

Engineering EFL learners' Vocabulary Depth Knowledge and Its Relationship and Prediction to Academic Reading Comprehension

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Abstract– *An in-depth investigation of depth of vocabulary knowledge by the lexical researchers occupies indeed a prominent position in language learning and teaching. In order to achieve that, using an adapted morphological test and an analytic relations test, this study investigated knowledge of vocabulary depth of English as Foreign Language (EFL) learners and its association and prediction to the learners' academic reading success. Results showed that not only syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test had the most significant positive association with academic reading comprehension but also more importantly, vocabulary depth was found to be the strongest unique predictor of academic reading performance. In addition, derivative forms of words, represented morphological knowledge did not lag behind building significant positive association with reading skill and contributing to predicting to academic reading comprehension. The results of the study suggested that those students who gained depth of vocabulary knowledge, represented by both paradigmatic and syntagmatic relations performed better than morphological (derivative forms of words) knowledge and analytic (meronymy) relations. To conclude, moreover, the results of the current study also signified a unique and significant effect of depth of vocabulary knowledge on academic reading comprehension.*

Keywords – *Academic Reading Comprehension, Analytic Relations, Prediction, Vocabulary Depth Knowledge*

INTRODUCTION

More than three decades ago, vocabulary was treated as a neglected dimension of language teaching and learning [1]. Recently, it has plausibly become one of the most substantially research niches in second language (L2) acquisition, assessment and instruction [2]. Up till now, research on L2 vocabulary knowledge have evidenced a clear polarity regarding its multidimensionality [3]. For example, vocabulary researchers have mainly focused on the significant role played by vocabulary breadth or size (i.e., how many words one knows) on reading success [4]-[11]. Nevertheless, far less about vocabulary depth knowledge or different dimensions of depth of vocabulary knowledge (i.e., vocabulary knowledge that pertains to the quality of words) have been investigated by researchers [2]. Qian [12] argues that both breadth and depth dimensions deserve equal attention for investigating the significant role

vocabulary knowledge plays in reading comprehension. Contemporary researchers that encompassed depth of vocabulary knowledge put stress on mainly syntagmatic (synonymy and polysemy) and paradigmatic (collocation) relations of vocabulary depth knowledge and their relationship with reading comprehension in English as a Second Language (ESL)/English as a Foreign Language (EFL) contexts [12]-[19]. Little is known about the combined morphological (derivative forms of words) knowledge and analytic relations (part-whole) aligned with syntagmatic and paradigmatic relations and their association and prediction to scores of academic reading comprehension, particularly in the context of Bangladesh. To this end, employing an adapted morphological knowledge test and a developed analytic relations test, this study investigated Bangladeshi engineering EFL learners' depth of vocabulary knowledge and its relation and prediction to their academic reading comprehension.

Theory Relating Vocabulary to Comprehension

The nature of association that exists between vocabulary knowledge and comprehension is not completely fathomed [20]. Moreover, educational researchers have propounded a reciprocal model, and posited that vocabulary knowledge validates comprehension of text and text comprehension supports vocabulary learning [20],[21]. In addition, Anderson and Freebody [22] have accounted for several hypotheses that seek to explain the association between vocabulary and comprehension. The first one is aptitude hypothesis, which proposes that an underlying factor (i.e., general aptitude) links vocabulary and comprehension. The second one is knowledge hypothesis which suggests that in reality vocabulary stands for knowledge, and the knowledge itself improves comprehension. The third one is instrumentalist hypothesis which suggests that knowledge of a meaning of a word directly influences reading comprehension. The final one is known as speed-of-access hypothesis that focuses on speed of access to word meanings.

On the other hand, in connection with the assessment of L2 vocabulary depth, according to Read [11], that in the literature, the existence of two approaches can be found for the assessment of L2 depth of vocabulary knowledge (as cited in Zhang & Koda [23] p. 2). The first approach is “developmental” approach which represents the incremental nature of vocabulary acquisition. Also, the “developmental” approach is represented by Vocabulary Knowledge Scales. On the contrary, the “dimensional” approach maintains that depth of vocabulary knowledge includes different kinds of knowledge about words, and they can be meaning, form, and use in terms of both receptive and productive senses and in both written and spoken modalities. The current study has taken up the “dimension” approach to examine the relationship and prediction between different dimensions of depth of vocabulary knowledge and academic reading comprehension.

Paradigmatic, Syntagmatic and Analytic Relations

Read [24] 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 regarding the denotation of the target word). An example can be given to illustrate the point.

Contract agreement confident formal notice sign special (Source: Read, [24]: 221)

The appropriate answers for the above example are ‘agreement’ (paradigmatic), ‘sign’ (syntagmatic), and ‘formal’ (analytic).

Vocabulary Depth Knowledge and Reading Comprehension

Less investigation on how depth of vocabulary knowledge contributes to reading success has been conducted [4]. Qian [15] in his study of ESL learners in Canadian universities found that learners’ vocabulary depth explained about 11% extra variance in their reading success. His study suggested that vocabulary depth knowledge tended to be more significant predictor to reading comprehension than vocabulary size. Several studies [25]-[28] showcased significant, positive, and moderate correlations between depth of vocabulary knowledge and reading comprehension. The above studies that dealt with the association between reading comprehension and vocabulary depth knowledge only included paradigmatic relation (synonyms, antonymy, and superordinate under hyponymy) and 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 and their prediction to reading comprehension had not been delved into.

OBJECTIVES OF THE STUDY

Keeping the above discussion in mind, the following research objectives were formulated:

1. To determine the extent of syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations correlate with academic reading comprehension
2. To examine the level of prediction of different dimensions of vocabulary depth knowledge (i.e., paradigmatic relation, syntagmatic relation, analytic relations, and morphological knowledge) to EFL learners’ reading comprehension.
3. To determine the extent of scores of different dimensions of vocabulary depth knowledge have effect on predicting to academic reading comprehension.

MATERIALS AND METHODS

Participants

The participants of the current study were 64 students studying Engineering at a private university in Bangladesh. Out of them, 20 were female (31.3%) and 44 were male (68.8%), with an average age of about 20.16. One section consisted of 31 students who were pursuing studies in Bachelor of Science in Electrical and Electronic Engineering (EEE), and the other section comprised of 33 students who were under department of Computer Science and Engineering (CSE). All of the students' mother tongue was Bengali. 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.

Measures

Depth of Vocabulary Knowledge Test

Depth of vocabulary knowledge measure which was administered for current study was partly the version of Word Associates Test (WAT) by Read [24]. WAT was considered as a reliable test to assess several paradigmatic and syntagmatic characteristics of depth of vocabulary knowledge [16]. The depth of vocabulary knowledge test comprised 40 items, and 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 $4 \times 40 = 160$.

Analytic Relations Test

Analytic relations test for the current study was adapted on the basis of the idea about part-whole relations propagated by Winston, Chaffin and Herrmann [29], and the aim of the test was to measure the part-whole relations of words. A part-whole relation is one of the significant aspects of vocabulary depth knowledge. 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 analytic relations 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. Students were asked to jot down the correct derivative forms of the target word in the provided each blank. If the learners believed that no derivative form did exist, they simply placed an X in the blanks. As the main focus was on derivational, the researchers disregarded any attached inflections. For the current study, the structure of the morphological knowledge test was adapted on the basis of the test designed by Schmitt and Zimmerman [30]. 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.

Reading Comprehension Test

The 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, [31], pp. 343-345). Out of several 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 current study followed multiple regression analysis of correlation design under quantitative research. In other words, the quantitative approach was selected, and the multiple regression analysis was used to describe the potential prediction 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 \checkmark or \times) where the students were asked whether they participated willingly or not. The participation of the students for the tests measure was voluntary.

One reading comprehension test and an analytic relations test were administered in one session, and depth of vocabulary knowledge test and morphological knowledge test were administered in another session, i.e., the four tests were conducted in two successive sessions to the students in regular English classes of the students. The time assigned for depth of vocabulary knowledge was 40 minutes and 30 minutes morphological knowledge test. The students were provided 25 minutes to answer reading comprehension test and another 30 minutes to perform the analytic relations test.

In order to find out the level of inter-correlations among depth of vocabulary knowledge test, analytic relations, morphological knowledge and reading comprehension, the two-tailed Pearson correlation was selected for analysing the data. In addition, to determine the powerful predictors of reading comprehension, standard multiple regression analysis was carried out. In other words, force-entry multiple regression (not stepwise) analysis was applied to find out the significant role played by knowledge of vocabulary depth in explaining academic reading skill. SPSS version 24 (Statistical Package for Social Studies) was exercised as the key statistical program for analysing the data.

Validity of the Instruments by Pilot Study

Kuder-Richardson Formula 20 or K-R-20 is used for measuring reliability of a test which consists of right or wrong answers, and it is designed to investigate how well a test measures that a researcher intends to measure [32]. Considering K-R 21 as a method of rational equivalence for checking out internal consistency [32] of the four tests, K-R 21 was employed to compute their reliability coefficients. The computing of K-R 21 was performed, following the formula which is $[n/(n-1) * [1-(M*(n-M)/(n*Var))]]$ where 'n' stands for 'sample size'; 'Var' stands for 'variance for the test', and 'M' stands for 'mean score for the test'.

Table 1. K-R Reliability Coefficients of the Pilot Study

Test	K-R Reliability Coefficients
DVK ¹	0.75
MK ²	0.516
AR ³	0.631
RC ⁴	0.63

DVK¹=Depth of Vocabulary Knowledge test, MK²=Morphological Knowledge test, AR³=Analytic Relations test, and RC⁴=Reading Comprehension test

Table 1 shows the reliability coefficients of the four tests that were conducted under the pilot study before conducting the main study. The *r* values (reliability coefficients) of the four tests, namely vocabulary depth 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. Even though K-R 21 employs less information to compute, it always provides a lower reliability index than produced by other methods [32].

RESULTS

Table 2 shows the learners' performance on all the tasks and the correlations among the independent variables, namely depth of vocabulary knowledge test, morphological knowledge, analytic relations, and dependent variable, academic reading comprehension.

Table 2. Pearson Correlations between Independent Variables and Dependent Variable

	DVK	MK	AR
MK	0.556**	
AR	0.326*	0.430**
RC	0.421**	0.407**	0.374**

* $p < 0.05$, ** $p < 0.01$; ($N=64$)

Research objective 1 attempted to determine the extent the scores of depth of vocabulary knowledge test, morphological knowledge, and analytic relations correlate with academic reading comprehension. As shown in Table 1, the intercorrelations among independent variables and dependent variable appear to be close to strong. According to Cohen [33], the value *r* close to 0.50 shows strong correlation between the variables. The above Table 2 shows that a significant and positive correlation at the 0.01 level ($r = .421$; $p < .01$) existed between academic reading comprehension and syntagmatic and paradigmatic relations, which represented vocabulary depth knowledge test, and this indicates that those students who had more knowledge (under depth of vocabulary knowledge test) about paradigmatic and syntagmatic relations performed better in academic reading comprehension than students who had knowledge about morphological ($r = .407$; $p < .01$) aspect (derivative forms of words) of depth of vocabulary knowledge. The relationship between analytic

relations ($r = .374$; $p < .01$) and academic reading comprehension was the weakest. On the other hand, those engineering students who had morphological knowledge ($r = .407$; $p < 0.01$) performed better than those who had knowledge about analytic (part-whole) relations ($r = .374$; $p < .01$). Analytic relations as an independent variable did not have close relationship with academic reading comprehension for engineering students.

Table 3 and 4 demonstrate the values of R^2 , ANOVA and Coefficients between independent variables and dependent variable.

Table 3. R^2 Value, ANOVA and Coefficients Values among Independent and Dependent variable

R	R^2	Std. Error of the Estimate	ANOVA		
			df	F	Sig.
0.508	0.258	2.727	3	6.157	.001**

** $p < .001$

Table 4. Coefficients and Correlations Values among Independent and Dependent variable

Standardized Coefficients Test	Beta	Correlations	
		Partial	Part
DVK	0.255	0.237	0.210
MKT	0.172	0.155	0.135
AR	0.218	0.221	0.195

** $p < .001$

As presented in Table 3 and 4, the values of R^2 , ANOVA and Coefficients values among independent variables and dependent variable have met research objectives 2 and 3: to examine the level of prediction of different dimensions of vocabulary depth knowledge (i.e., paradigmatic relations, syntagmatic relations, analytic relations, morphological knowledge) to EFL learners' reading comprehension, and to determine the extent of scores of different dimensions of vocabulary depth knowledge have effect on predicting to academic reading comprehension. As Table 4 shows, syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test alone explained about $(0.210)^2=4.41\%$ of the variance in the dependent variable, academic reading comprehension; analytic relations alone explained $(0.195)^2=3.8025\%$ of the variance in academic reading comprehension, and morphological knowledge alone explained about $(0.135)^2=1.8225\%$ of the variance in academic reading comprehension.

In addition, depth of vocabulary knowledge test had $(0.237)^2= 5.6169\%$ shared variance with two other independent variables in academic reading comprehension. On the other hand, analytic relations

had $(0.221)^2 = 4.8841\%$ shared variance with two other independent variables in academic reading comprehension whereas morphological knowledge had $(0.155)^2=2.4025\%$ shared variance with two other independent variables in academic reading comprehension.

The largest Beta value of syntagmatic and paradigmatic relations, which represented vocabulary depth knowledge test ($\beta = 0.255$; $t = 5.085$, $p = .000$ (significant) ($p < .001$)) shows that depth of vocabulary knowledge test made the strongest contribution to explaining the outcome variable, reading comprehension when the variance was explained by other two variables jointly. The Beta values of other independent variables, namely analytic relations and morphological knowledge showcase that morphological knowledge ($\beta = 0.172$, $t = 1.724$, $p = .087$ (significant at the 0.10 level) ($p < 0.10$)) made less contribution to explaining the outcome variable than analytic relations dimension of depth of vocabulary knowledge ($\beta = 0.218$; $t = 2.264$, $p = .025$ (significant) ($p < .01$)), and morphological knowledge was the least contributor to explaining the outcome variable, academic reading comprehension.

Discussion

Correlations among the Variables

Depth of vocabulary knowledge, represented by both paradigmatic and syntagmatic relations was positively and significantly correlated with academic reading comprehension. The found result of the present study corroborated the findings of Qian [14], [15], [34]. This indicates that those students who had more both paradigmatic and syntagmatic relationship knowledge (under depth of vocabulary knowledge test) performed better in academic reading comprehension than other aspects of depth of vocabulary knowledge, namely morphological knowledge and analytic relations. Moreover, those students who gained morphological knowledge of depth of vocabulary knowledge performed better than analytic relations (part-whole) dimension of depth of vocabulary knowledge. On the contrary, the study of Horiba [35] found no unique and significant effect of depth of vocabulary depth knowledge on reading comprehension.

Depth of vocabulary knowledge, measured by different dimensions, namely, the blend of paradigmatic and syntagmatic relations, which represented vocabulary depth knowledge test made the strongest contribution to explaining the outcome variable, academic reading comprehension when the

variance was explained by all other variables jointly. The present result corroborated other previous findings of L2 learners of English (e.g., Li & Kirby [13], Qian [14], [15] & [16], Zhang & Yang [3]). On the other hand, the newly added variable, analytical relations predicted stronger to explaining the variance in academic reading comprehension than morphological knowledge, and morphological knowledge was the least predictor to explaining the outcome. The least contribution by morphological knowledge substantiated the previous findings (e.g., Qian [14], [15], & [16]); on the contrary, Zhang [19] found that derivational awareness, i.e., morphological awareness directly and significantly predicted to reading comprehension of ESL learners.

CONCLUSION AND RECOMMENDATION

When one seeks to generalize the findings of the current study, some caution needs to be considered as the sample size was taken from only one university. Future research deserves more attention in this aspect, and other aspects of depth of vocabulary knowledge, like spelling, pronunciation, meaning, frequency, register, etc. can be delved into to find out their correlation and prediction to reading comprehension skill as well as to other English language skills.

The present study included five different dimensions of depth of vocabulary knowledge, namely synonymy, polysemy, collocation, derivational forms of words, meronymy (part-whole); therefore, caution should be exercised in generalizing the findings of the study since the other dimensions of vocabulary depth, graphemic, phonemic, semantic and phraseological features give researchers further scope to investigate. The investigation of measures of all the other dimensions of vocabulary depth knowledge would provide a fuller assessment of the dimensions of depth of vocabulary knowledge.

Those students who gained depth of vocabulary knowledge test, represented by both paradigmatic and syntagmatic relations performed better than morphological (derivative forms of words) knowledge of depth of vocabulary knowledge. 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 syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test

on reading comprehension, students need to master the different aspects of syntagmatic and paradigmatic relations of depth of vocabulary knowledge, and more attention should be paid to teach the different dimensions of depth of vocabulary knowledge, particularly syntagmatic and paradigmatic relations and 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.

To the best knowledge of the researchers of this study, 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 analytic relations with other aspects of depth of vocabulary knowledge has added to the body of knowledge.

The results of the multiple-regression analysis showcase that the syntagmatic and paradigmatic relations dimension of vocabulary depth knowledge is as vital as that of the analytic relations. These two aspects of depth of vocabulary knowledge are closely correlated ($r = .556, p < .01$) with each other and with academic reading comprehension as well. Even though the reading comprehension tasks in the current study was designed particularly for basic comprehension in academic settings, it can be restated that, for university level EFL speakers and in academic setting, syntagmatic and paradigmatic relations and morphological knowledge are not only closely, significantly and positively related with each other but also with the success on reading tasks for basic comprehension. The findings drawn from the current study corroborate those findings of Qian's [14, 15, 16, 12] earlier research. Thus, it can be inferred that vocabulary, particularly depth of vocabulary knowledge is a vital factor in reading success, and different dimensions of depth of vocabulary knowledge as predictor variables prove to be useful for academic reading success.

By assessing knowledge of polysemy (paradigmatic), collocation (syntagmatic), morphological (derivative forms of word), and analytic (part-whole) relations in place of just single

meanings of target words, depth of vocabulary knowledge taps deeper nuances of vocabulary knowledge. As a result, a productive positive effect on teaching and learning new vocabulary can be expected. In connection with the approaches presented in the study, the present findings of this study support the “dimensional” approach to the assessment of L2 vocabulary depth knowledge. A “dimensional” approach contends that vocabulary depth includes different dimensions of knowledge of words. Since the different dimensions of depth of vocabulary knowledge, namely syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, and analytic relations of depth of vocabulary knowledge played significant role in explaining the variance in academic reading comprehension, evidence in favor of the “dimensional” approach is established. On the other hand, in terms of the hypotheses presented in the study, the findings of the current study support the instrumentalist hypothesis which suggests that knowledge of the meaning of a word directly influences reading comprehension. The significant and positive correlations between three independent variables, i.e., syntagmatic and paradigmatic relations, which represented depth of vocabulary knowledge test, morphological knowledge, analytic relations and academic reading comprehension of the present study reveal that students’ knowledge about different aspects of depth of vocabulary knowledge directly have impacted academic reading comprehension of the students.

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