9. 3	9. 3
	2. 0	9	15. 5	16. 7	25. 9
	5. 0	2	3. 4	3. 7	29. 6
	6. 0	1	1. 7	1. 9	31. 5
	8. 0	1	1. 7	1. 9	33. 3
	9. 0	29	50. 0	53. 7	87. 0
	12. 0	2	3. 4	3. 7	90. 7
	17. 0	5	8. 6	9. 3	100. 0
	Total	54	93. 1	100. 0	
Missing	System	4	6. 9		
Total		58	100. 0		

BIOGRAPHY

Name	Vimolchaya Yanasugondha
Date of Birth	July 31, 1968
Educational Attainment	1992: Master of Arts, University of Kansas
	1989: Bachelor of Arts, Thammasat University
Work Position	Assistant Professor
	Language Institute, Thammasat University
Work Experiences	1992-2017:
	Lecturer
	Language Institute, Thammasat University