

# The Development of Vocabulary Learning Model Based on the Cognitive Theory of Multimedia Learning (VCML)<sup>1</sup>

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### Abstract

In learning a language, vocabulary is one of the most significant factors, lying as a solid basis for learners; however, the complex system of human's cognitive processing works under many constraints. Meanwhile, the Cognitive Theory of Multimedia Learning has entered the mainstream as an effective tool for the memory manipulation, in order to promote better understanding and deeper understanding of a learning content. Hence, a development of vocabulary learning model, incorporating the Cognitive Theory of Multimedia Learning, is worthwhile to be researched in the present study. Qualitative data for the model development were obtained by semi-structured interview, with nine experts across three different fields, including English language instruction, instructional design, and human cognitive study. As a result of the study, the five key components of the model comprised (1) Input, referred to as instructional materials and activities characterized the conceptual features, (2) Instructional Process, designed as a sequence of three stages, including pre-stage, while-stage, and post-stage, respectively, (3) Evaluation, consisted of achievement tests, a delayed test, a test of transferred knowledge to use, and an opinion survey, (4) Output, categorized into two aspects, namely, a word-form and meaning learning achievement, and word use, and (5) Outcome, included vocabulary size expansion, long-term retention and opinion towards the application of VCML. Quantitative data were collected from an experiment, carrying out to investigate the effects of the model application. The results indicated a significant higher level of the score on learners' achievement and retention ( $p=0.01$ ).

**Keywords:** Learning model development, Vocabulary learning, Cognitive Theory of Multimedia Learning

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### บทคัดย่อ

การเรียนรู้คำศัพท์เป็นรากฐานและองค์ประกอบที่สำคัญในการเรียนรู้ภาษา แต่กระบวนการเรียนรู้คำศัพท์ของมนุษย์มีความซับซ้อนเนื่องจากกลไกในการจำมีข้อจำกัดหลายด้าน ในขณะที่เดียวกันการประยุกต์ใช้มีลัดดีมีเดียได้เริ่มเข้ามามีบทบาทต่อผู้เรียนในยุคปัจจุบันเพื่อเสริมสร้างกระบวนการเรียนรู้เชิงพุทธิปัญญาของผู้เรียน โดยเน้นให้ผู้เรียนเข้าใจเนื้อหาที่เรียนได้ดีขึ้นและลึกซึ้งมากขึ้น งานวิจัยนี้จึงได้บูรณาการทฤษฎีการเรียนรู้โดยใช้มีลัดดีมีเดียที่เน้นส่งเสริมความจำ ผสมกับการเรียนรู้คำศัพท์ เป็นรูปแบบผสมผสาน ข้อมูลเชิงคุณภาพมาจากการสัมภาษณ์เชิงโครงสร้างกับผู้ทรงคุณวุฒิจำนวน 9 ท่าน จากสาขาการสอนภาษาอังกฤษ การออกแบบการสอน และด้านพุทธิปัญญา ผลการวิเคราะห์ข้อมูลได้รูปแบบการเรียนรู้ที่มีองค์ประกอบดังนี้ (1) ข้อมูลนำเข้า มีลักษณะเป็นสื่อตามหลักการการเรียนรู้โดยใช้มีลัดดีมีเดีย (2) กระบวนการเรียนรู้มี 3 ขั้นตอน คือ ขั้นเตรียมความพร้อม ขั้นระหว่างเรียน และขั้นหลังเรียน (3) การประเมินผล ประกอบด้วย การทดสอบวัดผลสัมฤทธิ์การเรียนรู้ การทดสอบวัดความคงทนในการจำ การทำสอบวัดการนำคำศัพท์ไปใช้งาน และการสำรวจความคิดเห็นในการใช้งานรูปแบบการเรียนรู้ VCML (4) ผลผลิต ประกอบด้วยผลสัมฤทธิ์ 2 ด้าน คือ ผลสัมฤทธิ์ในการรู้ความหมายของคำศัพท์ และการนำคำศัพท์ไปใช้งาน และ (5) ผลลัพธ์ประกอบด้วย การขยายขนาดวงคำศัพท์ ความคงทนในการจำ และความคิดเห็นที่มีต่อการใช้งานรูปแบบการเรียนรู้ VCML ในส่วนข้อมูลเชิงปริมาณได้มาจากการทดลองรูปแบบการเรียนรู้ ผลการวิจัยแสดงให้เห็นว่าผู้เรียนมีผลสัมฤทธิ์การเรียนรู้ ความคงทนในการจำสูงขึ้นอย่างมีนัยสำคัญ ( $p=0.01$ )

**คำสำคัญ:** การพัฒนารูปแบบการเรียนรู้ การเรียนรู้คำศัพท์ ทฤษฎีการเรียนรู้โดยใช้มีลัดดีมีเดีย

### Introduction

It is obvious that vocabulary learning plays an important role in language pedagogy, especially for the second language acquisition (L2) (Saengpakdeejit, 2014). Side by side, it turns to be one of the priorities that requires particular attention from all parties in L2 instructional area. As a part of this phenomenon, lexical competence is arisen as a key of language components since it is the main carrier of information and concepts through communication (Hammer, 1993). In daily life communication, unpredictable messages always occur at real time, in which an individual is required to use his or her utmost ability to interconnect the language skills of listening, speaking, reading and writing to overcome their goals of communication. Underneath the success of the communication, it lies heavily on the word level knowledge (Kim, 2008). This is because vocabulary is considered as the basis and the bridge interweave those elements within a language. As quoted in Hammer (1993, p. 153), "if language structures build up the skeleton of language, then it is vocabulary that provides the vital organs and the flesh". Without adequate knowledge of the words, it is impossible for learners to understand and produce the messages. Limited vocabulary size can lead to insufficient knowledge that consequently cause difficulties in second language acquisition (Asgari & Mustapha, 2011). Therefore, a sizable vocabulary is needed for L2 learners toward the ability of language use (Nunan, 1999).

However, to attain the sizeable vocabulary at a certain level to achieve the ability of language production is not an easy task. Vocabulary learning is one of the most difficult and



complicated activities for L2 learners (Liu, 1995) since it deals a lot with human cognitive systems. To elaborate, the cognitive process of the word input is interwoven in a complex mechanism, from receiving to remembering the information in the memory. When it is about the time to retrieve a word, an activation of the words takes place, which means the individual can get across the messages appeared in their communication. Nation (2001) added that the process of learning new words seems to be as “a learning burden” that occurs when an individual approaches new words in different cultural as well as educational contexts, and he or she attempts to negotiate the meaning of the word according to his or her prior background and individual learning style. This sort of burden is the amount of mental effort for a L2 learner to acquire a word's meaning. It is a very tough task dealing with these complicated process of information in human cognitive system, with the restriction that the information shortly decays unless retrievals are made within appropriate time intervals.

### **Cognitive Theory of Multimedia Learning**

A theoretical concept of The Cognitive Theory of Multimedia Learning (Mayer, 2005, 2009) underlines three main concepts which include dual coding theory (Paivio, 1986), cognitive load (Sweller, 1988), and active learning process (Nation, 2001). The Cognitive Theory of Multimedia Learning (CTML) was initiated on the belief that people learn better and deeper from words and pictures than from the words alone. More specifically, learning from multimedia of word presentation occurs when the individual constructs his or her mental representations of the lexicon from words and pictures simultaneously. The words can be heard as spoken units or seen as printed texts and pictures such as illustrations, photos, videos, and so on. Date back to the pioneer idea, the first concept of the multimedia learning theory was originally brought in from Dual Coding Theory (Paivio, 1986), describing work of two sensory information receptors through verbal and imagery channels. The two channels work separately to create each own representation. Then, at the referential level, the representation will be activated on those in the other system. The information will finally be integrated for a meaning interpretation.

The second concept on cognitive load grew from working memory model proposed by Baddeley and Hitch (1974). The structure of working memory has a very limited capacity to store incoming data before transferring to the long-term memory. Heavy cognitive load can lead to a major hindrance of learning. To avoid the cognitive load, learning conditions must be aligned with human cognitive structure (Sweller, 1988). Within subcomponents in working memory, not only they temporarily hold information in separate storages of verbal and visual information, but also simultaneously manipulate and integrate the information from both storages to make sense of the information.



According to the first and the second concepts, the core idea revolves around the initial gates of information processing. The last concept combined all the concepts into active cognitive learning processing, which focuses on the management of the whole information processing from the beginning to the end at the long term memory. It can be referred as meaningful learning process that only occurs when a learner engages in learning conditions that best promote his or her learning capability (Mayer, 2008). It includes the following processing:

1. Reducing extraneous processing (Sensory memory):

1.1. Selecting relevant words for processing in verbal working memory

1.2. Selecting relevant images for processing in visual working memory

2. Managing essential processing (Working memory):

2.1. Organizing selected words into a verbal model

2.2. Organizing selected images into a pictorial model

3. Fostering generative processing (Integration between working memory and long term memory)

3.1. Integrating the verbal and pictorial representations with prior knowledge.

Alongside, Mayer (2008) proposed several researched-based principles for instructional designers in shaping and organizing multimedia presentation for pedagogical purposes. The principles are based on the three categories of active cognitive processing: (1) reducing extraneous processing, including Coherence principle, Signaling principle, Redundancy principle, Spatial Contiguity principle, Temporal principle, (2) managing essential processing, including Segmenting principle, Modality principle, Pre-training principle, and (3) fostering generative processing, including Multimedia principle, Personalization principle, and Voice principle, for instance. The application of the principles yields advantages for designing multimedia materials, in terms of reducing learners' cognitive load (smaller amount of relevant information to process at one time), manage the information (simpler transformed version of information), and (3) fostering generative processing (deeper interconnection between new incoming information and prior knowledge).

### **Vocabulary Learning**

Vocabulary knowledge is the matter of gradual accumulation by time and by rich exposures in various contexts. The words can also be easily diminished in a very short time without rehearsals or without appropriate learning settings (Nation, 2001). There are many influential factors affect the word memory, for example, frequency of exposures, and the time intervals between the first to the next encounters, word input presentation, word internalization process, attention, motivation, etc. All the above factors must be taken into consideration for a pedagogical design.

As apparently seen in Thailand, there are many challenges in teaching and learning English language. Foremost amongst those, are the challenges which revolve around vocabulary. Although vocabulary is very vital in building up the foundation of English learning, surprisingly, vocabulary learning appears to be critical for most Thai learners. According to the result of the investigation of the problems occurring in learning English from a previous study, the main obstacle was discovered as the learners' inadequate vocabulary knowledge (Supatranont, 2005). This is due to the fact that Thai learners have little opportunity to appropriately build up on their vocabulary repertoire. Furthermore, In Thai university curriculums, there is no particular course that is designed for vocabulary learning or even no explicit guide on how to integrate vocabulary with the course contents (Tassana-ngam, 2004). Therefore, it is necessary to design a learning model that best goes with the vocabulary size development of Thai learners. Thus, vocabulary learning model based on the cognitive theory of multimedia learning is one of the alternatives.

To pave the ground of vocabulary learning process, theoretically, Nation (2001) has proposed psychological conditions for vocabulary learning in form of three consecutive processes including, (1) noticing process, (2) retrieval process, and (3) generative use process. Those processes provide guidelines with steps of learning from word recognition level (familiarity with the words when some clues are given), word recall level (word retrievals without or less clues given) and generative use level (retrieval and integration of the information). Of note, the processes overlap with the multimedia learning processing, reassuring that the cognitive learning process is scientifically proved. Thus, settings of learning conditions that are designed in coherent with the process is ultimately substantial. When turning the learning process into a classroom, the strands are something that can't be overlooked. Nation (2007) also recommends the combination of 4 essential strands of language learning at an equal amount of time allocation, comprising (1) meaning focused input, (2) meaning focused output, (3) language focused learning, and (4) fluency development. The construction of a unit of vocabulary instruction is required the interactive integration of those learning elements.

Embedded with the key theoretical concepts mentioned above, the conceptual framework of the present study was constituted as illustrated in figure 1.

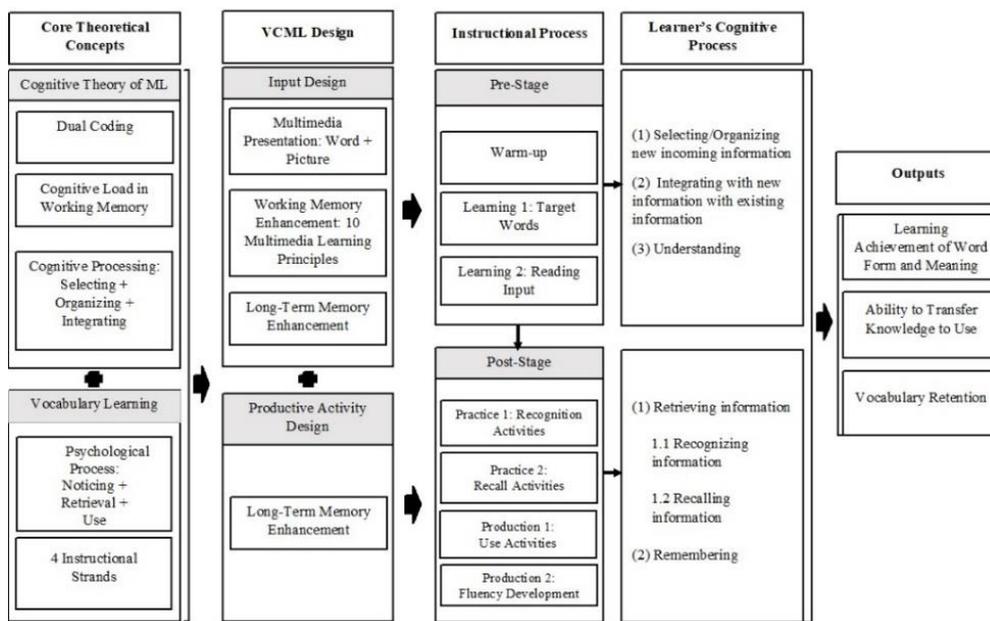


Figure 1 Conceptual Framework of the Study

### Objectives of the Study

1. To develop the vocabulary learning model based on the Cognitive Theory of Multimedia Learning for vocabulary size enhancement
2. To investigate the effects of the vocabulary learning model based on the Cognitive Theory of Multimedia Learning on EFL learners' achievement, and retention

### Research Hypothesis

1. The Vocabulary Learning Model based on the Cognitive Theory of Multimedia Learning can enlarge the number of vocabulary in the learners' corpus after the experiment.
2. The learners have better learning achievement, and get long-term retention of the vocabulary knowledge after the experiment of VCML.

### Research Methodology

The research design was Mixed Methods. The research conduct contained two main phases including phase I: development of Vocabulary Learning Model Based on the Cognitive Theory of Multimedia Learning (VCML), and phase II: the experiment of the VCML.

In phase I, the purposive samples for qualitative data collection included nine experts from related fields, with the purpose to develop the vocabulary learning model. The comments and feedbacks from the experts were gathered to create the final version of VCML.

In phase II, the purposive samples included twenty five freshmen as an intact class from Business English Department, Faculty of Humanities and Social Sciences, Muban Chombueng Rajabhat University with the purpose to experiment the VCML and to investigate its effectiveness towards the learners' vocabulary achievement and retention. The quantitative data were obtained as the results of the study.

Details of the research methodology in each phase can be described as follows:

#### **Phase 1: The development of VCML**

*Purposive sampling in phase 1* drew on nine experts across three different fields, including English Instruction, Instructional Design, and Human Cognitive Study. As the present study was interdisciplinary. Insightful knowledge earned from key domain scholars was of paramount importance to triangulate data in constructing VCML, particularly when the questions taps into their areas.

*The research instrument in phase 1*, consisted of three sets of semi-structured interview with three groups of experts according to their fields. IOC (index of congruence) was used to validate the tool by three raters, with the IOC score result of 1.0 in all those sets. Additional comments were given to adjust some questions on clarity. The interview questions were structured to investigate data, derived from five key proposed components of the model, which included (1) materials preparation component, (2) learning process component, (3) practicing process component, and (4) assessment process component, with additional the (5) for overall model.

*Procedure and Data Collection in phase 1:* In order to develop an instructional design, Alessi and Trollips' instructional design model (Alessi & Trollip, 2001) was used in the study as the process for development of VCML. It was a model for multimedia instructional designers, consisting of three main stages, namely planning, design, and development.

##### Stage 1: Planning

The ultimate goal of stage 1 was to propose a tentative model with its own distinctive characteristics. The process can be illustrated as in figure 2.

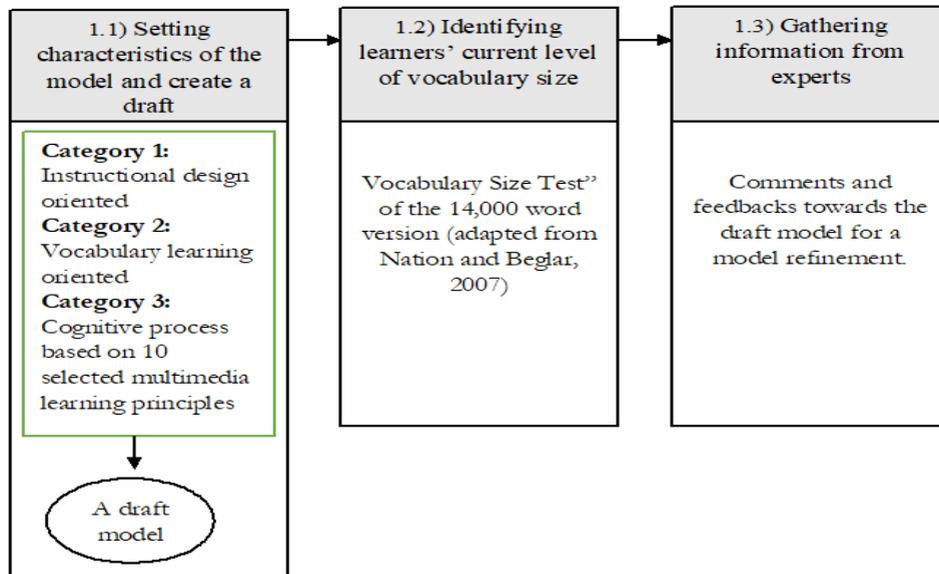


Figure 2 VCML Planning Process

1.1. Setting of characteristics of the model and create a draft model: theoretical data were firstly compiled from related literature reviews. The scopes of the reviews related to instructional design, vocabulary learning, and cognitive process based on ten selected multimedia learning principles. The final synthesized characteristics were set out in the following categories:

Category 1: Instructional design oriented: inclusion of key instructional components reflecting multimedia input, instructional process, and output

Category 2: Vocabulary learning oriented: inclusion of the process of noticing, retrieval, and generative use, together with the 4 strands of meaning focused input, language focused learning, meaning focused output, and fluency development

Category 3: Cognitive process based on 10 selected multimedia learning principles: inclusion of reducing extraneous processing - (1) Coherence principle, (2) Signaling principle, (3) Redundancy principle, (4) Spatial Contiguity principle, and (5) Temporal principle; managing essential processing - (6) Segmenting principle, (7) Pre-training principle; and fostering generative processing, (8) Multimedia principle, (9) Personalization principle, and (10) Voice principle. All the principles work on its own functions.

1.2. Identifying the learners' current level of vocabulary size: A vocabulary size test was conducted to a homogenous group of the sample learners on their vocabulary size. In this regard, the International Standardized Test called "Vocabulary Size Test" of the 14,000 word version, designed in MC format, developed by Nation and Beglar (2007) was adapted. The result indicated the average current level of the homogenous group of the sample learners as of 2,032 words, out

of 2,800 in total of New General Service List of high frequency vocabulary words (Browne, 2013). The result showed the estimated coverage of a reading text for comprehension around 90.34% according the threshold proposed by Nation (2006). According to him, the empirical evidence from a number of previous studies indicated that the lexical coverage for sizeable vocabulary can range between 95%, 98% up to the ideal of 100%. That means the learners still required more vocabulary for their safe zone.

1.3. Gathering information for the experts: semi-structure interview was used as the tool. In the interview process, the tentative model was proposed to the expert group of the 9 experts (3 from each domain) by using semi-structured interview. Guided questions were investigated to elicit comments and feedbacks regarding the tentative model. Data were analyzed by using content analysis.

Stage 2 Design

The main activities in stage 2 aimed at refining and evaluating the final model. There were three processes in stage 2 as illustrated in figure 3.

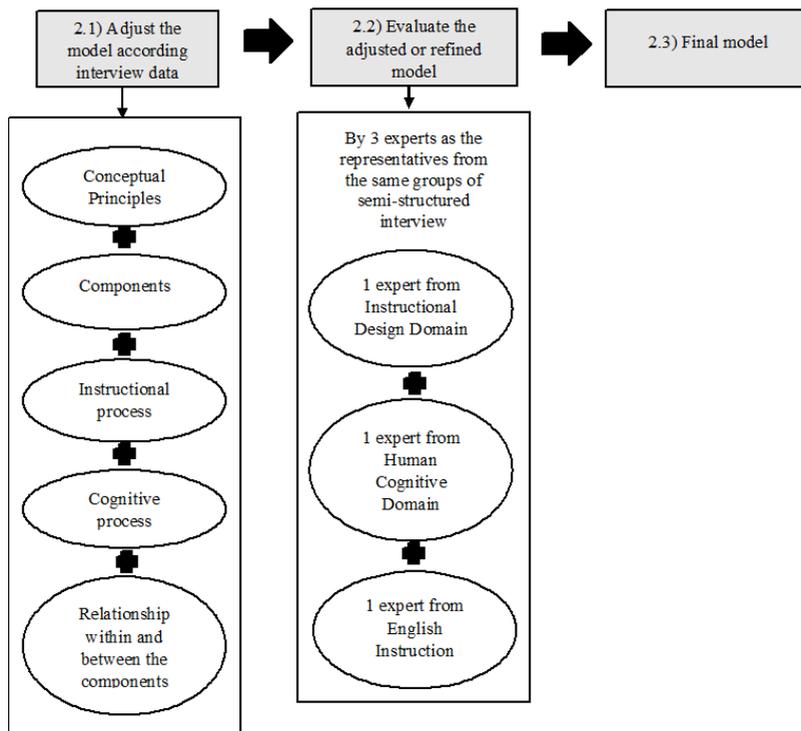


Figure 3 VCML Design Process

2.1. Adjusting the model according to the interview data: the results from semi-structured interview were schematized and categorized for the model refinement. Schematized codes from data arisen were grouped into five categories including conceptual principles, components, instructional process, cognitive process and relationship within and between the components. The refinement were performed accordingly.

2.2. Evaluating the refined model: the refined model was again proposed to three experts from the same group of participants in semi-structured interview, (one representative from each domain) for an evaluation on its appropriateness and practicality. To assure the appropriateness of the model design, the evaluation form was validated by using IOC form. The result from experts' agreement proved the appropriateness and practicality of the VCML that was ready for a try out.

2.3 Finalizing the model: after the evaluation, some comments and feedbacks were adjusted to form the final model. The final model was presented in figure 4.

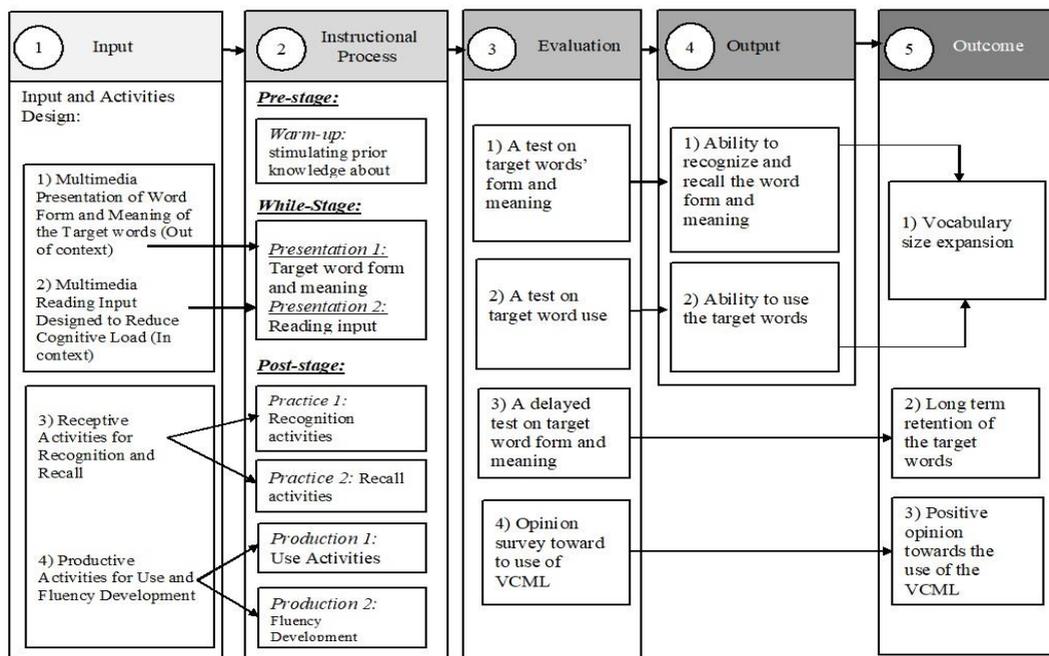


Figure 4 VCML final model

The components of the model mainly includes Input, Instructional Process, Evaluation, Output and Outcome, which will be discussed more in the findings of the study.

#### Stage 3 Development of multimedia materials

After the model was finalized and evaluated, multimedia materials were developed and aligned with the model as listed out in the following process:

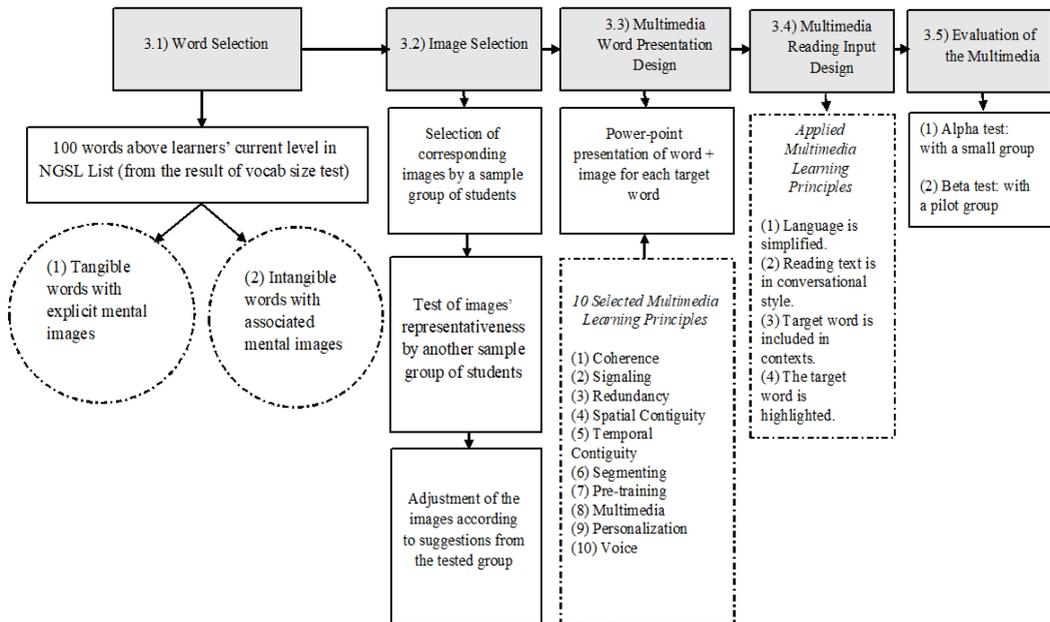


Figure 5 Multimedia Material Development process

3.1. Word Selection: based on their result of vocabulary size test, 100 word representatives were selected from the above level of their average current level in NGSL list. The selection of words was basically considered from the concreteness of the potential images towards the degree or extent they can represent the word meaning. Tangible were the first choices. Intangible were selected after the tangible word list in the category ran out.

3.2. Image Selection: the processes started from firstly to select corresponding images, and secondly to test the image representativeness to the word's meaning with a small group, and finally to adjust the images until they are clear enough to be the representation of the word's meaning.

3.3 Multimedia Word Presentation Design: based on ten selected multimedia learning principles to characterize multimedia, they consisted of ten principles including (1) Coherent, (2) Signaling, (3) Redundancy, (4) Spatial Contiguity, (5) Temporal, (6) Segmenting, (7) Pre-training, (8) Multimedia, (9) Personalization, and (10) Voice.

For more details about the aforementioned principles which functioned in reducing extraneous processing, managing essential processing, and fostering generative processing, the multimedia presentation of the words were coherently designed.

In terms of reducing extraneous processing, extraneous materials were excluded (Coherent principle), cues that highlight the essential material were added (Signaling principle),

only graphics and narration presented, excluding unnecessary printed text (Redundancy principle), corresponding words and pictures were placed near each other rather than far (Spatial Contiguity principle), and corresponding words and pictures were presented at the same time rather than in succession (Temporal Contiguity principle).

In terms of managing essential processing – the information was segmented into small chunks (Segmenting principle), and key terms needs to be presented beforehand (Pre-training principle).

In terms of fostering generative processing, the presentation was designed in form of word and image together (Multimedia principle), and it was presented with natural human voice (Voice principle). For Personalization principle, it was included in reading input design.

After the multimedia have been designed, they were validated again by three experts. A sample of multimedia presentation of a target words can be illustrated in figure 6.



Figure 6 A Sample of Multimedia Presentation of a Target Word

3.4 Multimedia Reading Input Design: the reading input was designed in form of a dialogue story with illustrations. The story length was limited to 8-10 pages. One story was created for one lesson, containing 10 target word diffused in the story narration. The main characteristics of the reading input was shaped by the theoretical framework as follows: (1) the language is simplified with illustrations (Multimedia principle), (2) the text was in a conversational style (Personalization principle), (3) the target words were highlighted (Signaling principle), and (4) the target words were included in contexts (meaning focused input). The purpose of the reading input was to provide an opportunity for learners to learn the recurrent target words in meaningful and larger context. The reading inputs were validated by three experts. A sample of multimedia reading input was illustrated in figure 7.

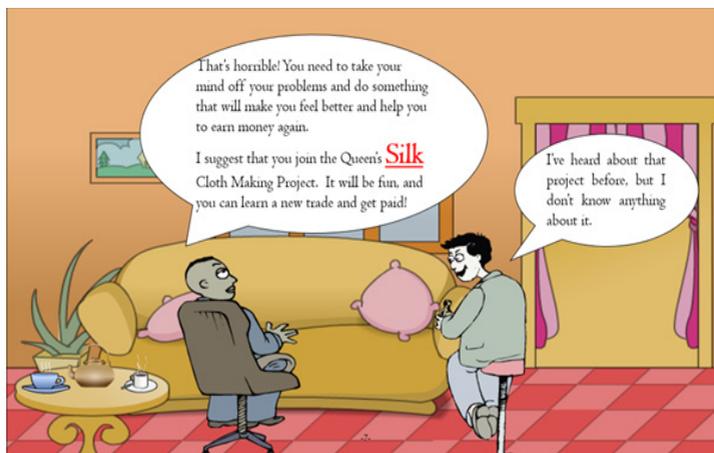


Figure 7 A Sample of Multimedia Reading Input

3.5 Evaluation of the multimedia materials: Tests were conducted to ensure the quality of the multimedia materials.

(1) Beta test with a small group: testing the representativeness and the clarity of the developed multimedia for the target words: a small group of 10 students were presented with the multimedia. Comments from the group were mainly on the adjustment of font sizes and the positions of the images or dialogues for a better vision.

(2) Alpha test with a pilot group: it was a conduct of a pilot study with a homogenous class of 30 freshmen students from English Education program, Faculty of Education, Muban Chombueng Rajabhat University. Further comments made on the requirement of oral explanation supplemented while some intangible words were presenting or whenever the presentation couldn't establish a crystal clear representation of the words in individuals' mental image.

#### Phase 2: Experiment of the VCML

In the experiment of VCML phase, the focus was to collect quantitative data to answer the research questions.

*The experiment of VCML:* the research implementation of the VCML was conducted in phase 2. It was one group pretest-posttest design. Samples of 25 freshmen from Business English Department, Faculty of Humanities and Social Sciences, Muban Chombueng Rajabhat University, were chosen as an intact class of the study. All of those were enrolled in the course called "English Vocabulary Development for Communication". The course was an elective course of 3 credits in Business English Curriculum. It was designed for new comers with the aim at building up an ample vocabulary size when they first roll out their academic journey. The course was suggested to be enrolled in the first semester of the first year.



*Research instruments in phase 2:* the instruments in phase 2 basically comprised the materials used for instruction and data collection.

(1) Lesson plans: All 10 lessons were set out in a same sequence of the pedagogy, beginning from pre-stage: the teacher stimulated the students' prior knowledge of the target words by using the images, while-stage: the teacher demonstrated the target words in form of written words and the image representations, and reading input (in PowerPoint multimedia). The teacher might give some spoken explanation as necessary, post-stage: students experienced several repetitions of the target words by provided activities, focused on word form and meaning memorization, and also using the target words in various contexts. The lesson plan was validated by three experts and the pilot study.

(2) Handouts: Together with the PowerPoint multimedia presentations of the target words on a projector, a handout of a lesson was the instructional material used in the class as a course book. It included the activities in pre-stage (stimulating prior knowledge), while-stage (teaching), and post-stage (practicing and producing). Validation of the handout was performed by three experts and the pilot study.

(3) Pretest, immediate posttest, delayed test: All of the tests was in an identical copy. Test objective was to investigate the ability to recognize and recall the word form and meaning as an achievement test. There were 100 items in the test paper in multiple choice format (5 choices). The test taker was required to choose the best answer that could properly described the meaning of the tested word appeared in a context without any guessing clues. Choice 5 was unknown, additionally provided for those who didn't really know the answer from the four choices, in order to avoid a selection from guessing. One score was for one correct answer. The test was validated by three experts and the pilot study.

*Procedure and Data Collection in phase 2:* the experiment was carried out for 16 weeks long. One lesson for each week lasted for one hour and a half. The first week was preserved for the course introduction and pre-test, followed by 10 more weeks for the implementation of VCM. A cloze test was administered after each lesson, and the immediate post-test was in the week after the course completion. After that, the delayed-posttest was undergone for the period of 2 weeks or 14 days interval after the posttest. The summary can be presented as in table 1.

Table 1 Data Collection in the Experiment Phase

Timeline	Data Collection Sequence
Week 1	Course Introduction & Pretest
Week 2	Lesson 1 + Cloze test of lesson 1
Week 3	Lesson 2 + Cloze test of lesson 2
Week 4	Lesson 3 + Cloze test of lesson 3
Week 5	Lesson 4 + Cloze test of lesson 4
Week 6	Lesson 5 + Cloze test of lesson 5
Week 7	Lesson 6 + Cloze test of lesson 6
Week 8	Lesson 7 + Cloze test of lesson 7
Week 9	Lesson 8 + Cloze test of lesson 8
Week 10	Lesson 9 + Cloze test of lesson 9
Week 11	Lesson 10 + Cloze test of lesson 10
Week 12	Immediate Posttest/ Questionnaire
Week 13	-
Week 14	-
Week 15	Delayed Posttest
Week 16	Focus Group Interview

*Data Analysis in Phase 2:*

The statistics used in the present study included Mean, S.D., and Wilcoxon Sign Rank test.

**Research Findings**

1. The findings of the research objective 1 to develop the vocabulary learning model based on the Cognitive Theory of Multimedia Learning for vocabulary size enhancement:

According to the data arisen from the analysis of the semi-structured interview of the nine experts in phase I, based on the tentative model and the conceptual framework of the study, the data could be grouped into 5 categories: Conceptual Principles, Components of the Model, Instructional Process, and Cognitive Process.

*Conceptual principles of VCML:* the principles of VCML should radiate more on its own outstanding uniqueness and identity, and be well balanced and interconnected in line with the



basis of its theoretical concepts. An excerpt extracted from some of the experts' responses was as follows.

Expert 1 from English Instruction Domain: "To me, I think an instructional model should reflect a clearer capture on its own outstanding structure. At the same time, in some degree, it should reflect the roots of its origin, but that is in a new way."

*Components of VCML:* the components of VCML should cover all the elements of an instructional model containing input, process, output, and outcomes of the model, to ensure appropriate flow of the model from the start to the end. The model should be cultivated from real needs of a particular group with a particular purpose to serve the desire. Needs analysis, in other words, Front-End analysis should be conducted at the beginning of the study, so as to pave the ground of the design. In designing the diagram or illustration of the model, it could be flexible, but still maintain the clarity, conciseness, and interpretability of the model. Additionally, the whole process should be well organized. Sub-layers could be added if the model tended to be more complicated in a single layer, especially the key words that were important to be clearly defined. An excerpt elicited from the experts' responses was as follows.

Expert 1 from Instructional Design Domain: "The process of an instructional design should be constructed in a systematic sequence, starting from Needs analysis or Front-End analysis, followed by input design, process organization, and output and outcome setting. There are no rigid patterns or rules to design a chart or symbols in representing the model. To create those things, my advice was to take consideration on how clearly and easily it can convey the meaning."

*Instructional process of VCML:* Through English instruction perspectives, the instructional model should be viewed more like an instructional process guideline that clearly and simply labelled and easy to follow. In addition, VCML should provide more activities on vocabulary use and offer more repetitions to help students memorize the target words. Some excerpts found from the experts' responses were as follows.

Expert 2 from English Instruction Domain: "As long as the model is easy to follow, the users would know how to implement it properly. The core idea is just to draw the process that is understandable and practical."

Expert 3 from English Instruction Domain: "My suggestion is to focus more on vocabulary use. Also, not only learning the word meaning in isolation, the vocabulary should come with meaningful context for learning. Repetitions are very important too. It's better if the learners experience many exposures of the target words."

*Cognitive Process of VCML:* VCML should be designed in coherent with the structure and system of human memory processing which includes sensory memory, working memory, and long-term memory. While information first entering to the gate in sensory memory, attention is the

key due to the very quick process. Only the information that have been attended will be selected and passed on to working memory. The idea implies that VCML should take the golden opportunity of the first few seconds of incoming information to draw on the students' attention. The target information should be highlighted and extraneous information should be excluded. In working memory, it has very limited the capacity as called the store of magical number 7. Therefore, the information in a VCML materials should not be added more than 7 chunks, plus or minus two to process in one time. To enhance long term memory, the words should be created or attached with stories or events relating to students' backgrounds. That information activation with events would help strengthen the memory in long-term memory. Images used in the multimedia design were suggested to be clear to represent the target words meaning. Some excerpts discovered from the experts' responses were as follows.

Expert 1 from Human Cognitive Study Domain: "My recommendation goes onto the attention of learners for incoming information. The process is very quick. Their eyes' positions should be encouraged to fix or attend on the target information. Also, the numbers of information in a presentation should not more than 7 chunks, plus or minus two."

Expert 2 from Human Cognitive Study Domain: "There should be some process allowing students to use the words in context that can be connected with events. It would help a learner to process information deeper in the long term memory."

From the information given through comments and feedbacks by experts from all key domains, together with the literature that had been reviewed on theoretical concepts. The synthesis of information showed that all the information was consistent and interconnected. The final version of VCML model was eventually proposed.

As resulted, VCML consisted of 5 main components as follows:

1.1. Input includes: sub-components were as follows:

(1) Multimedia presentation of word form and meaning, manifested in the following characteristics:

- Extraneous words, pictures and sounds are excluded (Coherence).
- The target words are highlighted (Signaling).
- Graphics and narration come together (Redundancy).
- Corresponding words and pictures are presented nearby and together (Spatial Contiguity).
- Corresponding words and pictures are presented simultaneously (Temporal Contiguity).
- Words come with pictures (Multimedia).
- Narration in multimedia lessons is spoken in a friendly human voice (Voice).
- Multimedia lesson is started with key terms (Pre-training).
- Multimedia lesson is segmented (Segmenting).



(2) Multimedia reading input, manifested in the following characteristics:

- Language is simplified (Coherence).
- Reading text is in a conversational style (Personalization).
- Target words are included in contexts (Meaning focused input).
- Target words are highlighted (Signaling).

(3) Receptive activities, manifested in the following characteristics:

- Language structure is not focused (Fluency development).
- Several encounters of the words both in and out of contexts (Fostering Generative Processing).

(4) Productive activities, manifested in the following characteristics:

- Opportunity in producing the words (Meaning focused output).
- Little attempt to use the target words (Fluency development).
- Little unfamiliar words appeared in the tasks (Fluency development).
- Addition of some degree of pressure for learners to perform the tasks faster (Fluency development).

1.2. Instructional process: the sequence was listed out as follows:

1.2.1. Pre-stage: warm-up to activate prior knowledge,

1.2.2. While-Stage: multimedia presentation of the word, and multimedia reading input

1.2.3. Post-Stage: (1) practice 1 at recognition level referred as data familiarity,

(2) practice 2 at recall level referred as data retrieval, (3) production 1 at integration level referred as data use, and (4) production 2 at a more advanced or deeper integration level referred as fluency development of data use

1.3. Evaluation included (1) pretest and posttest as an achievement test, (2) cloze test to evaluate use ability, (3) delayed test to evaluate retention, and (4) opinion survey.

1.4. Output included (1) ability to recognize and recall the target words' form and meaning, and (2) ability to use the target words

1.5. Outcome included (1) vocabulary size expansion, and (2) long term retention, positive opinion towards VCML.

To conclude, the components of VCML included five key components mentioned above. The interrelationship between and the components were linear, from one component to the other component along the line. The structure of VCML was designed to enhance students' memory of vocabulary, congruent with the theoretical concepts (Mayer, 2005; Nation, 2001).

2. The findings of the research objective 2 to investigate the effects of the vocabulary learning model based on the Cognitive Theory of Multimedia Learning on EFL learners' achievement, and retention:

2.1 The learners' achievement: since the number of samples was less than 30, Wilcoxon Signed-Rank Test was used as alternative of pair sample t-test. It was a non-parametric statistical tool effectively to test the hypothesis 1 of the study. The result was as in the following tables.

Table 2 The Wilcoxon Signed-Rank Test on the pretest and posttest score

		N	Mean Rank	Sum of Ranks
posttest - pretest	Negative Ranks	0	.00	.00
	Positive Ranks	25	13.00	325.00
	Ties	0		
	Total	25		

Z = -4.374; Sig (2-tailed) = .000

The hypothesis 1 testing was proven by the result of pretest and posttest. According the Wilcoxon Signed-Rank Test. The result showed a significant difference between the pretest and posttest scores. The posttest score was higher than the pretest score, with the Z value of 4.374, at the significance level of 0.000. This was a clear evidence that the pretest and posttest was significantly different. It could be concluded that the effectiveness of VCML on the learners' achievement was improved after the treatment by VCML.

## 2.2 The learners' retention:

Table 3 The Wilcoxon Signed-Rank Test on the posttest and delayed posttest score

		N	Mean Rank	Sum of Ranks
posttest- delayed posttest	Negative Ranks	10 <sup>d</sup>	9.15	91.50
	Positive Ranks	14 <sup>e</sup>	14.89	208.50
	Ties	1 <sup>f</sup>		
	Total	25		

Z = -1.675; Sig (2-tailed) = .094

Note: (d = posttest < delayed-posttest), (e = posttest > delayed-posttest), (f = posttest = delayed-posttest)

The hypothesis 2 testing was also conducted by Wilcoxon Signed-Rank Test. The result from the comparison between posttest and delayed posttest scores showed no significant difference, with the Z value of -1.657 and at the significance level of .094, which was considered higher than the alpha level set of .01. The interpretation of the result could infer that the effectiveness of VCML on the learners' retention was significantly improved after the experiment of VCML.

## Discussion

It could be concluded from the results on the learners' achievement that VCML helped promote cognitive information processing and that enhance learners in learning vocabulary. From



the starting step, when the learners were viewing the multimedia presentations of the target words, their focal attention shifted to the target words because the words stood out with colored highlighting and a notably large font size. They had better understanding of the meaning of the target word from the image representation that came together simultaneously. Since the working memory process with a very limited time within a few seconds, the word was attached on the image, so that their eyes sight could place at the same spot in order to reduce time in processing. Even though some words were intangible and hard to explain with only images, the teacher tried to use a brief oral explanation to supplement, and still they could get understanding in shorter time than with written text explanation. Similarly, in multimedia reading input, the learners learned the target word incidentally from the contexts of reading to get across the message. With the simplified language and illustration, it helped a lot for the learners to learn and get comprehension on the words that were contextualized. The target words still highlighted and put in a bigger font size to capture their attention.

Receptive activities could help very much in activating the memory of the target words that had been learned. At the recognition level, words and definitions were provided to trigger the memory of the words from long-term memory. At the recall level, words were presented without definitions, the learners needed to find out, that means they had the opportunity to retrieve data at a deeper integration level in their long term memory, and lead to better retention (Nation, 2007).

Productive activities enabled learners to integrate their knowledge with their prior knowledge or experiences, the use of the target words in various occasions, until they acquired fluency. Using the language was considered as an interconnection taken between the new information and the existing information. It was an effective way to strengthen the memory in long- term memory (Nation, 2007; Mayer, 2009).

The benefits of multimedia learning were profoundly discovered in Mayer's 2014 study. He investigated multiple research using multimedia principles as research-based principles on how to design effective multimedia. His study revealed that multimedia helped learners performed much better when they learned from words and graphics than from words alone. Extended with the application of the process and strands of vocabulary learning, meaningful contexts, repetitions and schema engagement was an important tool geared to better vocabulary learning performance (Nation, & Yamamoto, 2012).

### **Implications and Recommendations**

1. The study highlighted that teaching vocabulary through multimedia inputs could explicitly yields the best benefit for Thai learners who still possess limited vocabulary size and stuck at the state of uncertainty and confusions in learning English. The multimedia adhering with multimedia learning principles offers strongly positive impact on the enhancement of the learners'

vocabulary knowledge since the learning process was designed in coherent with human cognitive processing. It can facilitate learners to process the information to their memory better and deeper.

2. Advantages of VCML shed light on vocabulary pedagogy, in terms of multimedia use for better and deeper understanding of the vocabulary. However, it was not just a way to incorporate images and words in pedagogy as it simply sounds, but it features characteristics of the multimedia design that can effectively promote memory. VCML entails the principles outlined the instruction that is best congruent with structure of cognitive processing. The application of VCML was recommended to those instructional practitioners or learners who are struggling with how to expand corpus size of their vocabulary.

3. Further investigation is suggested on the information decay ratio with time series of intervals. It will be very useful for the practitioners to learn time spans of the information decay, so as to ensure that the information is retrieved before it has been forgotten.

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