The Acquisition Order of Vocabulary Knowledge Aspects in Thai EFL Learners

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Abstract

The present study explored vocabulary knowledge as a multi-aspect construct by examining the acquisition order of different vocabulary aspects and the relationships between these aspects. A battery test of receptive and productive vocabulary aspects, based on Nation's (2013) framework, was administered to 156 Thai EFL learners in tenth (n = 84) and twelfth (n = 72) grades. Two different grades of Thai EFL learners were used to better describe the vocabulary acquisition process. The results indicated that scores on the tests assessing receptive knowledge of an aspect were higher than scores on the productive knowledge tests, for both grades. However, overall, the twelfth-grade learners performed better than the tenth-grade learners. The findings also revealed significant correlations between knowledge of the different aspects. Furthermore, the Implicational Scaling (IS) analysis revealed that the two grades had distinct implicational patterns of vocabulary aspects. These results provide empirical evidence for the vocabulary acquisition pattern. The results also suggest that vocabulary knowledge is an incremental learning process and that exposure to vocabulary knowledge has positive effects on vocabulary acquisition.

Keywords: vocabulary acquisition, vocabulary knowledge aspects, receptive vocabulary knowledge, productive vocabulary knowledge

1. Introduction

Vocabulary knowledge is a complex construct that involves acquiring different aspects of word knowledge along a continuum, ranging from zero to partial to precise (Henriksen, 1999; Read, 2000; Milton & Fitzpatrick, 2014; Nation, 2013; Schmitt, 2010, 2014). Research on vocabulary acquisition has shown that word knowledge aspects are acquired at different speeds (González-Fernández & Schmitt, 2019; Laufer & Goldstein, 2004; Nation, 2013; Nontasee & Sukying, 2020, 2021; Schmitt, 2010; Sukying, 2017, 2020). However, the specific stages of the word acquisition process remain undetermined, particularly regarding the varying developmental rate for different word knowledge aspects (Henriksen & Haastrup, 2000; Schmitt, 2008; Zhong & Hirsh, 2009; Nontasee & Sukying, 2021). Research on second language (L2) vocabulary acquisition within the assumption framework has revealed that some vocabulary aspects seem to be acquired before others. For example, receptive vocabulary aspect is learned before productive vocabulary. That is, the ability to recognize the form and meaning of a vocabulary item is frequently mastered before the capability to recall and retrieve its form and meaning. The ability to use the word in contexts is often learned last in the learning process. However, the overall pattern of vocabulary acquisition remains unclear. Thus, this study investigated the multidimensional vocabulary construct by measuring 12 different knowledge aspects to identify the primary acquisition pattern in learners of English as a foreign language (EFL), in which English is rarely used outside classrooms. It also examined the relationships of different vocabulary aspects. Understanding the overall nature of the multi-aspect construct and its relationships may shed light on the role of the vocabulary acquisition process in an EFL context.

2. Literature Review

The concept of overall vocabulary knowledge is based on word aspects. Based on Richard (1976), Nation (2013) proposed a comprehensive list of vocabulary aspects, including the 18 sub-knowledge aspects and the receptive-productive learning process. The process begins with becoming familiar with the word and ends with using

the word correctly in context. Therefore, this process represents a receptive and productive vocabulary knowledge continuum, starting with word comprehension and leading to word production. Indeed, word knowledge can range from knowing that a given form is an existing word to complete mastery of all aspects of a word (Laufer, 1998; Schmitt, 2010). The extent of such knowledge applies to all learners, including native (L1) speakers and second language (L2) learners (Laufer & Goldstein, 2004). The framework of word knowledge by Nation (2013, p. 49) is shown in Table 1.

Table 1. Aspects of Vocabulary Knowledge (Nation, 2013, p. 49)

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?
	Concepts and Referents	R	What is included in this concept?
		P	What items can the concept refer to?
	Associations	R	What other words does this make people think of?
		P	What other words could people use instead of this one?
Use	Grammatical Functions	R	In what patterns does the word occur?
		P	In what patterns must people use this word?
	Collocations	R	What words or types of words occur with this one?
		P	What words or types of words must people use with this one?
	Constraints on Use	R	Where, when, and how often would people expect to meet this word?
		P	Where, when, how often can people use this word?

Notes: R = Receptive knowledge, P = Productive knowledge

While Nation's list presents the most comprehensive description of vocabulary knowledge to date, it does not specify the relationships between the aspects. Specifically, while the framework has helped explain the entirety of what learners must know, it makes no mention of any hierarchical structure, such as which aspects are learned before others or should be taught before others. This restricts its educational effectiveness because it is unclear how multiple aspects relate to one another and how to prioritize them during teaching.

Previous studies have explored the acquisition and development of vocabulary knowledge as a multi-construct concept and have shown that vocabulary aspects are continually acquired at different rates (e.g., González-Fernández & Schmitt, 2019; Henriksen, 1999; Laufer & Goldstein, 2004; Nontasee & Sukying, 2021; Pellicer-Sanchez & Schmitt, 2010; Schmitt, 2010; Schmitt & Meara, 1997; Sukying, 2020, 2022; Zhang & Sukying, 2021). For example, Schmitt and Meara (1997) examined how two aspects of word associations and grammatical suffix knowledge change over time, both receptively and productively, and found that word association knowledge and suffix knowledge correlated with each other, both receptively and productively. Laufer and Goldstein (2004) also tested the hypothesis that there is hierarchical development from receptive to productive vocabulary knowledge of the form and meaning of a word, resulting in productive knowledge being more advanced than receptive knowledge.

More recently, Zhong (2014, 2018) explored the interface between receptive and productive vocabulary knowledge in a multi-aspect framework to understand the transfer and change of these two dimensions over time by examining the relationship between multiple receptive word aspects and productive word use. The results provided empirical evidence for the multi-aspect construct of receptive and productive vocabulary knowledge and illustrated the contribution of each aspect to productive word use in context. Similarly, Lin (2015) investigated the impact of multi-aspect on word learnability with a specific focus on word form and argued that multiple related aspects influence acquiring a word. González-Fernández and Schmitt (2019) also explored the nature of vocabulary construct. They found that the receptive and productive dimensions are separate constructs, and the distinction between receptive and productive knowledge is fundamental to the conceptualization of the development of vocabulary knowledge. The results also demonstrated the hierarchical acquisition of vocabulary aspects, starting with the form-meaning link and ending with the multiple-meaning.

In EFL learners, Nontasee and Sukying (2020, 2021) investigated the acquisition of vocabulary knowledge and found that productive knowledge was obtained after receptive knowledge. The study also indicated a significant correlation between receptive and productive knowledge. Sukying (2022) also constructed a detailed representation of English affix acquisition through a study of high school learners in Thailand and proposed a five-stage order of

English affix acquisition. This finding raises questions about the effect of English affix knowledge on vocabulary acquisition and has pedagogical implications for language classrooms. Together, these studies indicate that vocabulary knowledge is developed in multiple language exposures, and learners' vocabulary knowledge develops over time.

Based on the existing literature, vocabulary researchers have proposed the concept of the growth process of vocabulary knowledge. This concept posits that the different aspects are interrelated but that some aspects are acquired before others. However, there is insufficient evidence to show the hierarchical acquisition of word aspects or describe the nature of their relationships. Indeed, Nation argued that knowledge of vocabulary development is constructed on fragmentary studies (Schmitt, 1995). One apparent reason for the lack of a general theory of vocabulary acquisition and development is that the construct of vocabulary knowledge as a whole is still undetermined. It is also unclear how different vocabulary aspects are acquired and fit together (Chen & Truscott, 2010; Chui, 2006; Milton & Fitzpatrick, 2014; Schmitt, 2014). Some limitations in the existing literature include, for example, testing only receptive or productive knowledge or testing both but inconsistently across aspects, measuring multiple aspects but for different target words, only testing a few words, low participant numbers, and the use of non-words (e.g., Kieffer & Lesaux, 2012; Li & Kirby, 2015; Milton & Hopkins, 2006; Nagy, Diakidoy, & Anderson, 1993; Schmitt & Zimmerman, 2002; Supasiraprapa, 2019; Tannenbaum, Torgesen, & Wagner, 2006).

Research exploring the developmental pattern within a multidimensional framework may be useful to describe the vocabulary construct. Indeed, studies within the assumption framework show that some word knowledge aspects seem to be acquired before others. Yet, it is difficult to conclude an overall pattern. This study thus aims to fill these gaps in the literature. Indeed, exploring the construct of vocabulary knowledge as a multidimensional framework will improve our understanding of the role of vocabulary aspects and the nature of vocabulary acquisition and development. In addition, the inclusion of learners from different grades will provide a better description of the vocabulary acquisition pattern of learners in an EFL context. As such, the present study explored the nature of overall vocabulary construct in different grades of Thai EFL learners based on Nation's (2013) word knowledge framework, which includes written form, word part, form-meaning link, association, grammatical function, and collocation, in both reception and production, by examining the acquisition order of vocabulary aspects and their relationships. The research questions were as follows:

RQ1: What is the acquisition order of vocabulary aspects in Thai EFL learners from different grade levels?

RQ2: What are the relationships between vocabulary aspects in Thai EFL learners?

3. Methodology

3.1 Participants

The present study included 156 participants who were senior high school learners at a well-established government university in northeastern Thailand. All were Thai native speakers who used their L1 to communicate in general, and no participants had studied in an English-speaking country. The participants consisted of tenth- (n = 84) and twelfth-grade (n = 72) learners ranging from 16 to 18 years old. All participants had learned English as a Foreign Language (EFL) for a minimum of ten years as a mandatory subject for tenth-grade students. The English level of the tenth-grade learners ranged from beginners to intermediate according to the Ordinary National English Test (ONET) scores. The twelfth-grade learners had two additional years of English learning experience compared to the tenth-grader learners. According to the Thai Ministry of Education, their English proficiency level ranged from advanced beginner to upper-intermediate.

3.2 Measures

Twelve different tests were used to measure learners' receptive and productive vocabulary knowledge. The target words were selected from the New General Service List (NGSL) (Browne, Culligan, & Phillips, 2013) and the New Academic Word List (NAWL) (Coxhead, 2012). Previous literature indicates that the vocabulary needed for language learners is 86% for high-frequency words and 10% for academic words (Hayashi & Murphy, 2011). The frequency of the target words was cross-checked with the Common European Framework of Reference for Languages (CEFR), an international standard for describing language ability. Then, based on Nation's (2013) frequency principle that the target words should be appropriate for the learners' current level of vocabulary knowledge, the Meaning Comprehension Test was used to check the familiarity of the target words in the research setting (Wesche & Paribakht, 1996). An additional consideration was that unknown and well-known words were removed based on participants' scores (Bruton, 2009; Morgan & Bonham, 1944). This led to a final list of 30 target words for the twelve tests, 19 selected from the NGSL and 11 selected from the NAWL.

Each test included 30 items. The duration of each productive test was 20 minutes, and 15 minutes was allocated for each receptive test. More time was allocated for the productive tests as they require more demanding knowledge strategies than receptive tests (Hayashi & Murphy, 2011; Laufer & Goldstein, 2004), and performance on productive tests can improve when there is a time extension (Webb, 2005). A test of reliability indicated the acceptance of the internal consistency reliability estimates for the twelve test formats (all Cronbach's α values ≥ 0.8) (DeVellis, 2003; Dörnyei, 2007; Mackey & Gass, 2005) and the content validity was rated by five experts (All items > 0.5) (Lynn, 1986). The item difficulty and discrimination analysis indicated that all items were rated moderate in a range of 0.3 to 0.7 (Hopkins & Antes, 1990).

The Form Recognition Test (FRT), developed based on the format version of the form recognition task (Webb, 2005, 2009), was used to measure receptive written form knowledge (word spelling knowledge). The test required participants to choose the correctly spelled target words from three distractors. Each item captured one target word and there was one correct form of the target word and three pseudo-words were used as distractors in each item. The distractors were created to resemble the target words both phonetically and orthographically. It was assumed that an accurate choice was made by discerning between correct and incorrect word forms. One point was awarded for each correct response, and no points were awarded for a blank or an incorrect answer. Example items from the FRT are shown below.

Instructions: Please select the word that is spelled correctly.

a. happyness

b. hapiness

c. happiness

d. happeness

The Form Production Test (FPT), developed based on the productive knowledge of orthography task by Webb (2005), was used to measure productive written form knowledge (word spelling knowledge). This test format version was considered an isolated measure of productive spelling knowledge. It was designed to assess participants who were likely to have learned and seen high-frequency words. The test required participants to rewrite or reproduce the misspelling of the target word into the correct form. This test measured the participants' ability to recall the word and produce it correctly in the form. It should be noted that all of the target words were provided as the derivative forms to prevent the recognition of knowledge from other tests. One point was awarded for each correct response, and no points were awarded for a blank or an incorrect answer. An extract of the FPT is shown below.

Instructions: Please write the correct form of the misspelled given word.

Strate = _____

The Word Recognition Test (WRT), designed and developed based on the morphology task by Ishii and Schmitt (2009), was used to measure receptive word part knowledge (word-class knowledge). The test was presented as a receptive measure and formatted as a fill-in-the-table task. This test encouraged participants to recognize the different word classes of the word. Participants were required to correctly match the target words with their part of speech, including nouns, verbs, adjectives, and adverbs. The test contained eleven nouns, eight verbs, eight adjectives, and three adverbs. A different number of items in each category (noun, verb, adjective, and adverb) of target words were used to prevent any guessing. One correct answer was awarded one point, and no points were awarded for no answer or an incorrect answer. An example is shown below.

Instructions: Please fill the given word in the correct part of speech [noun, verb, adjective, and adverb].

Target words: Available, Accept, Ability

Noun	Verb	Adjective	Adverb

The Recall Word Test (RWT) was designed and developed based on the morphology task by Ishii and Schmitt (2009) and was formatted as a fill-in-the-table task. The test was used to measure productive knowledge of word-class knowledge. This test encouraged participants to recall the different word classes of the word. Participants were required to supply a correct derived form of a word with its part of speech, including noun, verb, and adjective. One point was awarded for each correct response, such as providing a correct type of a derived word. No points were awarded for no answer or an incorrect answer. An example from the RWT is shown below.

Instructions: Please write the correct derivative form of the given word in each part of speech. If some of the given words have no form in any part of speech, such as nouns or adjectives, please leave the answer blank.

Target word	Noun	Verb	Adjective
Stimulate			
Develop			

The L2TT was designed and developed based on the translation task by Laufer and Goldstein (2004) and Webb (2005, 2009). Direct tests of the form-meaning link are tests in which the learners are required to demonstrate their understanding of the target words or produce the target form for given meaning (e.g., Laufer & Nation, 1999; Schmitt, Schmitt, & Claphan, 2001). By contrast, translation tasks are often recommended to measure meaning comprehension and form recognition (Schmitt, 2010, 2014), and L2-to-L1 translation requires the ability to recognize English words (Laufer & Goldstein, 2004). Therefore, the L2TT was presented as a receptive measure and formatted as L2-to-L1 translation to measure receptive form-meaning link knowledge. Participants were given the English words with the contextual sentences and required to translate the bolded word into Thai. The sentence provided the word's context to avoid misunderstanding the target meaning. A correct word definition was awarded one point, and no points were given for no answer or an incorrect answer, such as an incorrect form-meaning match definition. An example of this test is shown below.

Instructions: Please translate the underlined word in bold from English to Thai.

He smiles **happily**. = _____

The L1TT was developed based on the translation task by Laufer and Goldstein (2004) and Webb (2005, 2009). This test was presented as a productive measure and formatted as L1-to-L2 translation. L1-to-L2 translation requires the ability to recall English words (Laufer & Goldstein, 2004; Schmitt, 2010, 2014) and primarily measures productive form-meaning link knowledge. The instructions encouraged the participants to recall the form with the attached meaning of the word in the context. Participants were given the Thai words with the contextual sentences. They were required to translate the highlighted word and supply the correct definition in English by following a given initial letter. An accurate word definition was awarded one point, and no points were given for no answer or an incorrect answer. An example of this test is shown below.

Instructions: Please translate the underline given word in bold from Thai to English by following the two initial letters.

เธอยิ้มอย่างมีความสุข = ha_____

The Association Recognition Test (ART), developed based on the validated version of the Word Associates Test (WAT) by Read (1998) and Zhong (2014), was used to measure receptive association knowledge. The test required participants to choose the word that was associated with the target word. There were four words in each item, including one associate synonym and three distracters. This test required participants to recognize the semantic association of the word (synonym). To avoid providing any suggestions on the association of the word category, all of the words in each set of the vocabulary battery were presented in the same part of speech. One point was awarded for each correct synonym response, and no points were given for no answer or an incorrect answer. An example of this test is shown below.

Instructions: Please select a word that has a similar meaning (synonym) to the target word.

Target word: Beautiful

Gorgeous	Talkative	Cheerful	Generous

The Association Production Test (APT) was based on the active recall task by Laufer and Goldstein (2004) and was used to measure productive association knowledge. Associations tend to be related to concepts rather than forms (Schmitt & Meara, 1997). Therefore, asking the learner to recall or supply the related words to the target words could encourage their productive knowledge of word associations (Webb, 2005). This test was designed as an independent measure to capture learners' productive knowledge of associations. The test required participants to produce a synonym associated with the target word and measured the participants' ability to recall the semantic association of the word (synonym). A correct word association (synonym) was awarded one point, and no points were given for no answer or an incorrect answer. An extract from the APT is shown below.

Instructions: Please write a word that has a similar meaning (synonym) to the target word.

Society = _____

The Collocation Recognition Test (CRT) was designed and developed based on the validated version of the collocation measure (Nontasee & Sukying, 2021; Zhong, 2014). The test was presented as a receptive measure and is used to measure only receptive collocation knowledge, with a specific focus on the collocations of adjective + noun. Adjective-noun collocations are frequently used in the literature, and this type of collocation is more common for learners in basic instruction. The test required participants to choose one word (among four) that appropriately collocated with the given word. No points were awarded for a blank or an incorrect answer. One point was awarded for each correct response. An example of this test is shown below.

Instructions: Please select the word (adjective) which collocates with the target word (noun) properly.

_____ coffee

long	speedy	strong	slow

The Collocation Production Test (CPT) was constructed and developed based on the productive version of the Vocabulary Levels Test (PVLT) (Laufer & Nation, 1999) and the Collocation Production Test (CPT) (Nontasee & Sukying, 2021). This test was presented as a productive measure and formatted as a gap-filling task. The test primarily measured productive collocation knowledge, particularly the collocations of adjective + noun. Participants were required to produce predetermined target words by supplying a sentence context. This test encouraged the participants' collocation knowledgeability in production. Only one correct answer was allowed. The beginning letters of the target collocations were provided to avoid non-target words that might fit in the allocated sentence. This was done to prevent guessing and ensure that the participants selected only the target word. The correct answer was awarded one point, and no points were given for incorrect or blank answers. An example from the CPT is shown below.

Instructions: Please complete the missing adjective to match the following noun in the sentence properly by following the three initial letters.

If you have any **spe**_____ requirements, you can directly inform my manager in the office.

The Grammatical Recognition Test (GRT) was based on the Vocabulary Size Test (Nation & Beglar, 2007) and the receptive grammatical functions (Webb, 2005). It was presented in a multiple-choice format and was used to measure receptive grammatical function knowledge. The GRT independently measured learners' receptive knowledge of grammatical functions. It was presented as three sentences containing each target word and required participants to select the correct sentence from the three alternatives. This test encouraged participants to recognize the grammatical accuracy of the word in the context. One point was awarded for each correct response, and no points were given for no answer or an incorrect answer. An example is shown below.

Instructions: Please select the grammatically correct sentence.

a. The test is a changed.

b. The test has been changed.

c. The test does not changed.

The Grammatical Production Test (GPT) was developed based on the productive grammatical functions test by Webb (2005) and was used to measure productive grammatical function knowledge. The test was formatted as a sentence writing task but captured only grammatical accuracy by allowing learners to produce a grammatically correct sentence with the given word. Sentence writing tasks have high internal reliability (Cronbach's Alpha > 0.91) (Zhong, 2014). A target word was presented in the test, and participants were asked to write a grammatically correct sentence using the target word. The target word was provided in derivative form, and participants needed to use the given form to produce a sentence. This test encouraged participants to produce the word with the correct grammar in the context sentence. One point was awarded for each correct grammatical function of the given word in the produced sentence, and no points were given for no answer or an incorrect grammatical function of the given word in the produced sentence. An example item from this test is shown below.

Instructions: Please write a sentence with grammatical accuracy by using the given word.

understandable = _____

3.3 Procedures

Twelve different vocabulary tests were given to all participants. Before the tests were administered, the instructions

and test examples were provided to participants in their native Thai language. Participants were not allowed to use any tools to assist their responses and could not ask questions or observe other participants' responses. Participants were required to complete all tests. Participants who did not complete all twelve tests, gave patterned answers to multiple-choice tests, handed in blank tests, or provided tests with over 50% missing data were excluded from the analysis.

The productive tests were conducted before the receptive tests to avoid any cross-effects (e.g., Read, 2000). The tests of word use aspect (collocations and grammatical functions knowledge) were given first, followed by the tests of word meaning aspect (form-meaning links and word associations knowledge) and, finally, the tests of word form aspect (word parts and written forms knowledge). The tests were administered across three days to avoid test fatigue. Specifically, the CPT, CRT, GPT, and GRT were conducted first, followed by the L1TT, L2TT, APT, and ART on the second day, and the FPT, FRT, RWT, and WRT on the third day. Cross-test effects were minimized by not telling the participants that tests using the same target words were to take place the next few days. Therefore, participants might have known there were three days of tests, but they did not know that the same words were tested across days.

3.4 Analysis

A paired-samples *t*-test was used to determine any significant differences between performance on the vocabulary tests in the same group of participants. An independent-samples *t*-test was also used to detect significant differences between test performances for participants at different grades. An ANOVA was also used to compare all within- and between-subject variables. A correlation analysis was used to examine the relationships between various vocabulary aspects and determine the interrelatedness of the various aspects. Implication Scaling (IS) was used to estimate the difficulty of acquiring different vocabulary aspects and underlying latent constructs, including written form, word part, form-meaning link, association, grammatical function, and collocation (receptive and productive). The IS permits the establishment of systematic hierarchical relationships between variables and can be regarded as a proxy for systematicity in the language (Rickford, 2002) and to make predictions about how the various vocabulary aspects are acquired. Finally, an effect size analysis was used to examine the strength of the effect when it was found in the population.

4. Results

Descriptive statistics showed that the twelfth-grade participants performed better than the tenth-grade participants in all tests and, at both grades, scores on the receptive test of an aspect were higher than scores on its productive test. As shown in Table 2, a paired-samples *t*-test showed that, for both grades, the receptive and productive tests of an aspect were significantly different ($p < 0.001$), and an independent-samples *t*-test showed that performance on the vocabulary tests differed between the two grades ($p < 0.05$). Effect sizes ranged from small to medium however, it should be noted that the effect sizes reported here may be smaller due to the restricted sample size of the participants.

Table 2. Descriptive Statistics of the Tenth- and Twelfth-Grade Performance (Total Percentage Scores)

Aspects		Tests	Grade 10		Grade 12		*t*-value	Effect Size (*d*)
			Mean	SD	Mean	SD		
Written Form	R	FRT	53.21	37.82	66.20	38.33	2.13*	0.34
	P	FPT	40.29	34.01	54.44	36.02	2.52*	0.40
Word Part	R	WRT	52.33	28.82	63.24	33.00	2.20*	0.35
	P	RWT	38.26	31.62	52.67	33.07	2.78*	0.45
Form-Meaning Link	R	L2TT	48.81	36.82	67.17	35.34	3.16*	0.51
	P	L1TT	36.87	28.90	55.32	27.69	4.05*	0.65
Association	R	ART	47.02	40.10	65.72	34.62	3.09*	0.50
	P	APT	34.38	32.11	53.99	32.22	3.80*	0.61
Grammatical Function	R	GRT	43.53	33.58	57.64	31.77	2.68*	0.43
	P	GPT	32.95	31.78	52.01	27.63	3.97*	0.64
Collocation	R	CRT	42.69	36.68	56.41	32.76	2.45*	0.39
	P	CPT	28.56	26.99	44.30	26.59	3.66*	0.59

Notes: R = Receptive knowledge, P = Productive knowledge, *p < 0.05

The ANOVA showed that there was a significant difference between vocabulary tests for the tenth-grade participants (F (83) = 102.26, $p < 0.001$, $\eta^2 = 0.55$) and the twelfth-grade participants (F (71) = 52.42, $p < 0.001$, $\eta^2 = 0.43$). Furthermore, the overall comparison of vocabulary tests for both grades illustrated a significant difference between tests (F (71) = 68.52, $p < 0.001$, $\eta^2 = 0.49$). All effect sizes were large.

As shown in Figures 1 and 2, scores on vocabulary tests for the tenth-grade (all r values ≥ 0.94, R^2 values ≥ 0.88) and twelfth-grade participants (all r values ≥ 0.87, R^2 values ≥ 0.76) were highly correlated with large effect sizes.

Tests	FRT	FPT	WRT	RWT	L2TT	L1TT	ART	APT	GRT	GPT	CRT	CPT
FRT	1											
FPT	.98**	1										
WRT	.95**	.96**	1									
RWT	.97**	.98**	.97**	1								
L2TT	.99**	.98**	.95**	.97**	1							
L1TT	.97**	.97**	.96**	.98**	.98**	1						
ART	.99**	.97**	.95**	.97**	.99**	.98**	1					
APT	.96**	.96**	.95**	.97**	.97**	.96**	.96**	1				
GRT	.96**	.97**	.96**	.98**	.96**	.96**	.95**	.98**	1			
GPT	.98**	.96**	.96**	.97**	.99**	.99**	.99**	.96**	.97**	1		
CRT	.98**	.96**	.95**	.96**	.98**	.98**	.99**	.96**	.96**	.99**	1	
CPT	.97**	.96**	.94**	.96**	.97**	.96**	.97**	.96**	.97**	.98**	.97**	1

Notes: **p < 0.001, r (0.10-0.29) = Small, r (0.30-0.49) = Medium, r (0.50-1) = Large (2-tailed)

Figure 1. Vocabulary Correlations in the Tenth-Grade Learners (n=84)

Tests	FRT	FPT	WRT	RWT	L2TT	L1TT	ART	APT	GRT	GPT	CRT	CPT
FRT	1											
FPT	.99**	1										
WRT	.95**	.97**	1									
RWT	.97**	.98**	.96**	1								
L2TT	.99**	.98**	.93**	.95**	1							
L1TT	.91**	.92**	.89**	.92**	.94**	1						
ART	.96**	.94**	.89**	.92**	.98**	.96**	1					
APT	.98**	.98**	.95**	.98**	.98**	.94**	.95**	1				
GRT	.97**	.98**	.96**	.99**	.96**	.95**	.94**	.98**	1			
GPT	.89**	.89**	.87**	.89**	.93**	.98**	.95**	.91**	.92**	1		
CRT	.97**	.97**	.95**	.96**	.97**	.96**	.96**	.97**	.98**	.93**	1	
CPT	.94**	.95**	.91**	.94**	.95**	.95**	.94**	.95**	.96**	.92**	.97**	1

Notes: **p < 0.001, r (0.10-0.29) = Small, r (0.30-0.49) = Medium, r (0.50-1) = Large (2-tailed)

Figure 2. Vocabulary Correlations in the Twelfth-Grade Learners (n=72)

The Implicational Scaling (IS) analysis was used to estimate the difficulty of the various vocabulary tests (FRT, FPT, WRT, RWT, L2TT, L1TT, ART, APT, GRT, GPT, CRT, and CPT) and form a systematic hierarchical relationship of the vocabulary aspects in acquisition. To assess difficulty, the twelve vocabulary tests were prescribed horizontally in a matrix and ordered from most known to least known (left to right). For the tenth grade participants, the following implicational scale of the twelve vocabulary aspects, in order of increasing difficulty, was observed:

Receptive written form knowledge > Receptive word part knowledge > Receptive form-meaning link knowledge > Receptive association knowledge > Receptive grammatical function knowledge > Receptive collocation knowledge > Productive written form knowledge > Productive word part knowledge > Productive form-meaning link knowledge > Productive association knowledge > Productive grammatical function knowledge > Productive collocation knowledge

The implicational scale of the twelve vocabulary aspects in the twelfth-grade participants, in order of increasing difficulty, was as follows:

Receptive form-meaning link knowledge > Receptive written form knowledge > Receptive association knowledge > Receptive word part knowledge > Receptive grammatical function knowledge > Receptive collocation knowledge > Productive form-meaning link knowledge > Productive written form knowledge > Productive association knowledge > Productive word part knowledge > Productive grammatical function knowledge > Productive collocation knowledge

Based on Guttman (1944), the Coefficient of reproducibility (C_{rep}) was set at ≥ 0.90, and the Coefficient of scalability (C_{scal}) was set at ≥ 0.60. The IS results indicated that the goodness-of-fit of this scale was very good for the tenth-grade (C_{rep} = 0.93; C_{scal} = 0.91) and twelfth-grade participants (C_{rep} = 0.94; C_{scal} = 0.91). The findings from

both patterns show that knowledge of a higher aspect on the scale entails knowledge of all lower aspects. That is, based on the reproducibility coefficient, if the participants can recall one aspect, it is assumed that they will always know the other five aspects at the receptive level. The scalability coefficient represents the strength of the aspects on an implicational scale, revealing whether the aspects are unidimensional and thereby scalable. If the scalability coefficient is > 0.60, the data is considered scalable, reflecting a greater implicational scale (Davidson, 1987). The scalability coefficient indicates that the scalability pattern is quite active and that the aspects are one-dimensional.

However, the hierarchical order of vocabulary aspects differed between the two grades. Specifically, the analysis of the tenth-grade participants' test scores showed that the aspects of written form and word part were acquired before the aspects of form-meaning link and association. In contrast, the twelfth-grade participants' test scores showed that the form-meaning link was achieved before the aspect of written form. Also, the aspect of association was mastered before the aspect of the word part.

Overall, the current results show that receptive and productive vocabulary knowledge differed between the education grades. Second, the correlation results showed strong positive relationships between all vocabulary aspects. Finally, the hierarchical patterns based on the IS results at both grades were shown to be a valid implicational scale. Together, these findings indicate that different aspects of vocabulary are learned at different rates and levels of language exposure.

5. Discussion

The present study explored the overall nature of vocabulary knowledge as a multi-aspect by examining the acquisition order of 12 different vocabulary aspects in participants at two different grades in Thailand. The results showed that the twelfth-grade participants achieved significantly higher scores than the tenth-grade participants on all vocabulary tests. The gain between the different grades varied from 10.91% to 19.61%, which indicates that the growth in Thai EFL participants' vocabulary knowledge aspects increases following their language exposure. These findings support previous claims that a more prolonged language exposure reflects the learnability of vocabulary knowledge (Nontasee & Sukying, 2020, 2021; Schmitt & Meara, 1997; Sukying, 2017; Zhang & Sukying, 2021). The current findings also suggest that vocabulary knowledge requires experience in language learning.

This study also revealed that participants performed better on the receptive tests than on the productive tests for each aspect in both grades. The distinction between two education grades could be accounted for by the developmental continuum of learning (Nation, 2013). More specifically, the receptive vocabulary knowledge dimension may have inflicted a weaker processing demand on Thai EFL learners than the productive vocabulary knowledge. That is, receptive knowledge acts as a building block for the development of productive knowledge of vocabulary. It is also possible that receptive vocabulary knowledge represents a primary stage in vocabulary processing in which such knowledge is not fully learned for more complex word production. That is, the productive use of vocabulary items may not be established unless receptive knowledge is completely mastered. This hierarchical pattern of vocabulary acquisition suggests that receptive vocabulary knowledge boosts productive use of vocabulary learning, which continues to grow incrementally throughout their language exposure and learning experience in a Thai EFL context. The current study provides further empirical support that vocabulary is incremental (e.g., González-Fernández & Schmitt, 2019; Jeensuk & Sukying, 2021; Hayashi & Murphy, 2011; Laufer & Goldstein, 2004; Lin, 2015; Sukying, 2017, 2018b, 2020, 2022; Zhong, 2018).

The correlation results showed positive relationships between all vocabulary aspects. This aligns with previous studies showing related vocabulary aspects (e.g., Nontasee & Sukying, 2021; Zhong, 2018; Zhang & Sukying, 2021). This suggests that vocabulary knowledge is an incremental learning process and that the multiple aspects interact to benefit vocabulary acquisition and development (Nation, 2013). Webb, 2005; Zhong, 2018; Zhang & Sukying, 2021). The results also suggest that a learner knows word forms such as written form and word part knowledge before or after word meaning (form-meaning link, and association) and then acquires the aspects related to word use (grammatical function and collocation).

At present, there is no consensus in the literature regarding the acquisition order of the various aspects. For example, Pellicer-Sanchez and Schmitt (2010) found that productive word class and meaning were learned after the receptive aspects of meaning and spelling. Conversely, Pigada and Schmitt (2006) found that the productive aspect of spelling was easier than the receptive aspect of grammatical knowledge, and Chui (2006) found that receptive collocation knowledge and productive derivative knowledge developed at a similar rate. The present study provides new insight into vocabulary acquisition in a Thai EFL context, indicating the hierarchical acquisition of different aspects. More precisely, the 12 measures of vocabulary knowledge showed a multi-aspect construct and suggested the various degrees of cognitive processing demand in the vocabulary learning process. That is, some aspects of vocabulary

knowledge were learned before other aspects were mastered. For example, the current findings showed that written forms of vocabulary knowledge were acquired before word parts, which were attained before grammatical functions in both grades and receptive and productive dimensions of knowledge. The knowledge of collocations appeared to be learned last in both grades.

In addition, the IS analysis estimated the difficulty in acquiring the various vocabulary aspects and addressed the systematic hierarchical relationships between the aspects. However, while the sequential addition of vocabulary aspects was demonstrated for both grades, the pattern differed between grades. Specifically, tenth-grade learners performed better on spelling and word-class than other aspects. Previous studies have shown that form knowledge was acquire first, before other knowledge (Nontasee & Sukying, 2020, 2021; Sukying, 2017; Webb, 2005) and others have shown that although form knowledge was the most accessible aspect, word-class knowledge was more difficult than meaning and association knowledge (Zhong, 2018). González-Fernández and Schmitt (2019) also demonstrated that the form-meaning link was better known than others. Nevertheless, it should be noted that the untested knowledge aspects such as spelling and word class may prove to be easier to learn than form-meaning links. Indeed, word form knowledge related to the syntactic constrained knowledge of word family members seems challenging for learners and is acquired relatively late in the process (Chui, 2006; Nagy, Diakidoy, & Anderson, 1993; Sukying, 2022). Form knowledge is one of the most challenging aspects to acquire and probably requires more explicit instruction, particularly in an EFL context (Barcroft, 2002; Sukying, 2020; Webb, 2005).

Interestingly, the twelfth-grade learners performed differently and first acquired the form-meaning link, followed by spelling and association, and then word class. Some previous studies showed that the form-meaning link was the best known aspect and appeared before other knowledge aspects (González-Fernández & Schmitt, 2019; Pellicer-Sanchez & Schmitt, 2010; Tannenbaum, Torgesen, & Wagner, 2006). However, others showed that the form-meaning link was acquired after affix (Nontasee & Sukying, 2020, 2021), orthography, part of speech, and association (Chen & Truscott, 2010), spelling, and word class (Webb, 2005). Wolter (2001) noted that meaning knowledge was an aspect generally learned late. It has also been reported that association is demanding for learners and is likely acquired after other aspects, such as verbal suffix knowledge (Schmitt & Meara, 1997). Supasiraprapa (2019) later clarified that word association acquisition depends on the learning environment, which is difficult for Thai EFL learners. Overall, it is clear that the interface between form (written form and word part) and meaning (form-meaning link and association) knowledge in acquisition requires further study.

In the current study, the aspects of grammatical function and collocation were considered the most difficult and were the last to be acquired, which is consistent with prior studies (Nontasee & Sukying, 2020, 2021; Peters, 2016). However, González-Fernández and Schmitt (2019) showed that collocation is easier than derivative and multiple-meaning knowledge. This was partly because of the different difficulty levels of the measures used (only a single collocation, but for four derivative forms) and the benefit of the cognate nature of Spanish participants (Elgort, 2013). Webb (2005) also argued that grammatical function might be easier to acquire because this knowledge overlaps with other knowledge, such as word part and collocation knowledge. Several errors were observed in the grammatical function measure used in the present study, indicating that it was particularly complex or difficult. Overall, the results suggest that learners first acquire form (spelling and word class) and meaning (form-meaning link and association) knowledge followed by knowledge related to word use (grammatical function and collocation).

Although the present study provides the initial vocabulary acquisition pattern in Thai EFL learners, there is still a pressing need to directly explore the acquisition order of vocabulary aspects as a multi-framework to gain more empirical evidence on the hierarchical order of vocabulary acquisition. The present study highlights that the implicational scale (the vocabulary acquisition pattern) may be useful in this field. This study offers an initial attempt to examine the vocabulary acquisition order, and further research using different measures and learner populations will indicate whether the current results can be generalized to other learner populations. We suspect that although the acquisition order of the aspects may change depending on the participants or measures, the receptive and productive distinction is likely to persist.

6. Conclusion

The current findings showed that the twelfth grade participants achieved better scores on all knowledge tests than the tenth grade participants, and slightly different acquisition patterns were also shown for each grade. Indeed, the study revealed the acquisition order of vocabulary knowledge aspects in both education levels in a Thai EFL context. The tenth-grade learners' vocabulary acquisition order was written form, word part, form-meaning link, association, grammatical function and collocation in receptive and production knowledge dimensions. The findings also showed a similar pattern of receptive vocabulary acquisition in twelve graders. However, the IS analysis revealed a different

order of productive vocabulary acquisition. Specifically, form-meaning links were first learned, followed by word forms, associations, word parts, grammatical functions and collocations, respectively. Although the current findings showed the hierarchical order of vocabulary knowledge aspects, such an order may vary depending on learning contexts and language exposure. The present study also indicated that different vocabulary knowledge aspects were closely interrelated and acquired at different times. The analyses of the current findings suggest that productive use of vocabulary knowledge is acquired after receptive vocabulary knowledge is mastered in both education levels. The current findings also provided empirical evidence to support the interrelated knowledge of vocabulary aspects. Together, these results provide L2 vocabulary researchers and pedagogues with insight into the acquisition order of the various word aspects in EFL learners and reveal the complexity of vocabulary knowledge. The current findings may also shed some light on the roles of different vocabulary knowledge aspects in pedagogical practices in the language classroom.

7. Limitations and Recommendations

The present study provides empirical evidence for the multi-construct nature of vocabulary acquisition in Thai EFL learners. Yet, it should be noted that this study examined learners of only one L1, which raises the question as to whether the results can be applied to other EFL learners. Second, participants with many different educational levels should be included in future studies to better understand the roles of vocabulary aspects in specific contexts, such as primary, high school, and university learners. This study is also limited to a cross-sectional design, and to better understand the nature of vocabulary development, longitudinal and experimental designs are needed. Future studies should also attempt to measure all 18 aspects of vocabulary knowledge. Other instruments, such as observation, questionnaires, and interviews, based on qualitative methodology, should be used to ensure the reliability and validity of the data and gain additional information regarding vocabulary acquisition. Finally, the tests used here were designed for the specific purposes of this study; therefore, future studies should ensure that the content of the tests and the tests themselves are adapted to the particular context of the study.

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