A Study of English Vocabulary Learning
Using the Dual Coding Theory

Vimolchaya Yanasugondha
Language Institute, Thammasat University, Thailand
vimolchaya@gmail.com

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) to 36 seven-letter English concrete nouns among 58 Thai EFL tertiary students who were at the beginning level. The investigation lookedat 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. 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 difference was found among the three groups.

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

Introduction

"Without grammar very little can be conveyed, without vocabulary, nothing can be conveyed" (Wilkins, 1972).

From the aforementioned quote, its shows that vocabulary is the most fundamental aspect for all language students, both native and non-native. Academically, it has been widely accepted that vocabulary knowledge is one of the keys to success in language learning. People with a greater number of known words receive greater benefits. However, the majority of Thai students learn English as a foreign language, implying that, for the most part, they are put in an English-poor environment, making it difficult, if not impossible, to develop full lexical repertoire as would normally be the case in such English-rich environments as those in the Outer- or Inner- Circles countries.

In accordance with the three-way categorization described in the previous section, Kachru divides World Englishes into three concentric circles, the **Inner Circle**, the **Outer Circle** and the **Expanding Circle**. The three circles 'represent the types of spread, the patterns of acquisition, and the functional allocation of English in diverse cultural contexts', as the language travelled from Britain, in the first diaspora to the 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). (Jenkins 2009, p. 18)

The paragraph below elaborated the above idea precisely and also concluded nicely the need for Thai students, especially low proficiency level, to be more equipped with more words.

> The model is based on geography and history rather than on the way speakers currently identify with and use English. Yet some English users in the Outer Circle speak it as their first language (occasionally as their *only* language). Meanwhile an increasing number of speakers in the Expanding Circle use English for a wide range of purposes, including social, with native speakers and even more frequently with other non-native speakers from both their own and different L1s, and both in their home country and abroad. (Jenkins 2009, p. 20)

Apparently, expanding English vocabulary among students who are in the Expanding Circle is a necessity rather than an option.

Background

One of the global factors that affects Thai students' English literacy relates to the aspect of English language diffusion across the world which is known as the English Circle concept. As it has always been an independent nation, Thailand adopted the EFL variation of English language teaching. In the English language education policy of the country, English is not mandatory in the curriculum. English language learning in the country is considered EFL where "English is not the usual language of communication" (Thornbury, 2006, p. 74).

As far as English education in Thailand is concerned, the Ministry of Education prioritizes not only English but also other foreign languages in the current curriculum. This might be one of the reasons why resources have not been allocated fully to the English subject. Stark evidence can be seen from the report of the Ministry of Education during 2013-2017. The summary of the report stated that the overall quality of education in the country had not been satisfactory. It can be said that since 2010 until 2013, the mean of ONET (Ordinary National Educational Test) English scores among Thai grade 12 students was under 50 percent. Figure 1 below shows the mean of ONET English scores among Matayom Six (Grade 12) students between the years 2011 and 2013.

Figure 1: ONET English Score 2011-2013 (www.niets.or.th)
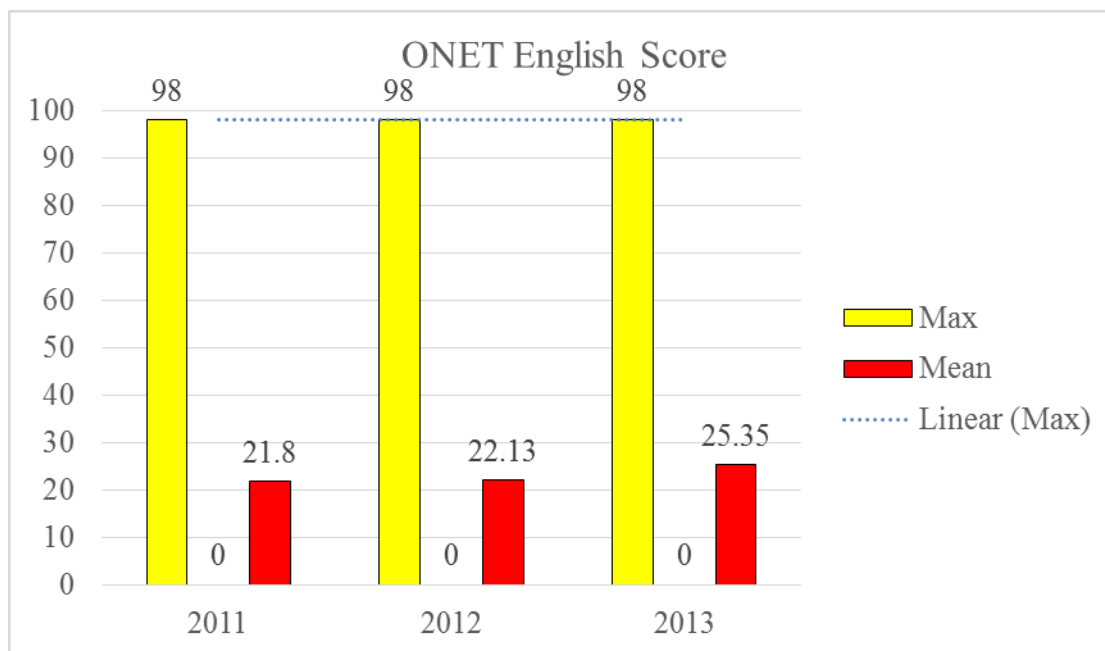
Digging deeper, the ONET English score proportion among students was not encouraging either. Out of 414,598 test takers in 2013, 167,012 or roughly 40 percent of students obtained scores between 10 and 20. Something clearly must be done to upgrade the English language proficiency of learners in Thailand.

In order to comply with the life-long learning principle as mandated by the Eleventh National and Economic Development Plan (2012-2016) and in light of the changing context of the ASEAN community in the region, a method of aiding learners to better learn English vocabulary as a core skill was highlighted. Low English proficiency means that scores among Thai students indicated that they have problem with English language learning.

Literature Review

A myriad of teaching techniques have been tested and implemented to help students of different proficiency levels learn English language better. Among these are ones developed based on the Dual Coding Theory (DCT). DCT was proposed by a Canadian psychologist from the University of Western Ontario named Allan UrhoPaivio during the 1970s. The theory takes issue with single coding theory, which maintains that during a learning session, one channel of either verbal or non-verbal is enough for the learning process and, more than that is considered an extra load for learners. In contrast, Paivio's DCT sees learning occurring through both verbal and non-verbal channels, and he strongly asserts that two are better than one in terms of memory aids. The table below summarizes the relationship between mental codes and sensory modes as suggested by the theorist himself.

Table 1: Orthogonal Relationship between Mental Codes and Mental Sensorimotor Modalities as Theorized by DCT (Sadoski & Paivio, 2013, p. 30)

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

While learning, students perceive learned items through both verbal and non-verbal channels. Within the context of this study, investigation was done within the realm of the visual sense where input refers to a written piece of language and non-verbal input refers to visual objects such as images. DCT proponents strongly believe that with the help of double-route input, students' memory is enhanced whether it be working memory or long-term memory.

The domain of memory is divided mainly into two areas which are working memory and long-term memory. The former, working memory, is a term coined to replace the word short-term memory whose meaning was obscure. The basic idea of working memory towards word recognition is elaborated below.

In their (Baddeley and Hitch's) 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.

(Grabe, 2012, pp. 33-34)

One very interesting fact about working memory is that about 98 percent of the information received would be discarded at this stage (while only the other two percent makes its way to long-term memory).

Long-term memory is very important for literacy since humans need to be able to retrieve what has been stored. Nation (2011, p.33) states that "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…" This means that long-term memory is a consolidation of working memory with subject matters one learned during the course of their life. The propertiesof long-term memory are described below.

> The storage of information in long-term memory—unlike in working memory—is 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. (Billbrough 2011, p. 5)

The above statement highlights the importance of repetition especially in terms of language learning. Zimmerman (2009, p. 9) indicates that "Word learning is incremental. In order for a new word to be retained, it must be repeated again (and again) before it is forgotten." She also maintains that "The importance of repetition of word learning is one thing that all vocabulary researchers agree on." Repetition in language learning is divided into two major types which are either spaced or mass. The former refers to the process of putting learners with words at intervals over an extended period of time while the latter referred to the process where learners meet heavily with words within a short amount of time. In second and foreign vocabulary research, the virtue of spaced repetition is conclusive. Nation (2011, p. 76) asserts that "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."

Research Questions
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?
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?

Research Design

Subjects

The subjects were 58 (22 males and 36 females) low proficiency level Thai EFL students from various disciplines studying at a government tertiary institute. All of them were in the remedial English course as stratified by the university upon admission. To be precise, the proficiency levels of students were determined by the national ONET English scores. Most of the participants were 19 years old. They were randomly assigned into three groups of 22, 17 and 19. The original number of participants were 49, 34 and 33 spreading over three groups. However, only those who watched the three presentations and sat for both the immediate and delayed posttests were left eligible for this study.

Research Instruments

Four instruments employed in this study. a delayed posttest.
1. The vocabulary screening test of 59 English words which acted like a pretest. However, it was not intended to quantify the knowledge learned before and after the word presentation. In fact, its purpose was to screen words that students were not familiar with. As a result, 36 out of 59 words were left to be put into the word presentation.
2. Three types of coding which were L2 ➲ L1 translation, pictorial, and simultaneous L2 ➲ L1 and pictorial. Each coding was done in the same fashion using the PowerPoint Program. As for the first coding (verbal only), students saw an English word above with its Thai definition below in one frame. As for the second coding (nonverbal only), students saw a picture instead of a Thai definition. And as for the third coding (both verbal and nonverbal), students saw both Thai definition and picture below its English word.

Examples of each coding.

L2 ➲ L1 translation

Pictorial

Simultaneous L2 ⊃ L1 and Pictorial

mittens

ถุงมือไม่มีนิ้ว

3. An immediate posttest was prescribed at the end of the third presentation. The test was done in a paper and pencil fashion. The purpose of this immediate posttest was to check for the recognition rate among students from different types of coding.

4. A delayed posttest was prescribed one month (four weeks) after the immediate posttest. The test was done in a paper and pencil fashion. The purpose of this delayed posttest was to check for the retention rate among students from different types of coding.

Data Collection

Students were asked at the initial stage to define or translate English words into Thai briefly. Only 36 words that were unable to be defined or translated by students were used for coding. Group 1 students received an L2 ⊃ L1 translation coding. Group 2 students received a pictorial coding and Group 3 students received a simultaneous L2 ⊃ L1 and pictorial coding. The coding was a presentation executed by the PowerPoint program. Each English word with its coding would appear on screen for five seconds. Thus, the presentation would last three minutes. Students watched the presentation at three spaced weeks. After the third presentation, the immediate posttest was administered. Four weeks after the immediate posttest, a delayed posttest was carried out. The test was in a paper-pencil fashion. For Groups 1 and 2, students got one point for each correctly matched item. For Group 3, students got half point for each correctly matched item (translation and picture) to prevent a surplus of scores. One-way ANOVA statistics was used to answer both research questions.

Findings and Discussion

Inferential statistics ANOVA 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)

Table 2: ANOVA Results for Immediate Posttest

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					

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

Table 3: ANOVA Results for Delayed Posttest

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					

Though inferential statistics ANOVA pinpointed no significant difference among the three types of coding during both the immediate and delayed posttests, while a 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 below. Had the number of subjects been greater, the results likely would have identified a true difference among the three groups. This supported the value of DCT as shown in several research studies examining multiple sensory effects in the field of foreign language learning (Sombatteerra and Kalyuga 2012; Jalilehvand 2011; Yoshii 2006; Kost, Foss and Lenzini 1999; Plass, Chun, Mayer and Leutner 1998; Mayer and Anderson 1991).

Table 4: Fisher's Least Significant Difference (LSD) Multi Comparisons Result

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

p< 0.5

In addition to the inferential statistics, descriptive statistics provided evidence for the power of DCT. Among the three groups, Group 3 students were able to both recognize and retain word meanings the most as shown in the table below.

Table 5: Descriptive Statistics Comparing Immediate and Delayed Scores

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

The percentage change affirmed that the deterioration rate among Group 3 students was the least among the three types of coding used in this study. Figure 2 below illustrates that change.

Figure 2: 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
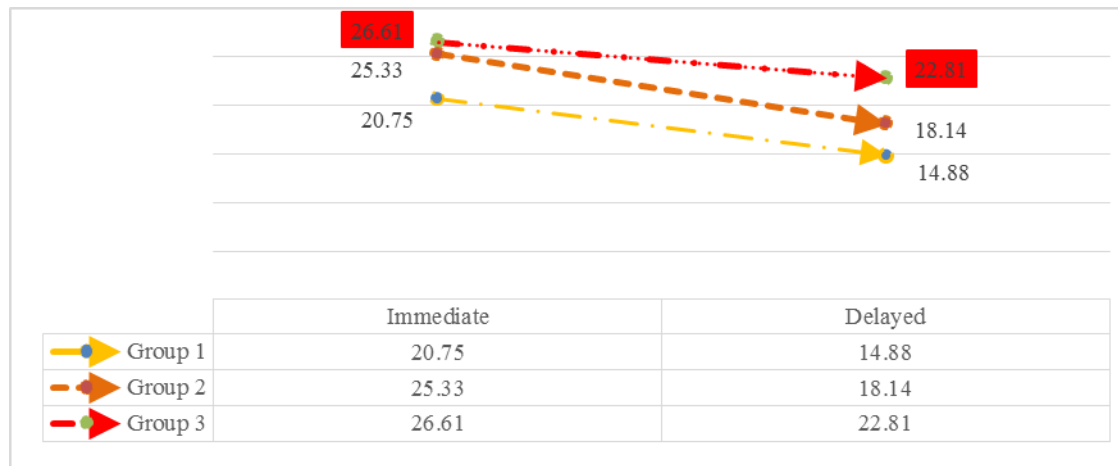
Recommendations and Conclusions

The recommendation concerning the future study would be the time reduction during word presentation to shorter than five seconds in order to see the feasibility of how far the power of DCT can go.

As for the conclusions, the results above suggests that giving minor information related to an L1 translation together with a picture in a non-contextual fashion aids students in learning a new word. The pedagogical implications for language teachers teaching English in Thailand is that spaced repetition of new words in conjunction with the coding of simultaneous L2 ⊃ L1 translation and pictorial coding can help low proficiency students recognize and retain the meaning of new words better than the other two types of coding administered over a period of more than a month. Read (2004, p. 41) confirms that "systematic learning of individual words can provide a good foundation of vocabulary development, especially in foreign language environments where learners have limited exposure to the language outside of the classroom." The virtue of DCT was also reinforced by Paivio (1990, p. 257), who states that "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." All in all, using the technique from this study to add new words into their repertoire, students are those who truly benefit from this English vocabulary learning research.

In sum, the essence of DCT in corporation with the concept of spaced repetition for at least three times among low EFL proficiency students at the tertiary level, at least, proved promising in both recognition and retention rates.

About the Author

Vimolchaya Yanasugondha is currently an assistant professor at the Language Institute, Thammasat University (LITU) in Bangkok/ Phathum Thani, Thailand. She obtained her Bachelor's degree in English and Literature from the Faculty of Liberal

Arts at Thammasat University, her Master's degree in Curriculum and Instruction majoring in Teaching English as a Second Language from the University of Kansas, and her Ph.D. in English Language Teaching from Thammasat University. Her fields of interest include English language teaching and vocabulary instruction.

References

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

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

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

Jenkins, J. *World Englishes: A resource book for students*. 2nd ed. Routledge English Language Introductions. London: Routledge, 2009.

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

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

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

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

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

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

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

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

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

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