

Examination of the Prediction of Different Dimensions of Analytic Relations' Impact on Academic Reading Comprehension: An Inter-Group Comparative Study¹

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Abstract

An in-depth investigation of analytic relations by lexical researchers plays a prominent role in language learning and teaching. The primary objective of the present study was to investigate the extent to which prediction regarding different aspects of analytic relations impacts reading comprehension. The current research employed a quantitative approach using standard multiple regression analysis. The study compared two language proficiency tests, namely an analytic relations test and an academic reading comprehension test, among a total of 91 participants with a Bachelor of Business Administration background and a total of 64 students with a Bachelor of Engineering background. The results of the study showed that for both the Business and Engineering School students, the component-integral analytic relations facet of vocabulary depth knowledge was not only the most statistically significant contributing predictor of academic reading comprehension, but it also had the largest effect (i.e., statistically significant) in explaining the outcome variable: Academic reading comprehension. By providing insights into the research gap, the present study suggests that the analytic relations dimension of vocabulary knowledge has practical use for English language learners and English teachers at the tertiary level, and it offers further implications for lexical researchers.

Resumen

Una investigación en profundidad de las relaciones analíticas por parte de investigadores léxicos juega un papel destacado en el aprendizaje y la enseñanza de idiomas. El objetivo principal del presente estudio fue investigar hasta qué punto la predicción sobre diferentes aspectos de las relaciones analíticas impacta en la comprensión lectora. La investigación actual empleó un enfoque cuantitativo utilizando análisis de regresión múltiple estándar. El estudio comparó dos pruebas de dominio del idioma, a saber, una prueba de relaciones analíticas y una prueba de comprensión lectora académica, aplicadas a un total de 91 participantes de la licenciatura en Administración de Empresas y un total de 64 estudiantes de la licenciatura en ingeniería. Los resultados del estudio mostraron que tanto para los estudiantes de la escuela de negocios como para los estudiantes de ingeniería, la faceta de las relaciones analíticas integrales componente del conocimiento profundo del vocabulario no sólo fue el predictor más estadísticamente significativo de la comprensión de lectura académica, sino que también tuvo el mayor efecto (es decir, estadísticamente significativo) para explicar la variable de resultado: Comprensión lectora académica. Al proporcionar información sobre la brecha de investigación, el presente estudio sugiere que la dimensión de relaciones analíticas del conocimiento del vocabulario tiene un uso práctico para los estudiantes y los profesores del idioma inglés en el nivel terciario, y ofrece más implicaciones para los investigadores léxicos.

Introduction

The vocabulary aspect of language learning and teaching has received significant attention amongst vocabulary researchers, and the dimension of vocabulary acquisition in terms of language teaching and learning has been substantially researched in second language (L2) assessment, acquisition, and instruction (Schmitt, 2010; Zhang & Yang, 2016). The significant role of vocabulary knowledge in L2 learning has been well- documented (Choi & Zhang, 2018; Nation, 1983; Schmitt, 2008; Zhang et al., 2017). Vocabulary knowledge shows an absolute predictive power of successful communication and comprehension over L2/FL language learners' other language competencies (Li & Kirby, 2015). L2/FL vocabulary language researchers (e.g., Bogaards & Laufer, 2004; Chapelle, 1998; Henriksen, 1999; Haastrop & Henriksen, 2000; Li & Kirby, 2015; Milton, 2009; Nation, 1990, 2001; Qian, 1998, 1999, 2002; Read, 1989, 1993, 1998, 2000; Richards, 1976; Wesche & Paribakht, 1996; Zhang, 2012; Zhang & Koda, 2017) have proposed that vocabulary knowledge has various constituents. In addition, vocabulary knowledge is comprised of minimally two features, namely breadth of vocabulary knowledge and depth of vocabulary knowledge. Vocabulary breadth knowledge denotes a learner's knowledge of words in terms of number. On the other hand, vocabulary

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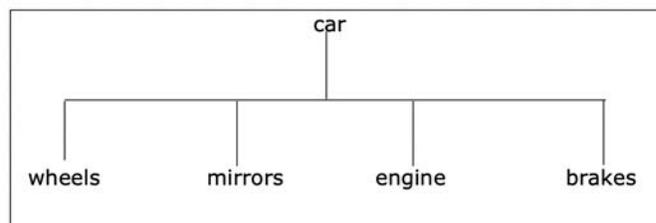
depth knowledge signifies how deeply or well a learner knows the meaning and the use of the word (Qian, 2005; Qian & Schedl, 2004).

Moreover, most of vocabulary researchers (i.e., Jeon & Yamashita, 2014; Laufer, 1992, 1996; Milton, 2013; Na & Nation, 1985) have mainly focused on the crucial role played by vocabulary breadth in reading comprehension. Nevertheless, there has been far less research examining the different dimensions of vocabulary depth knowledge (i.e., vocabulary knowledge that pertains to the quality of words, and learners need to have more than a superficial understanding of a word's meaning) (Schmitt, 2014; Teng, 2016). In addition, vocabulary depth knowledge encompasses dissimilar components, (i.e., pronunciation, spelling, frequency, meaning, register, morphological and syntactic characteristics) (Chapelle, 1994; Haastrup & Henriksen, 2000; Henriksen, 1999; Meara, 1996; Nation, 1990; Qian, 1998, 1999; Read, 2004; Richards, 1976). Few empirical studies (de Bot et al., 1997; de Bot, Paribakht, & Wesche, 1997; Qian, 1998; 1999) have investigated the relationship between the vocabulary depth knowledge and reading comprehension (Hasan & Shabdin, 2017).

Other researchers (i.e., Li & Kirby, 2015; Qian, 1999, 2000, 2002; Read, 1993, 1998; Zhang, 2012) who examined the vocabulary depth knowledge emphasized primarily the paradigmatic (synonym) and syntagmatic (collocate) relation of vocabulary depth knowledge and their association with reading comprehension in English as a Second Language (ESL)/English as a Foreign Language (EFL) contexts. According to Zhang and Koda (2017), paradigmatic relation is "an associate of the same word class as the stimulus word (i.e., free association) and performing the same grammatical function in a sentence" (p. 2), such as a synonym (i.e., *sudden*, *quick* and *surprising*). On the other hand, syntagmatic relation refers to "an associate of a different word class from the stimulus word and having a sequential relationship with the stimulus word" (p. 2), such as a collocate (i.e., *sudden change* or *sudden noise*). In addition, analytic relations connote "words that always belong to the target word," such as *yellow*, *fruit*, and *peel* for *banana* (Zhang and Koda (2017, p. 13).

Analytic Relations

Winston et al. (1987) proposed that in terms of semantic relations, analytic relations is classified as a significant category. According to Schmitt and Meara (1997), word association knowledge plays an important role in the field of language learning. As a result, analytic relations (part-whole) can be regarded as one of the important dimensions of vocabulary depth knowledge. Schwartz and Katzir (2012) assert that academics have termed another type of lexical hierarchy as partonomic. Partonomic is often acknowledged as a part-whole hierarchy (holonymy or meronymy or part-whole relations are synonyms for analytic relations). For example, the instance of actors (actor-play) is a representative case of meronymy. According to Read (2004), meronymy is categorized under analytic sense relations. Figure 1 below shows an example of a part-whole relationship.



Source: Winston et al. (1987)

Figure 1: Part-whole relationship

From Figure 1, it is evident that engine is a 'part of a car'.

Parts of Analytic Relations

Winston et al. (1987) in their study provided a taxonomy of meronymic relations/analytic relations, and they proposed six types of meronymic relations.

The types were 'component-integral' (meronymic relation is between components and the objects to which they belong; e.g. pedal-bike, handle-cup, punchline-joke, wheels-car, refrigerator-kitchen, chapters-books, Belgium-NATO, Phonology-Linguistics, engine-car), member-collection (collections whose members are fixed by social

connection; e.g. ship-fleet, tree-forest, card-deck, juror-jury), portion-mass (having parts that are similar to each other and to the whole they consist; e.g. slice-pie, grain-salt, yard-mile, hunk-clay), stuff-object (expressed using the 'is partly' frame; e.g. steel-car/bike, gin-martini, hydrogen-water), feature-activity (designate the features or phases of activities and processes; paying-shopping, dating-adolescence, bidding-playing bridge, ovulation-menstrual cycle), and place-area (a relation between areas and locations within them; Everglades-Florida, Oasis-desert, baseline-tennis court). (p. 421)

In addition, Greidanus and Nienhuis (2001) conducted a study that investigated only three types of associations, namely paradigmatic, syntagmatic, and analytic (defining characteristics, such as those used in dictionary definitions) relations and did not examine any prediction of paradigmatic, syntagmatic, or manifold dimensions of analytic relations to academic reading comprehension. Similarly, Horiba (2012) investigated correlations and the prediction of syntagmatic relations, paradigmatic relations, and analytic relations to reading comprehension. They did not explore predictions of different facets of analytic relations to academic reading comprehension among EFL/ESL learners. From examining quantitative investigation, little is known about empirical research that dealt with the prediction of the different dimensions of analytic relations as parts of vocabulary knowledge to academic reading comprehension. However, there is a lack of empirical research related to the prediction of different dimensions of analytic relations to academic reading comprehension in an ESL/EFL context.

Vocabulary Research in the Bangladeshi Context

Afrin (2016) and Khan and Akter (2011) mentioned that most of the students at the tertiary level in Bangladesh are weak in English language skills. Even after completing their secondary and higher secondary levels of study, they fail to show their expected level of English language proficiency (Arju, 2011; Afrin, 2016; Khan & Akter, 2011) because of a lack of vocabulary knowledge (Arju, 2011). Students face enormous difficulty in understanding English written textbooks primarily because of their inadequacy of vocabulary knowledge (Jahan & Jahan 2011). As a result, the lack of vocabulary knowledge in English among students at the tertiary level in Bangladesh negatively affects their academic performance. Moreover, according to Jahan and Jahan (2011), the students are not able to acquire the coveted result (i.e., Cumulative Grade Point Average, CGPA) in their studies.

With a specific focus on the attitude and achievement of students, Siddiqua (2016) stressed the difficulties or challenges that EFL teachers face while they teach vocabulary in classrooms and the reasons that make teaching vocabulary difficult. Regarding the use of vocabulary learning strategies, Bristi (2016) emphasized the need to investigate vocabulary learning strategies employed by tertiary level EFL students in Bangladesh. Moreover, another study by Ashraf (2014) focused on strategies that can be used by Bangladeshi students to overcome their lack of vocabulary knowledge.

Afrin (2016) elaborated on the vocabulary knowledge aspect among Bangladeshi students at the tertiary level, focusing on the English writing skills of students. Furthermore, Opel et al. (2009) described the effect of preschool dialogic reading on vocabulary acquisition among rural Bangladeshi students with a view to increasing their expressive vocabulary. In summary, the aforementioned studies within the Bangladeshi context (i.e., Afrin, 2016; Arju, 2011; Ashraf, 2014; Bristi, 2016; Hasan, 2014; Jahan & Jahan, 2011; Khan & Akter, 2011; Opel et al., 2009; Siddiqua, 2016) have included the vocabulary knowledge aspect of students. However, the mentioned studies did not focus on the analytic relations aspect and its different constituents/aspects, particularly their prediction of the academic reading comprehension ability of tertiary level students in Bangladesh. To this end, by employing an adapted analytic relations test, this study investigated the prediction of six dimensions of analytic relations, which represented the depth of vocabulary knowledge to academic reading comprehension among tertiary level EFL Business and Engineering students in Bangladesh and also took an inter-group comparative study into consideration.

Assessment of Vocabulary Depth Knowledge

Anderson and Freebody (1981) have accounted for several hypotheses that seek to explain the association between vocabulary and comprehension. One of the hypotheses is the instrumentalist hypothesis, which refers to the grasping of the meanings of words explicitly influencing reading comprehension. On the basis of this hypothesis, it can be mentioned that one needs to either lower the demands of vocabulary in a text in order to improve text comprehension or make sure that about the meanings of the majority of the words in a text (Wright & Cervetti, 2017).

According to Read (2000), there are two approaches for the evaluation of L2 depth of vocabulary knowledge (as cited in Zhang & Koda, 2017, p. 2). The first approach is a 'developmental' approach that embodies the increasing type of vocabulary acquisition. According to Nation (2001), Schmitt (2014), Zhang and Koda (2017), the other approach, i.e., the 'dimensional' approach, maintains that the depth of vocabulary knowledge includes different kinds of knowledge about words. These different kinds of knowledge about words include meaning, form, and use in terms of both receptive and productive senses and in both spoken and written procedures. For example, according to Read (2004):

There are three different but connected meanings of depth, and they include precision of meaning, comprehensive word knowledge, and network knowledge. The precision of meaning incorporates "the differentiation between the existence of a restricted imprecise idea of what a word connotes and the existence of additional specified grasp of its meaning". Moreover, comprehensive word knowledge encompasses "comprehension of the semantic quality of a word and its phonological, orthographic, syntactic, morphological, collocational and pragmatic attributes", and network knowledge covers "the incorporation of the word into its related words in the schemata, and the ability to distinguish its meaning and use from related words" (p. 211).

Research Questions

Addressing the research gap in light of the previous studies, the current study's research questions are:

1. To what extent do different constituents of analytic relations (i.e., component-integral, member-collection, stuff-object, portion-mass, feature-activity, and place-area) contribute to predicting the performance of both EFL Business School and Engineering School students' academic reading comprehension? Which constituent of analytic relations (i.e., component-integral, member-collection, stuff-object, portion-mass, feature-activity, and place-area) is the most contributing predictor of academic reading comprehension for both Business School and Engineering School EFL learners?
2. To what degree do different constituents of analytic relations (i.e., component-integral, member-collection, stuff-object, portion-mass, feature-activity, and place-area) affect both EFL Business School and Engineering School students' academic reading comprehension?

Methodology

Participants

For the present study, the total number of students from three sections of the Business School was 91. The three sections included students from the Accounting department ($n = 30$), the Economics department ($n = 25$), and the Finance or other departments ($n = 36$) from a top-ranked private university in Bangladesh. All of the Business School students who passed a Basic English course (Course No. 1) were selected, and the course was equivalent to the A2-B1 level on the Common European Framework of Reference (CEFR). Of these, 44% (40) students were male, and 56% (51) students were female; the average age of the students was 20.54 (range 18-24, $SD = 1.241$). In addition, the total number of engineering students that participated in the current study was 64. Of these, 44 were male (68.8%), and 20 were female (31.3%). There were 31 students in one class, from the School of Electrical and Electronic Engineering. There were 33 students in another class, from the Computer Science and Engineering department. All the Engineering School students who passed the Basic English course (Course No. 1) were selected, and the course was equivalent to the A2-B1 level on the Common European Framework of Reference (CEFR). The average age of engineering students was 20.16 ($SD = 1.027$, range 18-23). Bengali (L1) as mother tongue (from one language background) was used by both business and engineering students. English as a foreign language was employed by all the students in the study. The students had studied English for at least 12 years; however, none had exposure to learning English in a native English-speaking country.

The total number of students studying English with their respective majors under different schools in the Spring trimester 2018 was 3,640. Out of the total number of students, 48 classes/sections (generally, one class comprised of 30 to 35 students) fell under the School of Science and Engineering, and 56 sections (i.e., classes) fell under the School of Business Economics. To achieve the aim of the study, the researchers employed purposive sampling first and then random sampling (as in our previous study, i.e., Hasan & Shabdin, 2017). Furthermore, under purposive sampling, the United International University was chosen since the researchers were able to get permission from the concerned authority to administer the tests.

Secondly, under random sampling, one section/class size out of 17 sections (Economics from the School of Business and Economics), another section out of 25 sections (Finance and Human Resource Management or other Majors under the School of Business and Economics), and the third section out of 14 sections (Accounting and Information System under the School of Business and Economics) were randomly chosen. On the other hand, one section out of 13 sections (Electrical and Electronic Engineering under the School of Science and Engineering) and another section out of 35 sections (Computer Science and Engineering under the School of Science and Engineering) were chosen randomly for the present study. In other words, five out of 104 sections were chosen randomly. As a result, 155 participants from five sections were extracted for the present study.

Measures

The participants completed one vocabulary instrument, namely an analytic relations test that consisted of six dimensions representing the depth of vocabulary knowledge, and a reading comprehension test that consisted of three reading passages, followed by multiple choice questions. The mentioned instruments that were employed in the current study are elaborated in the following section.

Analytic Relations Test

The researchers adapted an analytic relations test (i.e., an independent variable) for the present study. They adapted the test on the basis of the idea of part-whole relations promulgated by Winston et al. (1987). The objective of the adapted test concerned judging the part-whole relations of words (as in our previous study, i.e., Hasan & Shabdin, 2017). In addition, the analytic relations test of the current study was comprised of 30 items, and it proposed to evaluate part-whole constituents of depth of vocabulary knowledge. Furthermore, the analytic relations test was comprised of 30 blanks, and the students were asked to write/fill either part or the whole meaning of the words in the provided blanks. Regarding the score of analytic relations, the students obtained one point for each correct answer, so the maximum score was 30 for the test. One example is given below to show how to answer an analytic relations test:

Please fill in the following blanks with an appropriate word or words. If you think that more than one answer is possible, mention that too. One example is provided how to answer the rest of the questions.

_____ is a part of a play. Answer: act/actor/actress, etc.

Figure 2: Sample instructions for answering analytic relations test

In addition, concerning six types of analytic relations, each of the six kinds of analytic relations is given below. An example of component-integral analytic relation is "Pistons are parts of _____ (engines)." An example of member-collection analytic relation refers "Trees are part of a _____ (forest)." An example of the portion-mass denotes "A yard is part of a _____ (mile)." An example of the stuff-object analytic relation indicates "A part of an organization is _____ (employee/employer/employment)." An example of the feature-activity analytic relation mentions "Paying is part of _____ (shopping)." Finally, an example of the place-area analytic relation concerns "_____ (country/people/natural features) is a part of the world."

More than one answer is allowed for the test answers, but only one point was given for one or two or three correct answers. For the present study, the researchers investigated six types of meronymic relations (i.e., part-whole) under the analytic relations tests. In order to mark the answers of the adapted analytic relations test of the present study, the students' answers were considered in accordance with the answers provided in the study by Winston et al. (1987) or close to the answers provided by them.

Reading Comprehension Test

The reading comprehension test of the current research work comprised of reading passages followed by multiple-choice questions (as in our previous study, i.e., Hasan & Shabdin, 2017). The researchers also adopted the test from Longman's Test of English as a Foreign Language (TOEFL) (Phillips, 2006). The present study adopted three passages from the TOEFL reading comprehension test since the focus of the study was to examine the prediction of the depth of vocabulary knowledge to academic reading comprehension. Schmitt (1999) showed that the focus of TOEFL was on the target words "as they are used in the passage" (p. 190). In order to check the reliability and validity of the reading comprehension test, the reading

comprehension passages from TOEFL were chosen for the present study. According to Qian (1998), all of the official TOEFL tests were considered as established standardized language tests. Before being used, all the TOEFL tests underwent careful pre-testing for reliability and validity. In addition, Qian (1998, 2002) employed reading passages from a version of TOEFL for his study that examined the association between vocabulary knowledge and academic reading performance.

In addition, the researchers adopted the test from the original reading comprehension test, which consisted of five sections, and 55 minutes were allocated to complete the reading comprehension test. The researchers anticipated time constraint in conducting the tests of the current study, so the researchers shortened the original reading comprehension test passages by three. Consequently, the researchers took out two passages randomly. Out of five passages, the researchers selected three texts for the current study and also selected 20 multiple-choice questions in total. Since there was a total of 20 questions, the highest possible score for the test was 20. Moreover, the researchers shortened the original TOEFL reading passages because they intended to complete the tests in a single session/class. For each class where the researchers administered the study, the specified total time was one hour and 20 minutes (80 minutes). Conducting the two tests, including the five original TOEFL passages, would take more time (85 minutes) than the total class time, and the time for filling up the consent form and making the students comprehend the instructions for the two tests would add another five minutes. As a result, the researchers shortened the original reading passages to three.

After identifying the reading passages, the researchers processed the reading passages and the comprehension questions into a Microsoft Word document, and the total number of copies was printed for the study. For the marking of the responses for all questions concerning the reading comprehension test of the present study, the researchers followed the answer key provided by the Longman Test of English as a Foreign Language (TOEFL) (Phillips, 2006).

Research Design and Data Collection Procedures

Under a quantitative approach (Creswell, 2014), the present study employed a multiple regression analysis of the correlation design. That is to say, the researchers used correlation design to determine the independent variables' potential predictions to the outcome/dependent variable (as in our previous study, i.e., Hasan & Shabdin, 2017). Before using the two instruments, namely the analytic relations and academic reading comprehension test, the researchers provided the participants with a printed letter of informed consent and a background questionnaire. In the letter of informed consent, an option (tick \checkmark or \times) was provided, and the students were asked about their willingness to participate or not; the students' participation in the tests was optional. While conducting the present study, the researchers followed moral aspects of conducting the current study as mentioned by Creswell (2014). The researchers gained permission to conduct the study from the concerned authority. Moreover, the confidentiality of the students' information and performance was assured. Accordingly, not only the real names of the students, but also essential information about them was kept confidential. The researchers assured them that their performance in the tests would not affect their grades in their respective core courses or overall grades.

Creswell (2014) proposes an effective sample size for educational research as approximately 30 learners for a correlational study, which includes variables. Since the current research study involved a correlational study (i.e., research design), the sample size for the research was 155, which was valid. In addition, one reading comprehension test and an analytic relations test were administered in one session in the students' regular English classes. The researchers gave the students 25 minutes to complete the reading comprehension test and another 30 minutes to answer the analytic relations test (as in our previous study, i.e., Hasan & Shabdin, 2017). Only one of the researchers took the responsibility to administer the two language tests for the current study. To determine the powerful predictors of reading comprehension, the researchers carried out a standard multiple regression analysis. In other words, force-entry multiple regression (not stepwise) analysis was applied to find out the significant role played by the knowledge of the analytic relation dimensions of vocabulary depth knowledge in explaining academic reading comprehension skills. To analyse the data, researchers employed SPSS version 24 (Statistical Package for Social Studies) as the key statistical program.

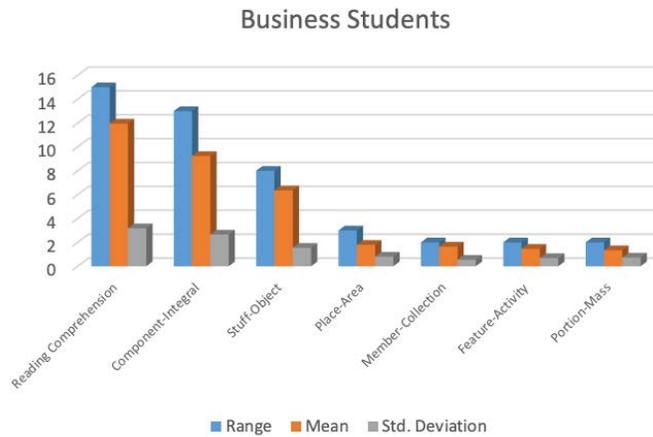


Figure 3. Overall mean, range, and standard deviation of six dimensions of analytic relations for the Business School students

As presented in Table 2, in terms of the six components of the analytic relations test and academic reading comprehension test, the Business School participants scored the highest (i.e., about 82% in the member-collection part of the analytic relations test), followed by stuff-object (79%), feature-activity (73%), component-integral (71%), portion-mass (67%), reading comprehension (60%), and place-area (59.8%). It is evident that the Business School participants found the place-area analytic relations part of the vocabulary depth knowledge to be the most difficult dimension of the analytic relations test. The highest retrieval of scores for the Business School participants was the member-collection analytic relations part of vocabulary depth knowledge. This suggests that the Business School EFL students learned the member-collection analytic relations part considerably well compared to the other dimensions of analytic relations represented in vocabulary depth knowledge. The results of the descriptive statistics of the Engineering School participants are presented in Table 3 and visually illustrated in Figure 4.

	MPS*	Mean	Std. Deviation	n
Component-Integral	13	9.8413 (76%)	2.82390	64
Member-Collection	2	1.7302 (87%)	0.54496	64
Portion-Mass	2	1.5556 (78%)	0.61638	64
Stuff-Object	8	6.1746 (77%)	1.95547	64
Feature-Activity	2	1.3651 (68%)	0.67922	64
Place-Area	3	1.7778 (59%)	0.92361	64
Reading Comprehension	20	14.11 (71%)	3.080	64

*MPS=Maximum Possible Score

Table 3. Descriptive statistics concerning the Engineering School students

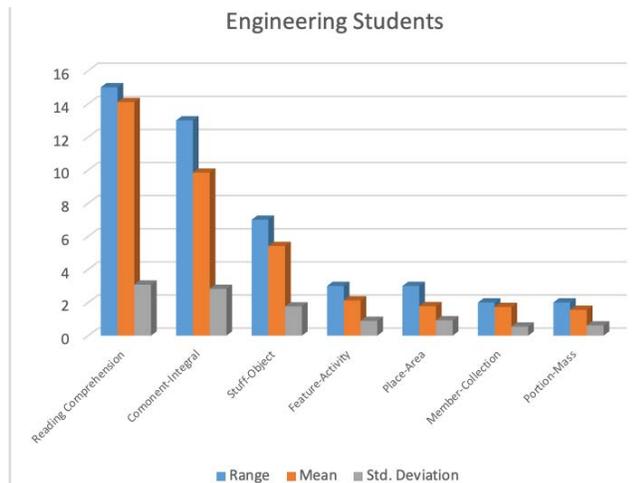


Figure 4. Overall mean, range, and standard deviation of six dimensions of analytic relations for the Engineering School students

As presented in Table 3, in terms of the six components of the analytic relations test and academic reading comprehension test, the engineering students scored the highest (i.e., about 87% in the member-collection part of analytic relations test), followed by portion-mass (78%), stuff-object (77%), component-integral (76%), reading comprehension (71%), feature-activity (68%), and place-area (59%). It is evident that Engineering School participants also found the place-area analytic relations part of vocabulary depth knowledge the most difficult dimension of the analytic relations test. Similarly, the highest retrieval of scores of Engineering School participants was the member-collection analytic relations part of the vocabulary depth knowledge, and this indicates that Engineering School EFL students learned the member-collection part of analytic relations considerably well than other dimensions of analytic relations that represented vocabulary depth knowledge. To conclude, both business and Engineering School participants found the place-area analytic relations part of vocabulary depth knowledge the most challenging dimension of analytic relations to tackle, whereas participants from both schools tackled the member-collection analytic relations part of the depth of vocabulary knowledge with considerable ease.

As shown in Table 2, the mean and standard deviation for Business School participants as a group indicate that the participants fell into a “medium” level of English proficiency in general. On the other hand, as shown in Table 3, the mean and standard deviation of the Engineering School participants as a group points out that the participants fell into a “higher” level of English proficiency in general. Overall, the results presented in Table 2 and 3 indicate that Engineering School participants performed better both in the six dimensions of analytic relations and academic reading comprehension than the Business School participants. Generally, the authority of the Business School at the tertiary level in Bangladesh focuses considerably on improving the proficiency level of students. In spite of that, the results showed that Business School participants lagged behind in achieving vocabulary depth knowledge as a component of the English proficiency compared to the Engineering School participants.

Research question 1 was developed to determine the most significant, unique predictor of academic reading comprehension and to address the extent of prediction of component-integral, member-collection, portion-mass, stuff-object, feature-activity and place-area analytic relations parts to academic reading comprehension for both Business School and Engineering School participants. Research question 2, was “To what level do different constituents of analytic relations represent depth of vocabulary knowledge (i.e., component-integral, member-collection, stuff-object, portion-mass, feature-activity, and place-area) affect both the EFL Business School and Engineering School students’ academic reading comprehension?”

Prediction of Component-Integral, Member-Collection, Portion-Mass, Stuff-Object, Feature-Activity, and Place-Area Dimensions of Analytic Relations to Reading Comprehension for both Business and Engineering School Students

Tables 4, 5, 6, and 7 show the prediction value, ANOVA, and coefficient values of all six independent variables on the dependent variable in terms of the scores of students from both the Business School and Engineering School.

<i>R</i>	<i>R</i> ²	Adjusted <i>R</i> ²	Std. Error of the Estimate	ANOVA				
				Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
.555	.308	.257	2.744	274.336	6	45.723	6.072	.000

*Dependent Variable= Reading Comprehension

Table 4: Prediction and ANOVA value of the Business School students’ score (n=91)

<i>R</i>	<i>R</i> ²	Adjusted <i>R</i> ²	Std. Error of the Estimate	ANOVA				
				Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
.426	.181	.083	2.950	96.361	6	16.060	1.846	.01

Table 5. Prediction and ANOVA value of the Engineering School students’ score (n= 64)

As shown in Table 4, since the “f” statistics ANOVA table was found to be significant at the 0.001 level (*R*² = .308), *F* (6, 82) = 6.072, *p* < .000, the run regression model was found to be well-fitted for the data regarding Business School students. Similarly, as shown in Table 5, since the “f” statistics ANOVA table was found to be significant at the .01 level (*R*² = .181), *F* (6, 50) = 1.846, *p* < .05, the run regression model was found to be well-fitted for the data regarding Engineering School participants. The values of *R*, multiple

correlation coefficient, i.e., .555 and .426 show an accepted level of prediction for this research work. In addition, the values of R-Square ($R^2 = .308$ and $R^2 = .181$) demonstrate how much the other six independent variables (i.e., six dimensions of analytic relations) explained the variance of the dependent variable, i.e., academic reading comprehension.

	Standardized Coefficients	t	Sig.	Correlations		Collinearity Statistics	
	Beta (β)			Partial	Part	Tolerance	VIF
Component-integral	.480	3.821	.000	.389	.351	.536	1.865
Member-Collection	.007	.067	.947	.007	.006	.770	1.299
Portion-Mass	.203	1.887	.063	.204	.173	.727	1.376
Stuff-Object	-.093	-.819	.415	-.090	.075	.653	1.532
Feature-Activity	-.055	-.510	.611	-.056	-.047	.722	1.386
Place-Area	.046	.456	.650	.050	.042	.824	1.214

*Dependent Variable=Reading Comprehension

Table 6. Under coefficients, correlations values of all variables of students from the Business School=91

	Standardized Coefficients	t	Sig.	Correlations		Collinearity Statistics	
	Beta (β)			Partial	Part	Tolerance	VIF
Component-integral	.523	2.286	.027	.308	.292	.313	3.196
Member-Collection	-.190	-1.100	.277	-.154	-.141	.551	1.815
Portion-Mass	.044	.283	.779	.40	.036	.690	1.449
Stuff-Object	-.233	-1.143	.259	-.160	-.146	.395	2.532
Feature-Activity	.037	.253	.801	.036	.032	.761	1.314
Place-Area	.156	.983	.330	.138	.126	.653	1.531

Table 7. Under coefficients, Correlations values of all variables of students of the Engineering School (n=64)

As Table 6 shows, concerning the Business School participants, the component-integral part of analytic relations, which represented vocabulary depth knowledge, uniquely explained about $(.351)^2 = 12.3201\%$ of the variance in the total academic reading comprehension score. It is evident that for Business School participants, the highest unique prediction (12.3201%) to academic reading comprehension was explained by the component-integral part of analytic relations, followed by portion-mass (2.9929%), stuff-object (.5625%), feature-activity (.2209%), place-area (.1764%), and member-collection (.0036%) dimension of analytic relations, respectively.

As Table 7 shows, regarding Engineering School participants, the component-integral part of analytic relations, which represented vocabulary depth knowledge, uniquely explained about $(.292)^2 = 8.5264\%$ of the variance in the total academic reading comprehension score. It is evident that the highest unique prediction (8.5264%) was explained in academic reading comprehension by the component-integral part of analytic relations, followed by stuff-object (2.1316%), member-collection (1.988%), place-area (1.5876%), portion-mass (0.1296%), and feature-activity (0.1024%) dimensions of analytic relations, respectively.

Effect of Six Facets of Analytic Relations on Academic Reading Comprehension for both Business and Engineering School Students

Research question 2 was developed to identify the largest, larger, or the least impact of the six dimensions of analytic relations, which represented the depth of vocabulary knowledge on academic reading comprehension. With regard to Business School participants, as presented in Table 6, the Beta value under the standardized coefficients of the component-integral analytic relations of vocabulary depth knowledge was the largest ($\beta = .480$; $t = 3.821$, $p = .000$ (significant) ($p < .001$)). The largest Beta value indicates that the component-integral analytic relations part made the largest effect on explaining the outcome variable, i.e., academic reading comprehension, when the variance was explained by the other five variables jointly. As shown in Table 6, concerning the Beta values of all six dimensions of analytic relations, it can be inferred that both the component-integral analytic relations part and portion-mass analytic dimensions of the depth of vocabulary knowledge had a significantly greater effect statistically on explaining the outcome variable, i.e., academic reading comprehension. The other four analytic relations dimensions of vocabulary depth had an effect on explaining the outcome variable, but they did not have a statistically significant effect on explaining the outcome variable, i.e., academic reading comprehension.

Based on the above discussion, it can be implied that:

1. Regarding the scores of students of business participants, the learners found the place-area part of analytic relations the most challenging one whereas they handled the member-collection analytic relations dimension of vocabulary depth with considerable ease.
2. For Business School participants, the component-integral part of analytic relations made the strongest, statistically significant unique contribution to explaining the outcome variable, i.e., academic reading comprehension, when the variance was explained by the other five variables jointly.
3. For Business School participants, the component-integral part of analytic relations had the largest, statistically significant effect on explaining the outcome variable, i.e., academic reading comprehension.

With respect to the Engineering School participants, as presented in Table 7, the largest Beta value of the component-integral analytic relations of the depth of vocabulary knowledge ($\beta = .523$; $t = 2.286$, $p = .027$ (significant) ($p < .05$)) shows that the component-integral analytic relations part made the largest effect on explaining the outcome variable, i.e., academic reading comprehension, when the variance was explained by the other five variables jointly.

As shown in Table 7, concerning the Beta values of all six dimensions of analytic relations, it can be inferred that the component-integral analytic relations part of vocabulary depth knowledge had significantly the largest effect on explaining the outcome variable, academic reading comprehension, while the other five analytic relation dimensions of the depth of vocabulary knowledge had an effect on explaining the outcome variable, but they did not have a significant effect on explaining the outcome variable, i.e., academic reading comprehension.

Again, based on the above discussion, it can be implied that:

1. Regarding the Engineering School participants' scores, like those of the Business School, the Engineering School participants found place-area analytic relations part the most challenging one to retrieve whereas they dealt with the member-collection analytical relations dimension with considerable ease.
2. Similar to the Business School participants, for the Engineering School participants, the component-integral part of analytic relations not only made the strongest unique significant contribution to explaining the outcome variable, i.e., reading comprehension, but it also had the largest impact on explaining the outcome variable, i.e., reading comprehension, when the variance was explained by other five variables jointly.

Discussion

Even though the reading comprehension tasks in the current study were designed, particularly for basic English comprehension in academic settings, it can be restated that, for university level EFL learners, component-integral and portion-mass analytic relations aspects of vocabulary depth knowledge were not only significant unique predictors of reading comprehension, but also they had a large impact (in explaining the variation) on the success in reading tasks for basic comprehension. Thus, it can be inferred that vocabulary, particularly the analytic relations part of the depth of vocabulary knowledge is a vital factor for reading comprehension, and different analytic relations dimensions of the depth of vocabulary knowledge as predictor variables prove to be useful for academic reading comprehension.

By evaluating the knowledge, particularly, of component-integral, stuff-object, place-area, feature-activity, and member-collection analytic relations (part-whole) parts of vocabulary depth knowledge in place of just single meanings of target words, the analytic relations of the 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 achieved.

In terms of answering reading comprehension questions, test-takers were evaluated on the basis of the following reading skills, and they were (a) location of key ideas, (b) comprehending implications, (c) understanding the sequence of the events, (d) grasping the text coherence, and (e) spotting the meaning of unknown words. The above-mentioned criteria for answering reading comprehension questions could have also significantly impacted the component-integral part of analytic relations influencing reading comprehension.

As mentioned in the literature review above, quantitatively, there has been lack of empirical research that has dealt with the different dimensions of analytic relations and their prediction of academic reading comprehension among ESL/EFL learners (Greidanus & Nienhuis, 2001; Horiba, 2012). As a result, an

attempt to compare and/or contrast the results of this study with other published research works becomes slim. Thus, the current study has provided a new perspective by investigating the prediction of the six facets of analytic relations that represented the depth of vocabulary knowledge to reading comprehension.

Keeping the issue of theory in consideration, the present findings of this study support the “dimensional” approach of the assessment of L2 vocabulary depth knowledge (Nation, 2001; Read, 2000; Schmitt, 2014; Zhang & Koda, 2017). A “dimensional” approach contends that vocabulary depth includes different dimensions of knowledge of words. Since the different dimensions of depth of vocabulary knowledge, namely different aspects of analytic relations of depth of vocabulary knowledge played a significant role in explaining the variance in academic reading comprehension, this is evidence in favour of the “dimensional” approach being 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 (Anderson & Freebody, 1981; Perfetti, 1985, 2007). The significant predictions of at least two aspects out of the six components of analytic relations of academic reading comprehension reveal that the participants’ knowledge of the different aspects of analytic relations that represented vocabulary depth knowledge have directly impacted the academic reading comprehension of the participants.

Implications for Teaching

Many language teachers recognize that vocabulary depth knowledge is pivotal in the academic success of learners. This deserves significant attention for teaching English in an ESL/EFL context. However, in Bangladesh, English teachers have a propensity to seemingly irrationally adopt the subscribed curriculum and/or the prescribed textbooks from western countries. This is a result of a variety of local, national, and global EFL factors. Nonetheless, the context of teaching English as L1 (native language) in western countries is different from each western country to another. The context of teaching in an EFL setting is equally as divergent based on the context. Bangladeshi EFL tertiary education is highly contextualized, despite being informed by well-founded literature in the field. The results need to be understood within the local context, whether it is in Bangladesh or other local contexts of readers.

Returning to the current study specifically, the results showed some of the constituents of the analytic relations predicted and influenced reading comprehension significantly. The results demonstrated teaching particular aspects of analytic relations would increase the students’ reading comprehension. The study provided some insights, which would work as suitable guidelines for curriculum designers and material developers. Curriculum designers for EFL students could incorporate and focus on different parts of analytic relations, particularly component-integral and portion-mass analytic relations components (e.g. handle-cup; punchline-joke, Phonology-linguistics; Belgium- NATO, etc.), while designing syllabi (i.e., vocabulary aspect) for the students at the tertiary level. In addition, the teachers would include the mentioned aspects of analytic relations in their vocabulary teaching materials to help students build deeper vocabulary knowledge. In terms of content, materials, strategies, and activities, the teachers could select reading passages in which he/she would incorporate target words in mind (here, dissimilar words under different constituents of analytic relations) and ask the students to go through the reading passages. Later, the teachers would be able to check the students’ understanding of the words and reading passages by providing “fill in blanks word-meaning,” “matching the target words and meaning,” “multiple-choice questions,” and “making sentences with the target words” types of questions. When the students are able to learn the words that come under different dimensions of analytic relations, they will be able to grasp other reading comprehension passages as well. Thus, teaching particular aspects of analytic relations will increase the students’ reading comprehension.

The analytic relations parts of the depth of vocabulary knowledge included component-integral, member-collection, portion-mass, stuff-object, feature-activity, and place-area aspects. Consequently, language teachers and practitioners would be able to make use of the results from the prediction of different types of analytic relations for reading comprehension to gain a better understanding of the significant prediction of component-integral and portion-mass types of analytic relations for reading comprehension, which can in turn endorse their pedagogical decisions.

Also, English language teachers could be able to make the students conscious of the importance of the analytic relations aspect of the knowledge of vocabulary amidst learners. Teachers can accomplish this in the classroom by choosing several reading comprehension passages that comprise of words from different aspects of analytic relations, particularly component-integral and portion-mass facets of analytic relations that represent the depth of vocabulary knowledge. While administering reading comprehension passages among the students in the classes, the teachers can ask them to be mindful of the words that have been selected, particularly from different dimensions of analytic relations. Furthermore, research indicates that the students' knowledge of the words helps them unlock the meaning of sentences where the words are used (Carlisle, 2010). Thus, awareness amidst learners would successively help them learn and develop other English language skills as well.

In other words, the above-mentioned analytic relations aspects of depth of vocabulary knowledge are recommended to be highlighted and included in teaching and learning vocabulary since they have a stronger prediction of academic reading comprehension. The improvement of English language in general and the possession of lexical competency in particular in reading can be achieved by EFL learners when they employ several means of receptive learning, and the learning of different analytic relations dimensions of vocabulary depth knowledge can facilitate that. It also is argued that more exposure to different dimensions of words by developing a reading habit would help EFL learners gain a stronger vocabulary knowledge.

Limitations

The study has put forwarded a comprehension of the prediction of the manifold analytic relations aspects, which represent depth of vocabulary knowledge regarding academic reading comprehension. However, there are some drawbacks/shortcomings to the study. For one, participants were from only one university. As a result, more participants from various sectors of tertiary education would make the study more all-inclusive. Moreover, any impact of the native language (i.e., Bengali) or background knowledge of the participants regarding the test results was not explored. Concerning the participants' majors, the study has limited the scope for generalisations of the research findings.

Conclusion

The primary objective was to examine the extent of predicting dissimilar dimensions of analytic relations to reading comprehension. To that end, the current study employed standard multiple regression analysis and two language proficiency tests, namely, an analytic relations test and an academic reading comprehension test among a total of 91 participants from the School of Business Administration and a total of 64 students from the School of Engineering. In conclusion, the findings of the study show that the engineering students found the place-area analytic relations part the most challenging one to retrieve, whereas they dealt with the member-collection analytical relations dimension with considerable ease. In addition, for both the Business School and engineering students, the component-integral part of analytic relations not only made the strongest unique significant contribution to explaining the outcome variable, i.e., reading comprehension, but it also had the largest effect in explaining the outcome variable, i.e., reading comprehension, when the variance was explained by five other variables jointly.

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