The Correlation and Contribution of Depth of Vocabulary Knowledge to Reading Success of EFL Bangladeshi Tertiary Students

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Abstract

The purposes of the present research work are to investigate which aspects of depth of vocabulary knowledge have strong and significant correlation with academic reading comprehension and examine to what extent different dimensions of depth of vocabulary knowledge have predicted to academic reading success in an EFL context. A total sample of 175 students at tertiary level was considered for the present study. The results of the study evince that a significant and strong correlation was found between the newly adapted analytic (meronymy) relations aspect of depth of vocabulary knowledge and academic reading success, and analytic relations was found to be the most unique predictor to explaining the academic reading success of the students. The results suggest that those students who had knowledge about the analytic (part-whole) relations of depth of vocabulary knowledge performed better in academic reading comprehension than knowledge of other dimensions of vocabulary depth, represented by morphological knowledge and both paradigmatic and

syntagmatic relations. The addition of analytical relations jointly with paradigmatic and syntagmatic relations and morphological knowledge, which represented depth of vocabulary knowledge for conducting the present research, has added to the body of knowledge.

Keywords: vocabulary depth, correlation, prediction, analytic relations, academic reading comprehension

Introduction

Lately, vocabulary dimension of language teaching and learning has gained much prominence, and it has been extensively researched in second language (L2) acquisition, assessment and instruction (Schmitt, 2010; Zhang & Yang, 2016). According to Meara (1996), the knowledge of vocabulary has definitive predictive power over the proficiency of foreign language (FL) or L2 learners, and students who possess more vocabulary knowledge are better skilled in language use than students who have less vocabulary knowledge. L2 vocabulary language researchers (e.g., Chapelle, 1998; Henriksen, 1999; Nation, 1990, 2001; Qian, 1988, 1999, 2002; Read, 1989, 1993, 1998, 2000; Richards, 1976; Wesche & Paribakht, 1996) reckon that vocabulary knowledge has manifold dimensions. Qian (1999), Read (1989), and Wesche and Paribakht (1996) propose that the knowledge of vocabulary encompasses minimally two features, i.e., breadth or size of vocabulary and quality or depth of vocabulary knowledge.

In terms of dimension, the size or breadth of vocabulary refers to the number of words a learner knows, i.e., the learner needs to possess minimal knowledge of the meaning of the words whereas depth of vocabulary knowledge denotes how well or deeply a word is known (Qian & Schedl, 2004; Qian, 2005). The facet of vocabulary known as depth of vocabulary knowledge includes different elements, such as, spelling, pronunciation, meaning, frequency, register, and syntactic and morphological traits (Qian, 1998, 1999). Vocabulary researchers have mainly focused on the significant role played by vocabulary breadth or size on reading success (i.e., Jeon & Yamashita, 2014;

Laufer, 1992, 1996; Milton, 2013; Na & Nation, 1985). Qian (2002) and Schmitt (2014) propagate that in the area of L2 research, lexical researchers have hardly recognized the significant role that depth of vocabulary knowledge (the quality of vocabulary knowledge dimension) plays till presently, and Qian (2002) further contends that few empirical studies report the association between reading comprehension and vocabulary depth knowledge (de Bot, Paribakht, & Wesche, 1997; Qian, 1998, 1999). Qian (2002) argues that both breadth and depth dimensions deserve equal attention when investigating the significant role vocabulary knowledge plays in reading comprehension; as a result, measures which have the capability to evaluate vocabulary depth knowledge effectively are sought after since L2 vocabulary knowledge investigation has demonstrated "a clear imbalance" (p. 699) regarding its multidimensionality, particularly in terms of depth of vocabulary knowledge (Zhang & Yang, 2016).

In a recently published paper, Hasan and Shabdin (2016) provided rationales for assessing different dimensions of depth of vocabulary knowledge, namely paradigmatic relation (synonyms, hyponymy, antonymy), syntagmatic relation (collocation), analytic relations (meronymy) and morphological knowledge (affixes) as integral parts of depth of vocabulary knowledge regarding the examination of "their correlation and prediction to academic reading comprehension" (p. 235).

To the best knowledge of the authors of this research work, there is a considerable lack of empirical research which deals with the relationship and prediction of the said different dimensions as indispensable parts of vocabulary depth knowledge to reading comprehension in English as a second language (ESL)/English as a foreign language (EFL) context. Keeping the above discussion in mind, the present study makes an attempt to examine the degree to which different parts of depth of vocabulary knowledge are better predictors of academic reading comprehension. It also seeks to determine the degree to which dissimilar aspects of vocabulary depth knowledge, namely paradigmatic relation (synonyms, hyponymy, antonymy), syntagmatic relation (collocation), analytic relations (meronymy) and

morphological knowledge (affixes) as integral parts of depth of vocabulary have effect on predicting to EFL learners' academic reading success. To this end, employing two new independent variables, morphological knowledge and analytical relations with paradigmatic and syntagmatic relations as parts of depth of vocabulary knowledge tests, the present study examines the depth of vocabulary knowledge of Bangladeshi EFL tertiary learners and its correlation and prediction to academic reading comprehension.

Review of Literature

Paradigmatic, Syntagmatic and Analytic Relations

Read (2004) distinguished that three fundamental associations existed between target words and associates, and they were syntagmatic (collocations), paradigmatic (synonyms, superordinates) and analytic (vocabulary items that represented a vital component concerning the denotation of the target word). An example can be given to illustrate the point.

		contract			
agreement	confident	formal	notice	sign	special

(Source: Read, 2004: 221)

The appropriate associates for the target word 'contract' in the above example are 'agreement' (shows paradigmatic relation), 'sign' (shows syntagmatic relation), and 'formal' (shows analytic relations).

Vocabulary Depth and Reading Comprehension

In connection with L2 research, Qian (1998, 1999) and Paribakht and Wesche (1997) pointed out that few empirical studies had been conducted on the association concerning depth of vocabulary knowledge and reading skill. de Bot, Paribakht, and Wesche (1997) found that varying aspects of knowledge of vocabulary, such as morphological aspect and word associations had close relationship with reading comprehension processes. Qian (1999) revealed that depth of vocabulary knowledge provided a distinctive contribution to

the prediction to the reading proficiency of the learners. His study pointed out that vocabulary depth knowledge of the learners explained about 11% of the additional variance in reading comprehension.

Furthermore, other lexical researchers acknowledged the special role of knowledge of vocabulary depth on reading skill. For example, the research conducted by Nation and Snowling (2004) focused on the predictive role of depth of vocabulary knowledge which was evaluated by an exercise of meaning aspect for the improvement of academic reading comprehension. The results from L2 vocabulary research gave evidence that a distinct relationship existed concerning depth of vocabulary knowledge and academic reading proficiency. The findings also affirmed that depth of vocabulary knowledge worked as an important contributor to success in reading achievement in L2.

A study conducted by Mehrpour, Razmjoo and Kian (2011) examined the same issue in a different context, i.e., an EFL context. Their findings showed that depth of vocabulary knowledge proved to have greater influence over the academic reading proficiency of the students from a university in Iran than breadth of vocabulary knowledge. In Korean EFL context, Kang, Kang, and Park (2012) found out that in comparison with breadth of vocabulary knowledge, vocabulary depth worked as more significant predictor to reading comprehension of the students of Korean high school. The study of de Bot et al. (1997) found out that some parts of knowledge of vocabulary; for example, associations of word, word morphology and other vocabulary depth measures had close relationship with reading comprehension process.

Morphological Knowledge and Analytical Relations

Particularly, the measures that investigated different parts of vocabulary depth knowledge in English made greater and more powerful influence over reading success in comparison with the measures which solely tested only one terming of an utterance (Nassaji, 2004). According to Vermer (2001), there was not much investigation conducted by the lexical researchers on the association among different dimensions of vocabulary knowledge. Special

importance is needed for learning the morphological properties of vocabulary knowledge by the learners (Weixia, 2014). Even though other aspects of morphological properties, such as, spelling, pronunciation, parts of speech and register were not negligible parts of depth of vocabulary knowledge (Weixia, 2014), the present study takes one aspect of morphological knowledge (derivative forms of words) as an essential part of depth of vocabulary knowledge. Morphological knowledge is an important aspect of vocabulary depth as Li and Kirby (2015) argued that the knowledge of root and affixes could help learners comprehend the formation of words which in turn would develop the learners' understanding of the relationships among words.

The assertion of Li and Kirby (2015) was that only as single vocabulary depth measure could not encompass the whole gamut of the construct; as a result, an examination of the whole set of tests that include entire aspects of vocabulary depth knowledge is needed. For example, other aspects of vocabulary depth knowledge, like morphsyntactic needs to be explored for getting complete understanding about depth of vocabulary knowledge (Ma & Lin, 2015).

Studies (Deacon & Kirby, 2004; Kieffer & Lesaux, 2008, 2012; Mahony, 1994; Nagy, Berninger, & Abbott, 2006; Tyler & Nagy, 1990) which encompassed the association concerning knowledge of morphology and reading skill fell under the scope of Psychology, and some of the studies (Deacon & Kirby, 2004; Tyler & Nagy, 1990) are longitudinal in nature and the participants of those studies include learners from second to fifth grade (Deacon & Kirby, 2004), students from sixth grade (Kieffer & Lesaux, 2012), learners from fourth to fifth grade (Kieffer & Lesaux, 2008), students from high school and college (Mahony, 1994), learners from fourth to ninth grade (Nagy *et al.*, 2006), students from tenth to eleven grade (Tyler & Nagy, 1990). None of the above mentioned studies that dealt morphological knowledge aspect and its effect on reading comprehension included participants from tertiary level.

Moreover, all the mentioned studies investigated native (L1) English speaking students (Schmitt & Zimmerman, 2002), and they did not address the association between morphological knowledge and

reading skill among EFL or ESL learners (Ma & Lin, 2015). Even though Kieffer & Lesaux (2008) conducted a study which investigated the association concerning morphological knowledge and English reading skill among Spanish-speaking students, the students were fourth-to fifth grade English language learners. The focus of most psycholinguistic research was on investigating morphological learning and processing under laboratory conditions (Schmitt & Zimmerman, 2002), and the majority of the work on morphology included inflectional knowledge (Salabeery, 2000); factors that influenced morphological processing (Zwitserlood, 1994); the frequency of a word family' members (Nagy, Anderson, Schommer, Scott, & Stallman, 1989); and a word family's size (Bertram, Baayen, & Schreuder, 2000).

Analytic relations, particularly part-whole is known as important type of sematic relation (Winston, Chaffin, & Hermann, 1987). Schmitt and Meara (1997) also claimed the importance of word association knowledge in the field of language learning; consequently, analytic (part-whole) relations could be considered as one of the significant facets of vocabulary depth knowledge. Greidanus and Nienhuis (2001) conducted a study on three types of associations among paradigmatic, syntagmatic and analytic (defining characteristics, such as those used in dictionary definitions) relations, and they found that for both higher–proficiency learners and lower-proficiency learners, the scores for both paradigmatic association and analytic association were significantly higher than those for syntagmatic association. Their study included 54 learners of French from two Dutch-speaking universities without considering learners from ESL/EFL context like the present study. Moreover, their study investigated only association among paradigmatic, syntagmatic and analytic relations and did not examine any prediction of paradigmatic, syntagmatic or manifold dimensions of analytic relations to academic reading comprehension. In a similar vein, it can said that Horiba (2012) investigated a depth test for types of associations (i.e., paradigmatic, syntagmatic and analytic). Her study conducted an investigation on only associations among paradigmatic, syntagmatic and analytic relations, and did not explore any prediction

of paradigmatic, syntagmatic relations, and different facets of analytic relations to academic reading comprehension.

Recent studies (e.g., Atai & Nikuinezad, 2012; Chen, 2011; Choi, 2013; Farvardin & Koosha, 2011; Kameli, Mustapha & Alyami, 2013; Kezhen, 2015; Li & Kirby, 2015; Mehrpour, Razmjoo & Kian, 2011; Moinzadeh & Moslehpour, 2012; Rashidi & Khosravi, 2010; Rouhi & Negari, 2013) that dealt with the association between reading comprehension and vocabulary depth knowledge had only included paradigmatic relation (synonyms, antonymy, and superordinate under hyponymy), syntagmatic relation (collocations) as a part of vocabulary depth knowledge, but other aspects, like morphological knowledge and analytic relations as a part of vocabulary depth knowledge and their association and prediction to reading comprehension had not been explored.

To the best knowledge of the authors, there has been lack of empirical investigation which combines three components, namely analytic (part-whole) relations, syntagmatic and paradigmatic relations, which represented vocabulary depth test, and morphological knowledge all together as a part of vocabulary depth knowledge in a single study and examines the prediction of all three constituents of vocabulary depth knowledge to academic reading comprehension; as a result, considering a study along the line mentioned needs to be investigated (Ma & Lin, 2015). Therefore, in the context of Bangladesh, the present study also seeks to ascertain the extent to which different aspects of vocabulary depth knowledge (analytic relations, paradigmatic and syntagmatic relations, and morphological knowledge) predict to EFL learners' reading skill, and investigate to find out which among aspects of vocabulary depth knowledge have effect on predicting to EFL learners' reading comprehension. To address the research gap in the previous studies on its basis in the above literature review, the following research questions were formulated:

1. To what degree do syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations of depth of

vocabulary knowledge correlate with academic reading comprehension?

2. To what extent, do syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations of depth of vocabulary knowledge predict to EFL learners' academic reading comprehension?

3. Which aspect of depth of vocabulary knowledge does predict the most compared to other aspects of depth of vocabulary knowledge to academic reading comprehension?

4. To what extent, do syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations of depth of vocabulary knowledge have effect on EFL learners' academic reading comprehension?

Methods

Participants

The participants in the study were a sample of 175 Bangladeshi EFL students (six sections) in the first year of their bachelor degree (i.e., graduation) from a private university in Dhaka, Bangladesh. The native language of the learners of the study was Bengali (from one language background), and the students of the study used English as a foreign language. The participants of the study had at least 12 years of learning English, i.e., all the students who participated in the study had an average of 12 years exposure to English learning. Out of the participated students, 96 were male (54.9%) and 79 were female (45.1%) who were from Bachelor of Business Administration (BBA) in Accounting (n = 30), Bachelor of Science in Economics (pilot n = 20), Bachelor of Science in Economics (n = 25), BBA in Other Majors (n = 36), Bachelor of Science in Computer Science and Engineering (CSE, n = 34), and Bachelor of Science in Electrical and Electronic Engineering (EEE, n = 30). The average age of the students was about 20.33.

Measures

The participants completed three vocabulary instruments, namely a depth of vocabulary knowledge test which was represented by syntagmatic and paradigmatic relations, a morphological knowledge test, and an analytical relations test and a reading comprehension test that consisted of three multiple choice passages.

- ### *Depth of Vocabulary Knowledge Test*

The depth of vocabulary knowledge test which was administered for current study was partly the version of Word Associates Test (WAT). In other words, version 4 of the WAT and depth of vocabulary test used by Qian and Schedl (2004) were adapted and employed in order to assess the depth of vocabulary knowledge of the current study. The depth of vocabulary knowledge test comprised 40 items, and the test proposed to evaluate two constituents of vocabulary depth knowledge; they were paradigmatic (meaning/synonyms) and syntagmatic (collocation) relations of words. Under each item, there were two groups, and each group contained words. Each different column had four words, and out of the eight words, four words were associates to the stimulus words whereas the other four words worked as distractors. An incorrect selection of the answer was given 0; as a result, the maximum achievable score of the test was 4 x 40 =160.

- ### *Analytic Relations Test*

The analytic relation test for the current study was adapted on the basis of the idea about part-whole relations propagated by Winston, Chaffin and Herrmann (1987), and the aim of the test was to measure the part-whole relations of words. The test consisted of 30 blanks, and the testees were required to write/fill either part or whole meaning of the words in the blanks. In scoring the test, one point was given for each appropriate answer, so the highest score for the test was 30.

- ***Morphological Knowledge Test***

Morphological knowledge test of the present study was executed by checking the learners' productive knowledge of the derivative forms of a word family, particularly the word classes of noun, verb, adjective, and adverb. The students were asked to jot down the correct derivative forms of the target word in each blank. If the learners believed that no derivative form did exist, they simply placed an X in the blank. The students were told that the prompt word could be the proper target word without any alternation. The test directly aimed at examining the knowledge of the parts of speech of the learners. As the main focus was on derivational, the researchers disregarded any attached inflections.

Since the participants were university students who were not native speakers of English, the researchers decided to choose words from Academic Word List (AWL; Coxhead, 2000; Schmitt and Zimmerman, 2002). The AWL encompasses words that can be seen in different academic contexts, including reading texts, nonetheless any discipline. For the current study, the structure of the morphological test was adapted on the basis of the test deigned by Schmitt and Zimmerman (2002). In scoring for the morphological knowledge test, one point was awarded to the learners for their correct answers. An incorrect answer provided 0 point. The test had 30 blanks, so the maximum possible score for the test was 30. In addition, the main selection criterion regarding the target words was frequency, not the factors that were related to morphological difficulty. The majority of the words were derived from one parts of speech to another parts of speech; in addition, the students realized that some words could not be changed into an adverb form because those words do not any adverb from in English.

- ***Reading Comprehension Test***

Reading comprehension test of the study was a standard multiple-choice academic reading comprehension test, and this test was adopted from Longman Test of English as a Foreign Language (TOEFL) (Philips, 2006, pp. 343-345). The original reading

comprehension test that was taken from TOEFL by Philips (2006) consisted of five sections, and time allocated for completing the reading comprehension test was 55 minutes. In order to administer all the tests for the present study, constraints of time were anticipated, so there was a need to shorten the original reading comprehension test. Consequently, two passages were taken out randomly. Out of five passages, three texts were selected for the current study, and the total number of multiple-choice questions was 20. The maximum possible score for the test was 20 as there was a total of 20 questions.

Research Design and Data Collection Procedures

The present study followed multiple regression analysis under quantitative research. In other words, the quantitative approach was selected, and the multiple regression analysis was used to describe the potential predictions of the independent variables to dependent variable. Before administering the four instruments, namely depth of vocabulary knowledge test, morphological knowledge test, analytic relations test and academic reading comprehension test, a printed 'letter of informed consent' and a 'background questionnaire' were provided to the students. In the letter of informed consent, there was an option (tick √ or ×) where the students were asked whether they participated willingly or not. The participation of the students for the tests measure was voluntary.

Concerning the present study, the total number (i.e., population of the study) of students who were pursuing English courses with their respective majors under different schools in the university was 3,640. Out of the total number of students, 56 sections (classes) were under school of Business and Economics, and 48 sections (generally, one class consisted of 30 to 35 students) were under school of Science and Engineering. Furthermore, purposive sampling in the first place and random sampling as second step were employed for the present study. Figure 1 shows the details of the sample design for the current study.
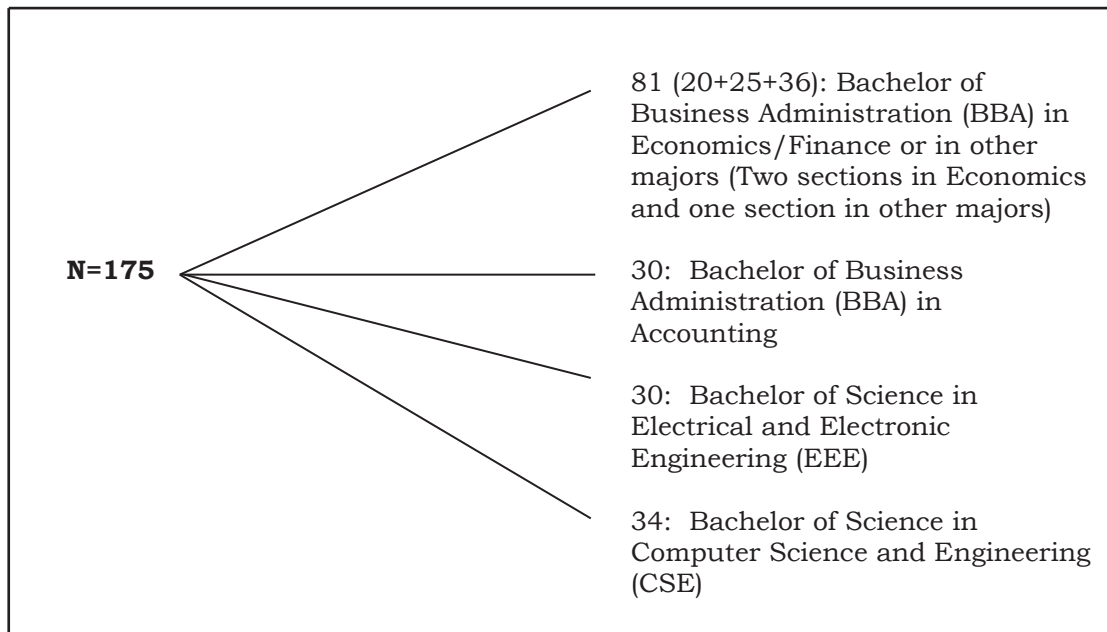
Figure 1: Sample design for the present study

In order to avoid the potential effect of order or to reduce the potential influence of learning effects, the depth of vocabulary knowledge test and morphological knowledge test were administered first in a day and then academic reading comprehension test and analytic relations test were conducted next in another class. In other words, the four tests were conducted in two successive sessions for the students in regular English classes of the students. The time assigned for depth of vocabulary knowledge was 40 minutes and 30 minutes for morphological knowledge test. The students were provided 25 minutes to answer reading comprehension test and another 30 minutes to perform the analytic relations test. More importantly, the basis of allowing maximum time to complete all the tests in the main study was on the experience of conducting all the tests under the pilot study.

In addition, the researchers intended to administer all the four tests in single sessions, but it was not possible because of the following reasons. Generally, the stipulated total time for each class of the participated students of the university where the current research was conducted was one hour and twenty minutes (80 minutes). Since the stipulated total time of all the four tests took 125 minutes to complete,

allocated one class hour (80 minutes) to conduct all the four tests in single sessions was not suffice. Moreover, time for filling up the consent form, and making each student understand the same type of instructions and explanations for each test before administering the tests took at least additional five minutes in addition to the time stipulated for each test.

Merging pilot sample into the main study

The background of the pilot group and main groups of the study was identical, including their mother tongue, Bengali. In order to identify whether the data obtained from both the pilot group (one section) and main group (five sections) could be compared and consequently, whether the six groups could be treated as one sample, the means, standard deviations, and the ranges of the scores of the pilot group and main group (all five sections) were computed. To this end, one-way ANOVAs (Analysis of Variance) were administered on four variables, depth of vocabulary knowledge test, morphological knowledge, analytic relations and reading comprehension to find out whether there were any differences among the means of the pilot group and main group (five sections).

In addition, full sample analysis of the data was followed, and later the means, standard deviations, and ranges of the score on depth of vocabulary knowledge test, morphological knowledge, analytic relations and reading comprehension were computed one at a time. The results are provided in Table 1.

Table 1: Means, Standard Deviations and Score Ranges of Depth of Vocabulary Knowledge, Morphological Knowledge, Analytic Relations, and Reading Comprehension for the Full Sample (N= 175)

Test	MPS*	Mean	Standard Deviation	Score Range
DVK[1]	160	144.87	8.317	118-159
MK[2]	30	18.70	3.959	08-28
AR[3]	30	22.83	3.804	10-30
RC[4]	20	12.80	3.292	04-20

MPS*= Maximum Possible Score; [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

Table 2 shows the means of depth of vocabulary knowledge test, morphological knowledge, analytic relations, and reading comprehension for BBA in Accounting ($n = 30$), Bachelor of Science in Economics (pilot $n = 20$), Bachelor of Science in Economics ($n = 25$), BBA in Other Majors ($n = 36$), Bachelor of Science in CSE ($n = 34$), and Bachelor of Science in EEE ($n = 30$).

Table 2: Means of Depth of Vocabulary Knowledge, Morphological Knowledge, Analytic Relations, and Reading Comprehension for all Six Sections

Test	[a] Account	[b] Eco (Pilot)	[c] Eco	[d] BBA OM	CSE	EEE	F	P Value	Sig.
DVK[1]	148.50	147.80	135.96	140.44	148.21	148.27	1.326	0.255	n.s.*
MK[2]	18.63	19.15	20.32	17.28	18.29	19.30	2.093	0.069	n.s.*
AR[3]	21.97	22.90	23.16	22.00	23.97	23.11	1.305	0.264	n.s.*
RC[4]	11.00	12.85	12.56	12.35	13.70	14.67	1.575	0.170	n.s.*

n.s.* = Not Significant at 0.05, [a] Accounting, [b] Economics Pilot, [c] Economics, and [d] BBA in Other Majors, [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

Table 3 shows the standard deviations of depth of vocabulary knowledge test, morphological knowledge, analytic relations and reading comprehension for BBA in Accounting ($n = 30$), Bachelor of Science in Economics (pilot $n = 20$), Bachelor of Science in Economics ($n = 25$), BBA in Other Majors ($n = 36$), Bachelor of Science in CSE ($n = 34$), and Bachelor of Science in EEE ($n = 30$).

Table 3: Standard Deviations of Depth of Vocabulary Knowledge, Morphological Knowledge, Analytic Relations, and Reading Comprehension for all Six Sections

Test	[a] Account	[b] Eco (Pilot)	[c] Eco	[d] BBA OM	CSE	EEE	F	P Value	Sig.
DVK[1]	5.970	6.678	7.558	6.367	6.573	8.217	1.326	0.255	n.s.*
MK[2]	3.479	3.717	3.902	4.138	3.762	4.244	2.093	0.069	n.s.*
AR[3]	4.567	3.726	3.880	3.284	3.477	3.745	1.305	0.264	n.s.*
RC[4]	3.930	3.281	2.518	2.751	2.899	3.293	1.575	0.170	n.s.*

n.s.* = Not Significant at 0.05, [a] Accounting, [b] Economics Pilot, [c] Economics, and [d] BBA in Other Majors, [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

Table 4 shows score ranges of depth of vocabulary knowledge test, morphological knowledge, analytic relations, and reading comprehension for BBA in Accounting (n = 30), Bachelor of Science in Economics (pilot n = 20), Bachelor of Science in Economics (n = 25), BBA in Other Majors (n = 36), Bachelor of Science in CSE (n = 34), and Bachelor of Science in EEE (n = 30)

Table 4: Score Ranges of Depth of Vocabulary Knowledge, Morphological Knowledge, Analytic Relations, and Reading Comprehension for all Six Sections

Test	[a] Account	[b] Eco (Pilot)	[c] Eco	[d] BBA OM	CSE	EEE	F	P Value	Sig.
DVK[1]	136-158	137-159	127-147	128-154	132-158	132-158	1.326	0.255	n.s.*
MK[2]	13-26	12-26	13-28	8-26	11-24	11-26	2.093	0.069	n.s.*
AR[3]	13-26	15-29	10-29	15-27	14-30	16-28	1.305	0.264	n.s.*
RC[4]	5-19	8-18	9-18	7-17	8-19	4-19	1.575	0.170	n.s.*

n.s.* = Not Significant at 0.05, [a] Accounting, [b] Economics Pilot, [c] Economics, and [d] BBA in Other Majors, [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

Form the results of the above Tables 1 to 4, it can be observed that the values of the corresponding parameters of the six sections appear to have almost identical patterns in general even though the values are not similar. The observation conforms that one-way ANOVAs found that statistical difference did not exist among the pilot group and main group (five groups) means of depth of vocabulary knowledge, morphological knowledge, analytic relations, and reading comprehension; as a result, both pilot group and main group (all six sections) could be treated as one sample in the analysis of the present study. The foremost reason to integrate the pilot group and main group (total six sections) related a purely technical aspect since reliable statistical results, particularly regarding multiple regression, could be better derived when there was availability of a sufficient large number of data points. Subsequently, all the six groups were merged in order to sustain a considerable sample size, and this in turns would enhance the power of standard multiple regression analysis.

Piloting

Before commencing the main study, the researchers conducted piloting in order to measure the reliability and validity of the major instruments, namely depth of vocabulary knowledge test, reading comprehension, analytic relations, and morphological knowledge of the current research work and also to make an attempt to figure out related pragmatic issues, which included the suitability of the materials for testing and total time which was prerequisite to accomplish the assessments.

Validity of the Instruments of the Study
- *Descriptive Statistics and Reliability*

Table 5 demonstrates the performance of the learners (n =20) on all four language tests and the reliability of the tests (n = number of items) of the pilot study.

Table 5: Means, Standard Deviations and Reliability Coefficients Values

Tests	n*	Range	Minimum	Maximum	Mean	Std. Deviation	K-R 21 Reliability Coefficients	MPS**
DVK[1]	40	22.00	137.00	159.00	147.80	6.677	0.750	160
MKT[2]	30	14.00	12.00	26.00	19.15	3.717	0.516	30
AR[3]	30	14.00	15.00	29.00	22.90	3.726	0.631	30
RC[4]	20	10.00	8.00	18.00	12.85	3.281	0.630	20

** MPS= maximum possible score * n = number of items, [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

The *r* values (reliability coefficients) of the four tests, namely depth of vocabulary knowledge test, morphological knowledge, analytic relations, and reading comprehension were moderate even though the *r* value (0.516) of morphological knowledge was the lowest in comparison with *r* values of other tests. In spite of that, the score of morphological knowledge can be considered to have accepted level of reliability since the number of items (20) was small. Importantly, the acceptable K-R-21 score is dependent on the type of conducted test. Generally, a score, that is, above 0.05 is regarded as reasonable. According to Salvucci, Walter, Conley, Fink, & Saba (1997:115), in terms of the range of reliability measure, when the *r* value is less than 0.50, the reliability is considered low; if the *r* value is between 0.50 and 0.80, the reliability is

regarded as moderate whereas the *r* value is greater than 0.80, the reliability is treated as high. Even though K-R 21 employs less information to compute, it always provides a lower reliability index than produced by other methods (Alderson, Clapham, and Wall, 1995).

Results

Relationship Among the Independent Variables and Dependent Variable

To answer the research question one regarding the extent of correlations of syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations among each other and correlations between syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations of vocabulary depth knowledge and academic reading comprehension, a two-tailed Pearson correlation was conducted, and results are presented in Table 6.

Table 6: Correlations Among the Variables

	DVK[1]	MKT[2]	AR[3]
MKT	.434**	-----	
AR	.284**	.418**	-----
RC[4]	.381**	.390**	.502**

**p* < .01; [1] depth of vocabulary knowledge test, [2] morphological knowledge, [3] analytic relations, and [4] reading comprehension

As shown in the Table 6, inter-correlations among the scores of three independent variables, vocabulary depth knowledge test (represented by both paradigmatic and syntagmatic relations), morphological knowledge (the four major derivative classes, i.e., noun, verb, adjective, and adverb), and analytic relations (six components, i.e., component-integral, member-collection, portion-mass, stuff-object, feature-activity and place-area) were all statistically significant. A significant and positive correlation at the 0.01 level (*r* = .434; *p* = .000) was found between syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test and morphological knowledge. According to Cohen (1988, p. 80), in behavioural sciences,

a correlation of *r* about 0.50 or above generally indicates a 'large correlation effect size', and he also suggests that when the coefficient value *r* is between ± 0.30 and ±0.49, the relationship is considered as medium, and when *r* coefficient value is between ±0.1 and ±0.29, the association is said to be as small.

Accordingly, the correlation between vocabulary depth knowledge test and morphological knowledge suggests that students who learned both paradigmatic and syntagmatic relationship also mastered the four derivative forms of morphological knowledge, which represented depth of vocabulary knowledge. Also, a significant and positive correlation at the 0.01 level ($r = .284$; $p = .000$) was found between vocabulary depth knowledge test and analytic relations. It shows that students who learned both paradigmatic and syntagmatic relations aspects also mastered six dimensions of analytic relations, which represented depth of vocabulary knowledge.

The same can be observed regarding the correlation between morphological knowledge and analytic relations. A significant and positive correlation at the 0.01 level ($r = .418$; $p = .000$) existed between morphological knowledge and analytic relations. This indicates that students who learned the four major derivative word classes also mastered the six features of analytic relations. Out of the inter-correlations among the three components of vocabulary depth knowledge, the significant correlation between syntagmatic and paradigmatic relations, which represented depth of vocabulary test and morphological knowledge of vocabulary depth knowledge was the highest ($r = .434$).

However, as shown in Table 6, a statistically significant and positive correlation at the level of 0.01 ($r = .381$; $p = .000$) was found between both syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test and academic reading comprehension. Moreover, the four derivative word forms, which represented morphological knowledge of depth of vocabulary knowledge bore positive and statistically significant correlation at the level of 0.01 ($r = .390$; $p = .000$) with academic reading comprehension. The significant, positive, and high correlation at the level of 0.01 ($r =$

.502; *p* = .000) between six dimensions of analytic relations, represented depth of vocabulary knowledge and academic reading comprehension was the highest in comparison with associations between the other two independent variables and academic reading skill. This signifies that students who had knowledge about component-integral, member-collection, portion-mass, stuff-object, feature-activity, and place-area analytic relations parts of vocabulary depth knowledge performed better in academic reading comprehension than students with knowledge of syntagmatic and paradigmatic relations and the four major derivative word forms of morphological knowledge that represented depth of vocabulary knowledge. To conclude, in other words, all three components of depth of vocabulary knowledge helped learners perform better in academic reading comprehension.

Prediction of Depth of Vocabulary Knowledge, Morphological Knowledge, and Analytic Relations to Reading Comprehension

Research questions two, three and four were developed to determine the most significant, unique predictor of academic reading comprehension and to address the extent of the effect of the three dimensions of depth of vocabulary knowledge on academic reading comprehension, for the researchers conducted multiple regression analysis (force-entry). Results of the regression analysis which appear in Table 7 and 8 show prediction value, ANOVA and coefficient values of all the three independent variables on dependent variable in terms of scores of students of Business and Engineering schools. Since the 'f' statistics in ANOVA table was found to be significant at the 0.001 level (R^2 = 0.327), F (3, 162) = 26.277, p < .001, the run regression model was found to be well-fitted for the data.

Table 7: *Prediction Value of Independent Variables and ANOVA Value*

R	R^2	Adjusted R^2	Std. Error of the Estimate	ANOVA			
				df	Mean Square	F	*p*
.572	.327	.315	2.725	3	195.135	26.277	.000

a. Dependent Variable: reading comprehension; b. Predictors: (Constant), depth of vocabulary knowledge test, morphological knowledge, and analytic relations

Table 8: Coefficients of All Variables of Students of Business and Engineering

IV[1]	Standardized Coefficients β	t	Sig.	Correlations Part ial	Part	Collinearity Statistics Tolerance	VIF
DVK[a]	.212	2.943	.004	.225	.190	.799	1.252
MKT[b]	.137	1.799	.074	.140	.116	.717	1.395
AR[c]	.385	5.379	.000	.389	.347	.812	1.231

a. Dependent Variable: reading comprehension; IV[1] = Independent Variables, [a] depth of vocabulary knowledge test, [b] morphological knowledge, and [c] analytic relations

The value of R-Square (R^2 =.327) indicates how much the variance in the dependent variable, academic reading comprehension was explained by the other three independent variables, namely depth of vocabulary knowledge test, morphological knowledge, and analytic relations of the model. From the above Table 7, it can be said that the present regression model, using three predictor (independent) variables jointly explained about 32.7 % of the variance in academic reading comprehension. The R^2 value is .327, so it can be stated that 32.7% of the variation for the criterion/dependent variable, that is, academic reading comprehension was accounted for jointly by the independent variables, i.e., depth of vocabulary knowledge test, morphological knowledge and analytic relations.

In addition, as shown in Table 8, squaring the part coefficient value $(.190)^2$ means that syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test uniquely (alone) explained about 3.61% of the variance in total reading comprehension score. Squaring the part coefficient value $(.116)^2$ indicates that morphological knowledge uniquely explained about 1.3456% of the variance in total reading comprehension score. On the other hand, squaring the part coefficient value $(.347)^2$ reflects that analytic relations uniquely explained about 12.0409% of the variance in the total reading comprehension score. The above discussion shows that the highest

unique prediction was explained in academic reading comprehension by analytic relations of depth of vocabulary knowledge (12.0409%).

From the above Table 8, it can be seen that the Beta value of analytic relations of depth of vocabulary knowledge was the largest (β = .385). In terms of Beta value discussion, it is known that a large t value paired with small significance value suggests ('t' and 'sig' value) the predictor value (independent value) has large impact on the criterion or dependent value. Moreover, the largest Beta value indicates that analytic relations of depth of vocabulary knowledge (β = .385; t = 5.379, p = .000 (significant) ($p < 0.001$)) made the largest effect on explaining the outcome variable, academic reading comprehension when the variance was explained by all other variables jointly. The Beta values of the other independent variables, namely syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test and morphological knowledge inform that morphological (derivative words) knowledge (β =.137; t = 1.799, p = .74 (significant) ($p \leq 0.05$)) made lesser effect on explaining the outcome variable, reading comprehension than syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test (β = .212; t = 2.943, p = .004 (significant) ($p < 0.01$)), and morphological knowledge had the least effect on explaining the outcome variable, academic reading comprehension.

With a careful look of the above Table 8, it can be found that of all the three independent variables, analytical relations made statistically significant unique contribution to the prediction (at the 0.000 level) of the outcome in the model as the p value of analytic relation was less than 0.001 ($p < .001$), and out of the remaining two variables, syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test also made statistically significant unique contribution to the prediction (at the 0.01 level) since the p value of depth of vocabulary knowledge test was less than 0.01 ($p < .01$). The other independent variable, namely morphological knowledge made statistically significant unique contribution to the prediction (at the 0.05 level) of the outcome too as the p value is less than 0.10 ($p \leq 0.05$). From the result discussed above, it can be suggested that all the

three independent variables, namely depth of vocabulary knowledge test, morphological knowledge, and analytic relations (i.e., all the three independent variables represented depth of vocabulary knowledge) made statistically significant and unique contribution to the prediction of the outcome, academic reading comprehension.

Armed with the above discussion, it can be implied that (i) regarding the scores of students of Engineering and Business schools, analytic relations of depth of vocabulary knowledge had the highest correlation with academic reading comprehension whereas syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test correlated significantly and positively with morphological knowledge of depth of vocabulary knowledge, and (ii) analytic relations of depth of vocabulary knowledge not only made the strongest, unique, and significant contribution to explaining the outcome variable, reading comprehension but also it had the largest effect on outcome variable, reading comprehension when the variance was explained by the other independent variables jointly.

Discussion and Conclusion

Relationship Among the Independent Variables and Dependent Variable

Analytic relations, which represented depth of vocabulary knowledge was positively and significantly correlated with academic reading comprehension. In other words, those students who gained more analytical relations (part-whole) knowledge performed better than students with morphological knowledge and syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test. This is one of the new findings of the current research work, and this adds to the knowledge in vocabulary learning and pedagogy. Moreover, those students who gained morphological (derivative forms of words) knowledge performed better than students who had paradigmatic and syntagmatic relations, which represented depth of vocabulary knowledge test. This result did not corroborate the findings of Qian (1998, 1999, 2002). Qian's (1998, 1999, 2002) studies indicate that those students who had both paradigmatic and

syntagmatic relationship knowledge (i.e., depth of vocabulary knowledge test) performed better in academic reading comprehension than other aspects of depth of vocabulary knowledge, namely morphological knowledge. In the present study, morphological knowledge was found to have significant correlation with reading comprehension than syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test. If Qian (1998) increased the sample size (the sample size of his study was 74), he might have discovered strong correlation between morphological knowledge and reading comprehension. On the contrary, the study of Horiba (2012) found out no unique and significant effect of depth of vocabulary depth knowledge on reading comprehension. Her findings supported the findings of the current research work.

Moreover, the morphological knowledge test of the present study was different from the study of Qian (1998) in terms of designing the test items. Morphological knowledge test under the present study included words that were required to change different parts of speech (e.g., noun, verb, adjective and adverb) by the learners whereas the morphological test in Qian's (1998) study incorporated words which consisted of affixes that were to be identified to discern whether any change or not in parts of speech took place.

Prediction of Depth of Vocabulary Knowledge, Morphological Knowledge, and Analytic Relations to Reading Comprehension

Depth of vocabulary knowledge, measured by different dimensions, namely paradigmatic relation, syntagmatic relation, morphological knowledge and analytical relations jointly and significantly contributed more than 32.5% (32.7) variation in the dependent variable, academic reading comprehension. The result corroborated the other previous findings of L2 learners of English (e.g., Li & Kirby, 2015; Qian, 1998, 1999, 2002; Zhang & Yang, 2016) even though the cited studies did not include morphological knowledge and analytical relations under depth of vocabulary knowledge test. On the other hand, the newly added variable, analytical relations contributed the most to explain the variance in academic reading comprehension

than depth of vocabulary knowledge test, represented by both syntagmatic and paradigmatic relations and morphological knowledge. Morphological knowledge was the least contributor to explaining the outcome. The least contribution by morphological knowledge substantiated the previous findings (e.g., Qian, 1998, 1999, 2002); on the contrary, Zhang (2016) found that derivational awareness, i.e., morphological awareness directly and significantly predicted to reading comprehension of ESL learners.

Furthermore, the investigation by Li and Kirby (2015) showcased that breadth of vocabulary knowledge significantly predicted to reading comprehension measure which consisted of multiple choice questions; on the other hand, depth of vocabulary knowledge contributed more to summary writing which was treated as a measure of deeper text processing even though both breadth and depth of vocabulary knowledge contributed to word reading. Their study highlighted the significant roles of different facets of vocabulary knowledge for different types of L2 reading. Similarly, the findings of the current study demonstrated that different aspects of depth of vocabulary knowledge, particularly analytic relations significantly predicted to an academic reading comprehension measure which comprised three multiple choice passages. In addition, the dynamic relations between the growth of vocabulary knowledge and reading comprehension was explored by Quinn, Wagner, Petscher, and Lopez (2015), and they pointed out that the development of both vocabulary knowledge and reading comprehension took place every year, but the rate of the development decreased over time. In other words, their study revealed that the growth in the reading comprehension was dependent partly on vocabulary knowledge. The results of Quinn, Wagner, Petscher, and Lopez (2015) shed light on the findings of the current study where an association and prediction of different dimensions of depth of vocabulary knowledge with/to academic reading comprehension were found.

In the present study, analytic relations also made the most statistically significant unique contribution to the prediction to the outcome, academic reading comprehension. As analytical relations is

considered an important aspect (e.g., Winston, Chaffin & Herrmann, 1987) of vocabulary depth knowledge, the significant role played by analytical relations is not surprising. This is the new finding of the current research, and this aspect of inclusion of analytical relations under vocabulary depth knowledge and its contribution to academic reading comprehension in the present study is a contribution to the knowledge domain.

Implications

The lack of depth of vocabulary knowledge of the students affects their overall language proficiency as well as their language skills. Not having sufficient knowledge of manifold dimensions of depth of vocabulary knowledge by the students would hinder the growth of their academic reading success and overall language proficiency in general. Since the present study found the significant role played by analytic relations (part-whole) of depth of vocabulary knowledge on reading comprehension, students need to master the different aspects of analytic relations of depth of vocabulary knowledge, and more attention should be paid to teach the different dimensions of depth of vocabulary knowledge, particularly analytic (meronymy) relations part, morphological (derivational forms of words) knowledge in the classroom. Since the present study investigated primarily the relationship and prediction between different dimensions of vocabulary depth knowledge and academic reading comprehension, any impact of the native language or background knowledge of the participants on the test results was not explored.

From the discussion that has been dealt so far, it can be observed that the correlation between analytic relations and academic reading comprehension was the strongest, and analytic relations was the most significant predictor to reading comprehension. About 32.7% of the variance in academic reading comprehension was explained jointly by all the three independent variables. About 12.04% of the variance was explained by analytic relations alone. To the best knowledge of the researchers, little empirical evidence in quantitative research work was conducted by adding analytical relations jointly

with paradigmatic and syntagmatic relations, which represented depth of vocabulary knowledge test and morphological knowledge of depth of vocabulary knowledge, and conducting the present research with comprising analytical relations with other aspects of depth of vocabulary knowledge has added to the body of knowledge.

Suggestions for Future Research

While designing the analytic relations test, the researchers focused on taking tests by asking students to fill in the blanks questions option. However, similar multiple choices options (providing distractors responses as well) like depth of vocabulary knowledge test of the present study can be tried out for testing analytic relations. Will the results be different when the analytic relations test is conducted in the said fashion? This needs further future investigation. In addition, the present research study did not include the relationship and prediction of different aspects of depth of vocabulary knowledge with/to other language skills, such as, listening, writing, and speaking. Further research investigations can be carried out to find out whether different dimensions of depth of vocabulary knowledge can correlate and predict strongly and significantly to other language skills as well.

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