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An Investigation of the Relationships and Order of the Recall/Recognition Knowledge of Word Acquisition Components in an Iranian EFL Context

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Abstract

Vocabulary is a powerful carrier of meaning in a language, and developing vocabulary knowledge is an essential task in the process of enhancing a foreign language. The current study explores vocabulary knowledge as a multi-component construct by analyzing various vocabulary components' relationships and acquisition order in an Iranian EFL context. Moreover, this study aims to provide a better conceptualization of EFL vocabulary knowledge. A total of 170 Iranian EFL learners were evaluated using eight vocabulary tests that assessed recall and recognition knowledge of derivatives, form-meaning link, multiple meanings, and collocations, following Nation's (2022) framework. First, correlational analyses indicated that all measured word knowledge components were interrelated. Moreover, the Implicational Scaling analysis uncovered a uniform trend in vocabulary acquisition for these components, suggesting that recognition knowledge is obtained before recalling knowledge across all aspects. Therefore, the hierarchy pattern indicated that the participants with knowledge of higher aspects are highly likely to know the lower aspects. Furthermore, Confirmatory Factor Analysis indicated that word knowledge in this context can be conceptualized as a unidimensional construct. A comprehensive understanding of the nature of vocabulary knowledge and the interrelationships among its components can provide critical insights into the role of vocabulary acquisition in EFL contexts.

Keywords: vocabulary knowledge components, vocabulary recall, vocabulary recognition, implicational scaling

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Introduction

Wang & Zhang (2025) describe word knowledge as a "web" of words, emphasizing the interconnected and multifaceted nature of vocabulary knowledge (p.2). This metaphor suggests that vocabulary is not a linear acquisition but a network of interwoven aspects. The multicomponent description of word knowledge acknowledges a shared agreement among linguistic scholars that the knowledge of vocabulary is not an all-or-nothing construct; instead, the construct encompasses various independent components for each word (Nation, 2020; Schmitt, 2014). Research on vocabulary acquisition has indicated that word knowledge components are acquired at different speeds (González-Fernández, 2025; González-Fernández & Schmitt, 2020; Laufer & Goldstein, 2004; Nation, 2013). Furthermore, the acquisition of one aspect of a word is also associated with other vocabulary knowledge aspects (Nation, 2013; Nontasee & Sukying, 2020).

To date, most of the studies have only focused on single aspects of lexical knowledge components, for instance, collocations (Jeensuk & Suckying, 2021; Peters, 2016), and the form-meaning link (Laufer & Goldstein, 2004). Moreover, such studies have not investigated the relationship between these interrelated word components. In addition, to the best of our knowledge, the exploration of multicomponent vocabulary knowledge among Iranian (EFL) learners has not been considered in previous studies. Studies investigating the developmental pattern of vocabulary through a multicomponent lens can give valuable insights into the nature of the vocabulary construct. Investigating the relationships, order, and multicomponent nature of the word acquisition components can lead to a more holistic and practical language learning. Therefore, using the framework of vocabulary knowledge proposed by Nation (2022), including form-meaning link, derivatives, multiple meanings, and collocation, the current study examined the overall vocabulary construct's nature across various proficiency levels of Iranian EFL learners in both recall and recognition aspects by investigating their relationships and order of difficulty and offering the best conceptualization for vocabulary knowledge construct. The following research questions are framed for this study:

RQ1: Are vocabulary knowledge components of Iranian EFL learners interrelated in an Iranian EFL context?

RQ2: Is there a systematic order of difficulty in the acquisition of vocabulary knowledge recall, and recognition of English by Iranian EFL learners?

RQ3: How can the relationship between vocabulary knowledge components be best conceptualized among Iranian EFL learners?

Literature Review

Several theoretical conceptualizations have been developed to elucidate the elusive and intricate nature of word knowledge, outlining the multiple components of vocabulary knowledge. One of the distinctions exists between breadth and depth (Milton, 2009; Read, 2004). The breadth of vocabulary knowledge pertains to the

quantity of words the individual knows or has partial meaning knowledge at a specific time (Nation, 2001). The depth of vocabulary, instead, signifies the quality of a learner's knowledge of a lexical item. Another widespread perspective on conceptualizing depth is connected to how productive and receptive knowledge of a lexical item is distinct (Nation, 2013; Schmitt, 2010).

Researchers typically represent vocabulary as consisting of components, dimensions, aspects, and constructs. Nation's (2022) framework of word-knowledge components, which underpins the present study, categorizes vocabulary knowledge into several key components, often summarized into three main categories: form, meaning, and use. There are three knowledge components in each category, and these can be divided into receptive and productive aspects. Therefore, there are 18 distinct sub-aspects of vocabulary knowledge derived from this list. Being familiar with the word is the initial step in the receptive and productive process of learning, which ends with the word being used correctly in context. Thus, this process, which begins with word comprehension and progresses to word production, reflects a vocabulary learning process that is receptive and productive. The vocabulary knowledge framework proposed by Nation (2022) is indicated in Table 1.

Table 1

Vocabulary Knowledge Aspects (Nation, 2022, p. 54)

Form	Spoken	[R]	What does a word sound like?
		[P]	How is the word pronounced?
	Written	[R]	What does a 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 the concept?
		[P]	What items can the concept refer to?
	Associations	[R]	What other words does this make us think of?
		[P]	What other words could we use instead of this one?
	Grammatical functions	[R]	In what patterns does the word occur?
		[P]	In what patterns must we use this word?
Use	Collocations	[R]	What words or types of words occur with this one?
		[P]	What words or types of words must we use with this one?
	Constraints on use	[R]	Where, when, and how often would we expect to meet this word?
		[P]	Where, when, and how often can we use this word?

Note: [R] = receptive; [P] = productive

Differentiating between recall and recognition aspects in learning a language can significantly affect word mastery. Recall knowledge is the ability of a learner to independently produce or retrieve the target word form from memory when presented with a relevant stimulus. This means the learner can actively recall the L2 word form without being provided the word itself. Recognition knowledge involves the ability of a learner to recognize and understand the word's meaning or meanings when they are presented with the word form. In this case, the learner is not required to produce the word actively, but rather to identify and comprehend its meaning (Read, 2000). Recall requires deeper encoding and stronger memory associations, while recognition may rely more on familiarity and passive understanding. Developing recall and recognition knowledge can lead to more comprehensive and durable word mastery for language learners.

In this study, four components of vocabulary knowledge based on Nation's (2022) framework are going to be explored: form-meaning link, derivatives, multiple meanings, and collocation. The form-meaning link is a fundamental aspect of vocabulary knowledge that involves connecting the written or spoken form of a word to its meaning (Laufer & Goldstein, 2004). Derivational knowledge entails recognizing and recalling morphological processes by which new words are created from existing base words through affixation (Nation, 2013). Multiple meanings knowledge refers to a learner's understanding that many words have more than one meaning or sense, a phenomenon known as polysemy (Schmitt, 2010). Finally, collocation knowledge concerns word pairs that frequently co-occur in a language and convey specific meanings not directly deducible from the individual words (Cao & Badger, 2023).

Nation's (2022) framework has been invaluable in delineating the multifaceted nature of knowledge of vocabulary. This framework is the accepted and most widely preferred conceptualization among scholars exploring second language vocabulary knowledge (Li & Kirby, 2015; Cheng & Matthews, 2018). However, it does not fully explain how the different components are interrelated and how several aspects are learned before others, leaving gaps in our theoretical understanding of this construct.

Relationships Among Word Knowledge Components

Several researchers have conducted studies designed to reveal the relationships between components of vocabulary knowledge. They have proposed the notion of a growth process in word knowledge, which claims that various components are intrinsically interrelated and interact with each other, and no component is mastered in a completely detached manner from the other components (Schmitt, 2014; Zhong, 2014, 2018). For example, high correlations have been found between vocabulary size (i.e., form-meaning link) and associations (r = .70–.81; Qian, 2002), as well as collocations (r = 0.70; Nguyen & Webb, 2017). They followed Nation's (2013) framework for the conceptualization of word knowledge.

In Iranian EFL learners, Janebi Enayat and Amiran (2020) investigated the association between vocabulary size and depth. The study indicated a significant

correlation between vocabulary size and depth. Likewise, Karafkan (2021) investigated the acquisition of word knowledge and indicated a strong correlation between vocabulary size and depth.

Difficulty Order among Components of Word Knowledge

Previous studies concentrating on only components of single-word knowledge have revealed that the recall aspect of vocabulary knowledge appears to be more challenging than recognition for a single component. For instance, Laufer and Goldestein (2004) suggested a difficulty hierarchy among four word-knowledge aspects. The accuracy levels for these aspects demonstrated an order of difficulty from easiest to the most challenging: passive recognition, active recognition, passive recall, and active recall.

Indeed, earlier research has examined the process of acquiring and developing vocabulary knowledge as a multifaceted construct, revealing that various vocabulary aspects are learned in different orders. Surer (2021) explored the performance of 283 ESL learners across five different word knowledge aspects. The findings of the study demonstrated that certain aspects of word knowledge have a form of relationship. Furthermore, receptive learning takes place before productive learning. The difficulty of the aspects of vocabulary knowledge, ranging from most accessible to most challenging, has the following order: recognizing the written form from the spoken form > recognition of the spoken form from the written form > recognizing the written form by its meaning > identifying the spoken form by its meaning > spelling words correctly from their spoken form.

Nontasee and Sukying (2020, 2021) researched how the knowledge of vocabulary is acquired, revealing that productive knowledge is typically acquired after receptive knowledge. Moreover, their research highlighted noticeable correlations between various components of vocabulary knowledge.

Sukying and Nontasee (2022) studied the relationships and order of difficulty between vocabulary knowledge aspects in an EFL context. The researchers administered a series of tests regarding productive and receptive vocabulary aspects, following Nation's (2013) model, with 156 Thai EFL students. The results indicated strong relationships among knowledge of vocabulary aspects, suggesting that vocabulary acquisition is an interconnected and progressive learning experience. Furthermore, they showed that learners performed more effectively on receptive tests compared to productive ones.

Hartshorn and Surer (2023) explored the acquisition of eight dimensions of vocabulary knowledge among 110 ESL learners. They demonstrated that passive recognition was more manageable than active recall. Indeed, the study findings revealed that, on average, the pronunciation component was more challenging than the collocation and spelling components.

More recently, González-Fernández (2025) examined eight aspects of word knowledge across EFL learners from two distinct L1 backgrounds. The results revealed that recognition knowledge preceded recall knowledge across all

components. Recognition of the form–meaning link was the aspect mastered earliest by the learners in the implicational scale. Collocation knowledge was mastered before knowledge of multiple meanings and derivatives.

Based on these studies, it can be inferred that the different components of word knowledge are known to various extents by EFL learners, and recognition mastery is better known than the recall dimension across these components. Nevertheless, the present research does not provide evidence regarding a definitive sequence in which EFL learners acquire these vocabulary components.

The Nature of Word Knowledge

Vocabulary knowledge has been widely conceptualized in the literature, with ongoing debate regarding whether it is best understood as a unidimensional or multidimensional construct. Several empirical studies have explored this issue, focusing on the relationship between different components of vocabulary knowledge. For example, Spencer et al. (2015) investigated the role of the derivational morphology component of vocabulary knowledge through two separate studies. These studies focused on the relationship between morphological awareness and word knowledge among 90 English-speaking eighth graders. The results of these two studies provided a uni-dimensional conceptualization, where all tasks converged into a single construct, which was a better fit with the data than a multidimensional model.

González-Fernández and Schmitt (2020) further investigated the nature of vocabulary knowledge construct. They saw significant correlations between the different vocabulary knowledge aspects, ranging from .70 to .94. Out of eight aspects of word knowledge in their study, derivative was more challenging than collocation, multiple-meanings as well as form-meaning links. Furthermore, they discovered that receptive and productive dimensions are distinct constructs, and the differentiation between receptive and productive knowledge is essential for understanding the development of vocabulary knowledge. Consequently, the findings indicated that vocabulary knowledge functioned as a single-dimensional construct.

Koizumi and In'nami (2020) explored the factor structure of vocabulary knowledge among Japanese ESL learners. The vocabulary knowledge was defined by two key aspects: the breadth (the link between word form and meaning) and the depth (including collocations, polysemy, and word associations). The study utilized pre-existing printed tests, initially made for various scientific aims, which assessed specific target words throughout each word knowledge component. The authors discovered that a model with two factors, where breadth and depth were thought of as separate yet correlated dimensions, was more suitable for the data than a model with one factor for these L2 students. Notably, the study revealed a high correlation between the breadth and depth factors.

More recently, González-Fernández (2022) aimed to investigate the vocabulary knowledge conceptualized as having multiple dimensions. The research involved EFL learners from two different native language backgrounds, Chinese and

Spanish. These learners were evaluated using eight different vocabulary assessments that focused on recognition and recall aspects of various components of vocabulary knowledge, including the knowledge of collocations, form-meaning, polysemy, and derivatives. First, although the concept of vocabulary knowledge is often described as multidimensional, these different aspects do not operate as separate entities. Instead, they are highly interconnected, indicating that vocabulary knowledge functions more in the form of a unified construct than a collection of independent dimensions, regardless of whether it is in the context of L1 or L2 English. Furthermore, the results of Confirmatory Factor Analysis demonstrated that vocabulary knowledge functions in the form of a unique construct with one dimension for each group of learners separately. These results offer empirical evidence that vocabulary knowledge in an L2 is unidimensional, suggesting the necessity to improve the theoretical understanding of this concept.

Overall, the above review shows that there is no consensus about or enough evidence to establish the nature of vocabulary knowledge as either uni- or multi-dimensional. Therefore, the current study examines the relationships among vocabulary knowledge components, the sequence of vocabulary acquisition, and the dimensionality of vocabulary knowledge among Iranian EFL learners. By incorporating both recall and recognition aspects of word knowledge, the study aims to contribute a more comprehensive and theoretically grounded understanding of vocabulary knowledge in Iranian EFL learners.

Method

Participants

A total of 170 undergraduate (BA) students participated in the study from the University of Tabriz, East Azerbaijan province, Iran. The criteria for selecting participants were centered on convenience sampling. The average age ranged from 18 to 30 (M =20.79, SD = 4.35), and all the students had previously passed their mandatory English course in the first year of university. Since implicational scaling (IS) requires the participants to have different proficiency levels, we aimed for a population of learners with a range of proficiency in English, from beginners to advanced.

Design

This research study is non-experimental and follows correlational, ex post facto, and exploratory designs. First, it seeks to identify possible existing correlations among the aspects of vocabulary knowledge. No predicting or predicted variables are established for this research design, and all aspects involved are treated as equal parts of the correlation (Creswell & Creswell, 2018). Next, an implicational scaling is used to rank the aspects of vocabulary knowledge based on their difficulty (Ary et al., 2019). This part of the research uses an ex-post facto design. However, here, unlike most ex post facto studies, the comparison is not made among participants but rather among the groups of vocabulary knowledge aspects. Finally, an exploratory design is used to determine the best model that describes the vocabulary knowledge among EFL learners (Stebbins, 2001).

Materials and Instruments

Selected Target Words

The researchers selected twenty English words, which offered the best opportunity to evaluate the four components of vocabulary knowledge, namely, form-meaning links, derivatives, multiple-meanings, and collocations. The selection was guided by the following criteria:

1. Frequency Range (1k-9k): The selection of words was guided by the frequency lists derived from the British National Corpus (BNC) and the Corpus of Contemporary American English (COCA), as compiled by Nation (2012). Specifically, words were drawn from frequency bands spanning the 1,000th to the 9,000th most frequently occurring English words. This range was chosen to align with the varying proficiency levels of the study participants and to fulfill the requirements of the IS analysis.
2. Representative list of parts of speech.
3. Multiple meanings, with at least three distinct senses for each word.
4. Presence of derivatives, requiring a minimum of three derivative forms linked to one meaning per word.

These words included: close, hard, mean, season, development, charm, fulfill, bank, grate, terminal, employ, distance, challenge, broad, redeem, character, bright, fresh, draught, and indent.

Test Battery

The test battery included eight different sections. Each section was numbered and separated from each other. The estimates of internal consistency reliability for the formats were accepted, according to a reliability test (all formats had Cronbach's Alpha values ≥ 0.73). To establish the content validity of the tests, a larger panel of TEFL experts conducted an evaluation, and their opinions and comments were received and considered.

Remember the Form (Recall Aspect)

Form-Meaning Link was operationalized as the learner's ability to associate a word's written form with its meaning. The test utilized a format of fill-in-the-blank, in which the learners needed to recall the L2 form based on the meaning provided in their first language (L1) (e.g., Webb, 2005; Laufer & Goldstein, 2004). The learners were given a context in Persian, describing the situation as well as the meaning of the word, as illustrated in the example below for the word "fresh":

همسایه ام مرا برای صرف قهوه به خانه اش دعوت کرد. او برایم قهوه تازه درست کرد.

My neighbour made a f---------- coffee for me.

Remember the Meaning (Recognition Aspect)

The current test utilized a multiple-choice test format for meaning recognition, which most previous researchers employed in their studies to assess this knowledge (e.g., Webb, 2005; Laufer & Goldstein, 2004). The target words were placed in a short sentence, and the students were asked to choose the correct meaning from four options with three distracters. Example:

We need some *fresh* evidence.
(a) Familiar
(b) Origin
(c) Careful
(d) Popular
(e) I don't know

Word Class Formation

Derivatives (word class knowledge) were operationalized as a learners' knowledge of different grammatical forms of a word (e.g., noun, verb, adjective, adverb). This section aims to measure the recall aspect of derivations. The test followed the format previously employed in studies on the productive aspect of derivatives (e.g., Saigh, 2015). Here, subjects were instructed to type the derivative forms of the target word that were suitable in four sentences intended to restrict the word's part of speech. Researchers informed participants that the form of a word does not always change for different word classes and that several words may not belong to all word classes. Example:

1	**Fresh**	
	Noun	I enjoy the _____ of the early morning in summer days.
	Verb	The wind will always _____ in the early morning in summer days.
	Adjective	The wind is very _____ in the early morning in summer days.
	Adverb	The wind blows _____ in the early morning in summer days.

Word Class Recognition

This part attempted to measure the recognition aspect of derivatives and involved a multiple-choice format with several possible answers. For each target word, learners were given eight different derivative options. Typically, these options included one correct derivative and one distractor for each word class. In designing distractors, a list of the most commonly used suffixes for each word class was planned and applied to the root of the target words to develop invalid forms of each word class. Since some target words do not have derivatives for all four word classes, option X was provided in all items. Example:

Fresh			
a. *Freshen*	***b.*** *Fresh*	***c.*** *Freshable*	***d.*** *Freshness*
e. *Freshment*	***f.*** *Freshate*	***g.*** *Freshly*	***h.*** *X*

Noun	I enjoy the _____ of the early morning in summer days.
Verb	The wind will always _____ in the early morning in summer days.
Adjective	The wind is very _____ in the early morning in summer days.
Adverb	The wind blows _____ in the early morning in summer days.

Polysemy Recall Test

Multiple meanings (polysemy) were operationalized as learners' capacity to understand and distinguish among various senses of polysemous or homonymous words. To test this component of Nation's (2013) framework, the selected target words encompassed both polysemes and homonyms. The word polysemy was utilized rather than multiple meanings. The design of the test is an open question in a written format. Learners were tested on three meanings of each target word. The learners were given the target words, their word class, and a clue for each of the three senses being assessed. Following each hint, they had a blank to type, in Persian or English, a synonym, a translation, a definition, a description, or a sentence where the particular sense being assessed is demonstrated. Example:

Fresh

(Adjective= ideas) _____
(Adjective=weather) _____
(Adjective= water) _____

Polysemy Recognition Test

In this measure, each word was employed in five various sentences, each with a distinct meaning. Of these five sentences, two served as distractors, using the word with an invented meaning. The other three sentences demonstrated the three senses assessed in the recall test. To minimize the memory effect, the clue words from the recall test were not included in these sentences. The subjects were told there was a maximum of three correct sentences and a minimum of one in each item. Example:

Fresh

a) After I had finished the work, my boss gave me fresh instructions.
b) He bought a fresh car.
c) The window glass was very fresh that morning.
d) These plants only survive in fresh water.
e) The mornings are always very fresh in the mountains.
f) I don't know.

Collocation Recall Test

In this study, collocations represented knowledge of commonly co-occurring word combinations. Participants were given a short context in Persian (the following example means 'to breathe fresh air, please open the window'), and were required to complete the English sentences by filling in the suitable collocate, providing the initial letter of the word. The sentences were typed in such a way that they did not allow for direct translations, ensuring that the subjects had to be familiar with the collocates to provide the correct answers, e.g., 'هوای کلاس عوض شود' from the example sentence below literally translates as 'to change the classroom's air' rather than the English collocate 'fresh air'. All the collocations tested were lexical. Example:

پنجره را باز کنید تا هوای کلاس عوض شود.

It was too warm in the classroom, so I asked the teacher to let some *fresh* a ……into the classroom.

Collocation Recognition Test

Based on the works of earlier studies (e.g., Chui, 2016), this test used a multiple-choice format. Participants were given a sentence containing an underlined target word and were required to choose the correct collocate from five available choices. The researcher informed the students that, although all the words in the sentence were credible, they had to select the option that seemed the most natural in English. Example:

After a day in the office, I need to go outside for some *fresh* _____.
a) Wind
b) Sun
c) Weather
d) Air
e) I don't know

Procedure

Eight different vocabulary tests were provided through the website https://survey.porsline.ir/s/hw7zuzx, and students were asked to log in using their laptops. To ensure the integrity of the testing process, students were actively monitored throughout the assessment. Monitoring was done through a combination of physical supervision by proctors who circulated in the classroom, random seat checks, and close observation of participants' screens. Additionally, students were explicitly instructed not to use dictionaries, mobile phones, or any AI-based tools, and any suspicious behavior was promptly addressed by the research team. Because the administration of the whole data collection procedure required more than 3 hours, the researchers divided the eight parts of the test into two parts. These two distinct tests were presented to the students in the counterbalanced order. Furthermore, to avoid test fatigue, the entire process of data collection was divided into two sessions, each lasting 90 minutes. Specifically, tests on form, meaning,

word class formation, and word class recognition were conducted first, followed by polysemy recall, polysemy recognition, collocation recall, and collocation recognition tests in the second session. Using the framework of vocabulary knowledge proposed by Nation (2022), which encompasses the form-meaning link, derivatives, multiple meanings, and collocation, the present study aims to examine the nature of the overall vocabulary construct among Iranian EFL learners. This investigation considers both recall and recognition aspects by exploring the relationships among these components, their relative order of difficulty, and ultimately providing an optimal conceptualization of the vocabulary knowledge construct.

Data Analysis

Answering the first research question required running a series of correlational analyses. The second research question was explored by running implicational scaling (IS), also known as Guttman scaling. This analysis was followed by Mokken scaling for confirmation. Finally, a confirmatory factor analysis (CFA) using IBM SPSS AMOS (version 26) was employed to provide the best conceptualization of the relationship between vocabulary knowledge components. The two hypothesized unidimensional and multidimensional models followed the dimensional approach, specifically Nation's (2022) framework.

Figure 1

Hypothesized Unidimensional Model of Word Knowledge

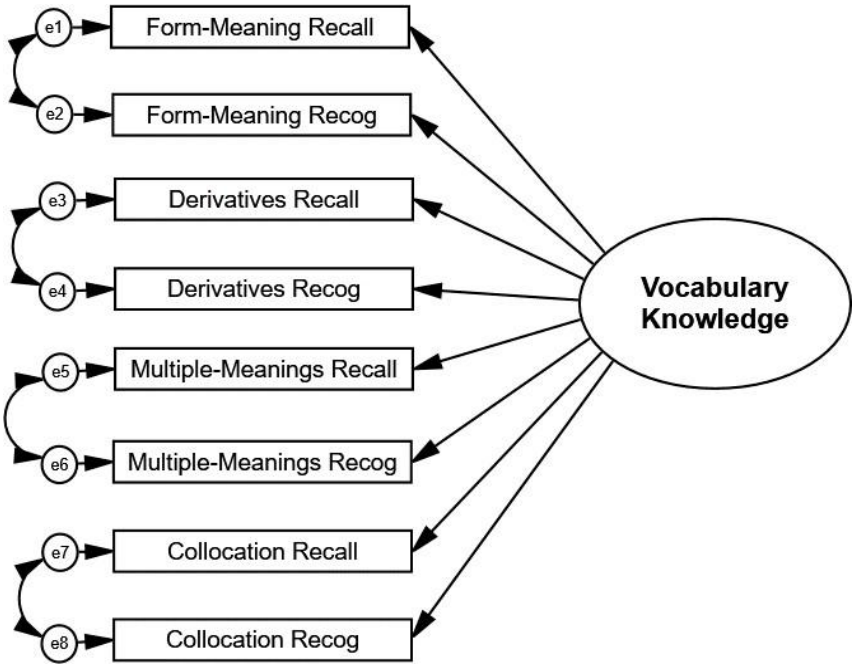
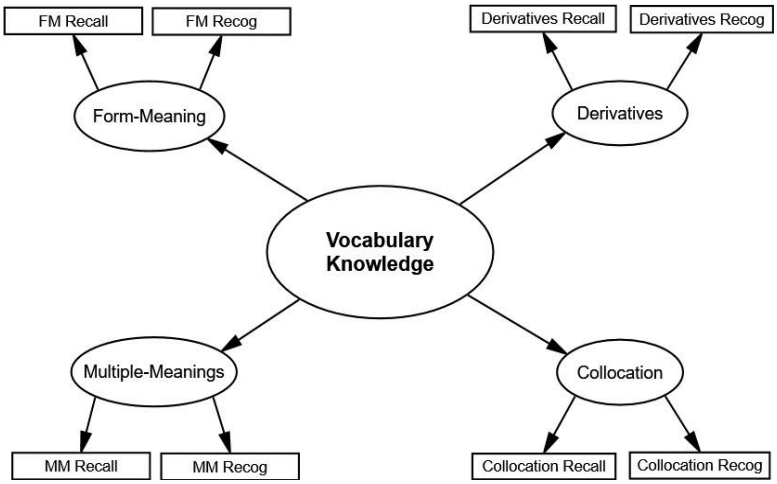


Figure 2

Hypothesized Multidimensional Model of Word Knowledge



Results

The results of the data analysis are provided in the following section.

RQ1: Are vocabulary knowledge components of Iranian EFL learners interrelated in an Iranian EFL context?

First, the descriptive statistics of the data were obtained. Then, to systematically examine the normality of the distributions, the Kolmogorov-Smirnov test was run, the results of which are presented in Table 3.

Table 2

Descriptive Statistics of the Scores

	N	Minimum	Maximum	Mean	SD
R. Form	166	1.00	20.00	9.4940	3.96767
R. Meaning	166	4.00	20.00	13.1807	4.22157
WC. Formation	166	.00	61.00	25.8072	15.81174
WC. Recognition	166	.00	72.00	32.8675	18.09589
P. Recall	166	.00	50.00	23.9940	11.66476
P. Recognition	166	.00	58.00	28.5241	12.71063
C.Recall	166	1.00	20.00	10.0361	4.15880
C.Recognition	166	3.00	20.00	12.4639	4.56421

Table 2 indicated that recognition mastery of an aspect reflected higher scores than its recall knowledge.

Table 3

The Results of Kolmogorov-Smirnov Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
R. Form	.075	166	.024	.986	166	.086
R. Meaning	.083	166	.007	.968	166	.001
WC. Formation	.095	166	.001	.952	166	.000
WC. Recognition	.094	166	.001	.965	166	.000
P. Recall	.068	166	.061	.978	166	.009
P. Recognition	.056	166	.200*	.985	166	.078
C.Recall	.088	166	.003	.984	166	.056
C.Recognition	.087	166	.004	.965	166	.000

* This is a lower bound of the true significance.

a. Lilliefors Significance Correction

As presented in Table 3, the Sig. values for most of the variables were not above the critical value (.05) in both Kolmogorov–Smirnov and Shapiro–Wilk tests. Since most of the main variables in this study were non-normally distributed, non-parametric tests can be used for data analysis. Therefore, a series of Spearman's correlation tests were run (Table 4) to answer the first research question.

Table 4

Spearman's Correlation Among the Variables

		R.F.	R.M.	W.C.F.	W.C.R.	P.Rl	P.Rn	C.Rl	C.Rn
R. F.	Rho	1.000							
	Sig.	.							
	N	166							
R.M.	Rho	.767**	1.000						
	Sig.	.000	.						
	N	166	166						
W.C.F.	Rho	.672**	.682**	1.000					
	Sig.	.000	.000	.					
	N	166	166	166					
W.C.R.	Rho	.634**	.655**	.909**	1.000				

	Sig.	.000	.000	.000	.				
	N	166	166	166	166				
P. Rl	Rho	.645**	.667**	.743**	.744**	1.000			
	Sig.	.000	.000	.000	.000	.			
	N	166	166	166	166	166			
P. Rn	Rho	.637**	.650**	.747**	.749**	.926**	1.000		
	Sig.	.000	.000	.000	.000	.000	.		
	N	166	166	166	166	166	166		
C.Rl	Rho	.722**	.666**	.638**	.622**	.654**	.656**	1.000	
	Sig.	.000	.000	.000	.000	.000	.000	.	
	N	166	166	166	166	166	166	166	
C.Rn	Rho	.673**	.715**	.687**	.698**	.703**	.692**	.876**	1.000
	Sig.	.000	.000	.000	.000	.000	.000	.000	.
	N	166	166	166	166	166	166	166	166

** Correlation is significant at $p < .01$

Notes: R.F. = Remember form; R.M = Remember Meaning; W.C.F. = Word Class Formation; W.C.R. = Word Class Recognition; P.Rl = Polysemy Recall; P.Rn = Polysemy Recognition; C.Rl = Collocation Recall; C.Rn = Collocation Recognition.

According to the results, the correlation among all variables was significant at $p < .01$. The highest observed correlation coefficients (rho) were observed between polysemy recall and polysemy recognition ($\rho = .926$), word class formation and word class recognition ($\rho = .909$), collocation recall and collocation recognition ($\rho = .876$) and remember the form and remember the meaning ($\rho = .767$). All other correlations were significant and robust. The lowest observed rho was the correlation between remembering the word and word class recognition ($\rho = 0.634$). Based on the results obtained above, it was concluded that there was a positive and significant correlation among all vocabulary knowledge components.

RQ2: Is there a systematic order of difficulty in the acquisition of vocabulary knowledge components recall and recognition of English by Iranian EFL learners?

Here, Guttman scaling was used. To do so, the scores were first transformed into 20-point scales. Then, the Guttman matrix was created by horizontally ordering the components from easiest to most difficult and vertically ranking the participants based on their performances. By doing so, an implicational scale was developed to examine each participant's distribution of known and unknown aspects and arrange the different vocabulary knowledge components according to their difficulty. If the vocabulary aspects are found to form an

implicational scale, we can assume that they are strongly, hierarchically interrelated. Using a 75% correct answers criterion (following Gonzalez-Fernandez & Schmitt, 2020), the following pattern was noticed (from easier to more difficult):

Form-meaning link meaning recognition > Collocation recognition > Multiple-meaning recognition > Derivative recognition > Form-meaning link form recall > Collocation recall > Multiple-meaning recall > Derivative Recall.

All aspects of vocabulary knowledge showed a pattern of hierarchy. The above hierarchy indicates that the participants with the knowledge of higher aspects are highly likely to know the lower aspects. For example, the participants with collocation recall knowledge are expected to know both collocation recognition and remember the meaning.

The above hierarchy was tested for goodness of fit. The two measures used by Gutmann (1944) are the coefficient of reproducibility (Crep) and the coefficient of scalability (Cscal). The former represents the predictability power of the matrix, while the latter shows the implicational strength of the aspects. The observed Crep was .92, which is above the cut-off point of .9, suggested by Guttman. To calculate the value, the ratio of the number of errors in the pattern was deducted from 1. In other words, there were only about 8% of errors in the pattern suggested above. The coefficient of reproducibility is calculated as shown below:

$$C_{rep} = 1 - \frac{Number\ of\ errors}{(number\ of\ participants)(number\ of\ items)}$$

As for the Cscal, the observed value was .69, which is safely above the cut-off value of 0.6. This value was obtained using the following formula:

$$C_{scal} = 1 - \frac{Sum\ of\ observed\ errors}{Sum\ of\ expected\ errors}$$

As the observed value was above the critical value, it can be concluded that the aspects of the suggested implicational scale could be considered unidimensional and, hence, scalable.

Finally, to ensure the validity of the results, a Mokken scale analysis was performed. The formula for this analysis is $H_{jk} = 1 - \frac{F_{jk}}{E_{jk}}$; Where $F_{jk}$is the observed number of Guttman error for item pairs (j and k) and E_{jk} is the expected number of errors. The obtained value was .72. This is considered acceptable and implies homogeneity of the results. Moreover, the overall reliability for the scale was estimated at .853, which is regarded as a strong index.

Based on the values obtained from the implicational scaling, it can be concluded that there is a systematic order of difficulty in the acquisition of vocabulary knowledge component of English by Iranian EFL learners.

RQ3: How can the relationship between vocabulary knowledge components be best conceptualized among Iranian EFL learners?

To answer the third research question, the researcher ran a confirmatory factor analysis. Two structural models could be hypothesized: one with components in the first order and one with them in the second order. Both models were tested to reach the model that best describes the structure. The analyses were run using IBM SPSS AMOS (version 29).

The First-Order Model

The first CFA model was created with all components in the first order. First, the standardized and unstandardized loadings of the items were inspected (Table 5).

Table 5

Standardized and Unstandardized Estimates in the CFA Model 1 (First-Order)

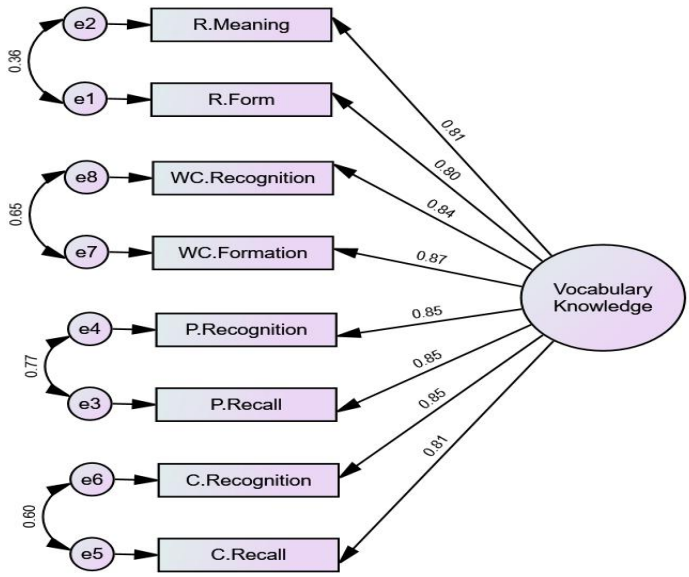
			Unstandardized				Standardized
			Estimate	S.E.	C.R.	P	Estimate
R. Meaning	<---	Vocabulary.Knowledge	1.000				.797
WC. Recognition	<---	Vocabulary.Knowledge	4.683	.355	13.193	.000	.870
P. Recall	<---	Vocabulary.Knowledge	3.078	.227	13.572	.000	.887
C.Recall	<---	Vocabulary.Knowledge	1.000	.084	11.902	.000	.809
C.Recognition	<---	Vocabulary.Knowledge	1.152	.091	12.723	.000	.848
R. Form	<---	Vocabulary.Knowledge	.937	.081	11.616	.000	.794
P. Recognition	<---	Vocabulary.Knowledge	3.356	.247	13.586	.000	.888
WC. Formation	<---	Vocabulary.Knowledge	4.170	.307	13.563	.000	.887

As presented in Table 5, the measured aspects had significant unstandardized loadings, and none of the items showed standardized loadings below 0.5, indicating convergent validity.

Furthermore, the researchers reviewed the modification indices recommended by the software and considered those that resulted in parameter shifts greater than 10 and were consistent with the literature. This involved identifying errors that could be regarded as shared determined by the content of the questions and the constructs to which they belonged. Figure 1 shows the final model.

Figure 3

Final Modified CFA Model 1 (First-Order) with Standardized Estimates



This unidimensional model of vocabulary knowledge removes the unnecessary latent dimensions and depicts vocabulary knowledge as a single construct, encompassing both the recall and recognition aspects of each word knowledge component.

The Second-Order Model

As evident from Figure 3, the errors of the aspects were highly correlated. Therefore, the researcher decided to create a second-order model and compare it to the first one. Table 6 below shows the standardized and unstandardized loadings for this model. Figure 4 also depicts the model with standardized loadings.

Table 6

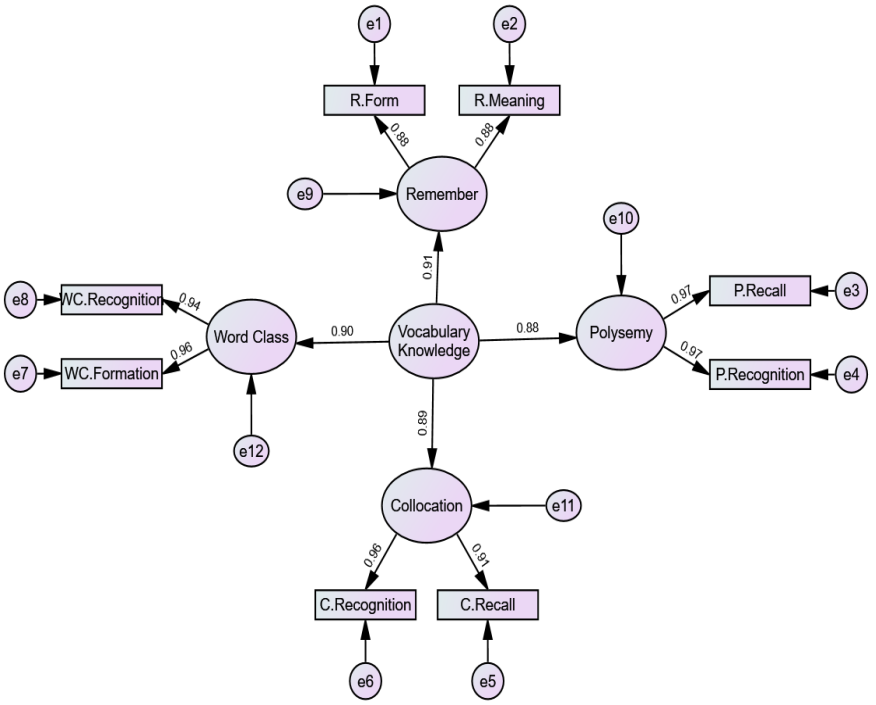
Standardized and Unstandardized Estimates in the CFA Model 2 (Second-Order)

			Unstandardized				Standardized
			Estimate	S.E.	C.R.	P	Estimate
Remember	<---	Vocabulary.Knowledge	1.000				.915
Form/Meaning							
Word Class	<---	Vocabulary.Knowledge	4.301	.339	12.705	.000	.898
Polysemy	<---	Vocabulary.Knowledge	3.103	.251	12.337	.000	.877

			Unstandardized				Standardized
			Estimate	S.E.	C.R.	P	Estimate
Collocation	<---	Vocabulary.Knowledge	1.054	.091	11.529	.000	.887
WC. Formation	<---	Word Class	1.000				.965
WC.Recognition	<---	Word Class	1.113	.047	23.769	.000	.938
R. Form	<---	Remember	1.000				.878
R. Meaning	<---	Remember	1.071	.073	14.643	.000	.883
P. Recall	<---	Polysemy	1.000				.967
P. Recognition	<---	Polysemy	1.091	.038	28.743	.000	.968
C.Recall	<---	Collocation	1.000				.910
C.Recognition	<---	Collocation	1.156	.058	19.874	.000	.959

Figure 4

Final Modified CFA Model 2 (Second-Order) with Standardized Estimates; Hierarchical Model of Vocabulary Knowledge



As the second model (the multidimensional model) had more than one component, unlike the first model, the discriminant validity and reliability of these components had to be checked. Table 7 presents the result.

Table 7

Reliability and Validity of CFA Model 2 (Second-Order)

	CR	AVE	MSV	MaxR (H)	Collocation	Remember	Polysemy	Word Class
Collocation	0.933	0.874	0.733	0.939	0.935			
Remember	0.873	0.774	0.733	0.873	0.856	0.880		
Polysemy	0.967	0.936	0.674	0.967	0.765	0.776	0.968	
Word Class	0.950	0.905	0.674	0.953	0.777	0.808	0.821	0.952

As shown in Table 7, all the values of CR (composite reliability) for the components were above the cut-off value of 0.7 (Hu & Bentler, 1999). Another measure that acknowledges the internal consistency is Maximum Reliability (MaxR(H)). The values for all eight components of the study were high, confirming the high reliability of the obtained data from this instrument. The average variance explained (AVE) by each component was also desirably high. This metric indicates the proportion of the variance that can be explained by the component, and values above 0.5 are generally considered desirable (Kline, 2016). Maximum shared variance (MSV), another validity measure, reveals that the variance shared by different components is safely below the AVE. This is an indication of discriminant validity. Finally, the Fornell – Larcker criterion was employed to examine the discriminant validity of the model. As evident from the table, for all five components, the square root of AVE is safely more than the correlation between that given component and the others. This affirms the discriminant validity of the model.

Comparing the Two Models

The two models' goodness of fit was investigated through different indices to see which one has more generalizability. Table 8 reports the results of the observed values and the thresholds of various model fit indices.

Table 8

Comparing the Goodness of Fit of the Two Models

Model	Criteria	Observed Values	Thresholds			Evaluation
			Poor	Acceptable	Excellent	
First-Order	CMIN	38.024				
	DF	16				
	CMIN/DF	2.377		> 5	> 3	*Excellent*
	RMSEA	0.081	> 0.10	> 0.08	< 0.08	*Acceptable*
	CFI	.985	< 0.9	> 0.9	> 0.95	*Excellent*
	TLI	.974	< 0.9	> 0.9	> 0.95	*Excellent*
	GFI	0.945	< 0.9	> 0.9	> 0.95	*Acceptable*
	SRMR	0.068	> 0.10	> 0.08	< 0.08	*Excellent*
Second-Order	CMIN	49.521				
	DF	16				
	CMIN/DF	3.095		> 5	> 3	*Acceptable*
	RMSEA	0.091	> 0.10	> 0.08	< 0.08	*Acceptable*
	CFI	.945	< 0.9	> 0.9	> 0.95	*Acceptable*
	TLI	.914	< 0.9	> 0.9	> 0.95	*Acceptable*
	GFI	0.895	< 0.9	> 0.9	> 0.95	*Poor*
	SRMR	0.098	> 0.10	> 0.08	< 0.08	*Acceptable*

The first index in Table 8 is CMIN/DF, which is the result of the chi-square test divided by the degree of freedom of the model. Values below 3 are considered excellent, while values between 3 and 5 are acceptable. The observed value for the first model was 2.377, regarded as excellent, and for the second model was 3.091, which was regarded as acceptable. The second index is the root mean square error of approximation (RMSEA), which is an absolute index that measures how different the observed model is from the perfect model. It does this by comparing the observed covariance matrix and the model-implied covariance matrix. Lower values indicate a lower difference. The observed values for the first and second models, .081 and .091, respectively, are considered acceptable. The following two indices, the comparative fit index (CFI) and Tucker-Lewis's index (TLI) analyze the model fit by exploring the difference between the hypothesized model and the data. They are employed to make a comparison between the fit of the fitted model and a model

predicated on the assumption of uncorrelated variables. The observed values for the first model were excellent, while the second model had acceptable values for both indices. Finally, the goodness of fit index (GFI) also showed an acceptable value of .945 for the first model and the below acceptable value of .895 for the second model. The SRMR index was also within the excellent range for the first model and the acceptable range in the second model. Overall, the conclusion is that the first-order model (unidimensional model) had the best fit.

Discussion

The findings of this study reaffirm the high interconnectivity among various written vocabulary knowledge components within an Iranian EFL context. Correlation analyses revealed significant, positive relationships across different facets particularly between recognition and recall of form-meaning connections, derivatives, multiple meanings, and collocations, aligning with prior research. Specifically, these results support González-Fernández and Schmitt's (2020) findings of strong correlations among vocabulary components. Furthermore, the current study's findings are in line with those of Janebi Enayat and Amirian (2020) and Karafkan (2021), who demonstrated a close relationship between the breadth and depth of lexical mastery in an Iranian EFL context. Overall, the results are consistent with existing literature emphasizing the interconnected nature of vocabulary knowledge components (González-Fernández, 2022; Sukying & Nontasee, 2022; Zhong, 2014, 2018). This high degree of interrelationships may be best interpreted through Nation's (2022) theory of the word knowledge framework, which views word knowledge as comprising three core dimensions and all aspects are deeply interconnected. Furthermore, there has been a great deal of debate concerning the relationship between depth and breadth of word knowledge. This study indicated that a strong relationship exists between vocabulary size and the different components of word knowledge.

Regarding the second research question, the IS analysis revealed that Iranian EFL learners performed better on recognition tasks than on recall tasks across vocabulary components, indicating that active recall poses greater challenges. This finding is consistent with those of Nontasee and Sukying (2020, 2021) and Hartshorn and Surer (2023). The data also suggested a developmental hierarchy, with learners acquiring form-meaning links first, followed by collocations, multiple meanings, and derivatives, aligning with prior research that highlights the early development of form-meaning connections (González-Fernández, 2025; González-Fernández & Schmitt, 2020; Laufer & Goldstein, 2004; Sukying & Nontasee, 2022). The findings further indicate that collocation knowledge is comparatively easier to acquire than derivatives and multiple meanings, partly due to assessment design. Additionally, recalling derivatives was more challenging than other aspects, aligning with Surer (2021). These results challenge Chen and Truscott's (2010) assertion that the form-meaning link is the most difficult component of post-spelling acquisition.

For the third research question, CFA supported a unidimensional, single-factor model of vocabulary knowledge, suggesting that different components

function as facets of a unified construct in the Iranian EFL context. Nation's (2022) framework of word knowledge posits that lexical knowledge necessitates mastery of several types of knowledge for each word. The unidimensional model in this study validates this theorization by showing that the four knowledge components tested in their recall and recognition masteries contribute highly to the general word knowledge construct. This empirical study indicated that each aspect of word knowledge plays a crucial and complementary role in representing learners' overall lexical competence in a foreign language. When recall and recognition aspects were modeled as independent factors in a unidimensional model, it was indicated that the key distinction lay in recognition and recall knowledge. The result aligns with González-Fernández's (2022) position that vocabulary knowledge should be conceptualized as a single, interconnected construct rather than separate dimensions, emphasizing the high interdependence among different vocabulary components. The present findings support a unidimensional conceptualization of vocabulary knowledge, aligning with Spencer et al. (2015), who found no evidence for multidimensionality and advocated viewing vocabulary as a single construct encompassing recognition and recall, where overall lexical understanding influences individual word knowledge. In contrast, our results do not corroborate Kieffer and Lesaux's (2012b) three-dimensional model, which characterizes vocabulary through morphological derivation, semantic associations, and contextual use, suggesting a more complex, multidimensional framework. Although their model with three (and even four or five) factors provided a good fit, González-Fernández (2022) noted that their use of unfamiliar words and lack of control over word set characteristics across tasks may have contributed to the emergence of additional dimensions, reflecting task-specific factors rather than true separate constructs. These findings diverge from Koizumi and In'nami's (2020), who identified a two-factor model comprising size and depth as the most accurate, with SEM analyses indicating that these constructs are related yet distinct, offering a better fit than a unidimensional model. Overall, the results highlight the complexity of modeling vocabulary knowledge and suggest that its dimensionality may vary depending on task design and conceptualization.

Conclusion

The current study investigated whether vocabulary knowledge in an unstudied group of Iranian university students operates in a manner consistent with multidimensional descriptions of the construct, as hypothesized, and found that the different aspects of word knowledge are interconnected rather than independent, offering empirical support for the interrelatedness of these components. Additionally, the study examined the hierarchical order of difficulty among eight aspects of word knowledge, revealing that learners acquire meaning (form-meaning link) and word use (collocation) knowledge first, followed by knowledge of multiple meanings and form-related knowledge (derivatives), thus establishing the scalability of these aspects and identifying the order of difficulty from easiest to most difficult as follows: form-meaning link recognition > collocation recognition > multiple-meaning recognition > derivative recognition > form-meaning link recall > collocation recall > multiple-meaning recall > derivative recall. Furthermore, the

study explored the validity of two opposing vocabulary conceptualizations in the Iranian EFL context and found support for a unidimensional model, which conceptualizes vocabulary knowledge as a unique construct encompassing both recognition and recall aspects.

Based on these outcomes, several pedagogical implications emerge, emphasizing the importance of sequential learning approaches that prioritize recognition before fostering recall abilities, as well as acknowledging the unified nature of vocabulary knowledge in instructional strategies to optimize language acquisition among EFL learners.

The findings of this study offer valuable insights for those responsible for assessing learners' vocabulary knowledge. It is imperative to recognize that each aspect of vocabulary, such as recognition, recall, form-meaning links, and derivatives constitutes an integral component of comprehensive word knowledge. Relying solely on a single dimension provides a limited perspective, risking an incomplete understanding of the construct. Consequently, scholars and educators should employ multifaceted assessment tools, similar to the comprehensive battery utilized in this study, to evaluate multiple aspects of vocabulary. Such an approach allows for a more thorough and nuanced understanding of learners' overall lexical knowledge and its developmental trajectory. Given that vocabulary encompasses both breadth and depth, integrating measures of both dimensions is essential for accurately capturing and representing the full scope of vocabulary knowledge (Koizumi & In'nami, 2020).

Practitioners and students alike must acknowledge the importance of vocabulary acquisition. As Barclay and Schmitt (2019) highlight, vocabulary growth is a gradual, cumulative process, with learners eventually attaining a comprehensive understanding that includes spelling, morphological structure, pronunciation, grammatical variations, meanings, word formation processes, common collocations, and contextual appropriateness. The current research offers valuable insights into the various facets of vocabulary knowledge and their roles within language education. However, limitations must be considered: although data were collected from a substantial sample of 170 participants, the findings may not fully generalize to the entire learner population. Additionally, since the study only involved university students, future research should include learners across different educational levels, such as high school and primary students to better understand how vocabulary components function in diverse contexts. To deepen understanding of vocabulary development, longitudinal and experimental studies are recommended. Given the impracticality of assessing all aspects simultaneously, future work should aim to develop comprehensive measurement tools that encompass all 18 identified facets, enabling a more holistic assessment of vocabulary knowledge over time.

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Mohammad Zohrabi was born in Tabriz, Iran in 1969. He is an assistant professor and has taught various courses both at undergraduate and graduate level at the University of Tabriz, Iran. He has published various articles in international journals and produced five books. His research interests include: discourse analysis, genre analysis, task-based language learning and teaching, program evaluation, material writing and evaluation, first and second language acquisition, teaching reading and writing skills, and English for academic and specific purposes.

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Aysan Bolandnazar received her M.A. degree in Teaching English as a Foreign Language (TEFL) from University of Tabriz, and she is a Ph.D. student of TEFL in University of Tabriz. Her research interests include Applied Linguistics, English for Specific Purposes, and Educational Psychology in foreign language learning and teaching. In 2021, she joined the University of Tabriz as a Lecturer on some General English courses.