Vocabulary Coverage and Size in EFL Critical Reading

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Abstract

Research on the relationship between vocabulary knowledge and reading has largely focused on literal comprehension of informational texts. The present study, however, investigates the vocabulary-reading relationship by specifically examining critical reading skills in an argumentative text.76 EFL university students majoring in Education and studying in English participated in this study. To assess vocabulary knowledge, two tests were administered: a vocabulary size test (VLT) and a lexical coverage test. The coverage test was prepared by generating word families from the text using Vocabprofiler computer program software. Students' critical reading skills were assessed using a multiple-choice test format. The findings indicate that participants had a vocabulary size of 4,000 to 5,000 words. Both vocabulary size and text coverage correlated significantly with critical reading. However, this correlation does not apply for all the targeted critical reading skills. The study concludes that a minimum vocabulary size of 4,000 words would ensure approximately 97% of text coverage, leading to successful performance in critical reading. Below this threshold, participants' performance declined. Both vocabulary measures correlated with critical reading skills that required some reliance on the vocabulary of the text. The study suggests some pedagogical implications.

Keywords: *Critical Reading, Vocabulary Size, Vocabulary Coverage*

Introduction

Vocabulary knowledge has been widely studied mainly in its relation to different language skills. Vocabulary is important for effective comprehension of language both in its written and spoken forms. Researchers (e.g., Ait Hammou & Ech-Charfi, 2024; Cain & Oakhill, 2014; Hirsh & Nation, 1992; Hu & Nation, 2000; Laufer, 1992; Laufer, 2010; Laufer & Ravenhorst-

Kalovski, 2010; Nation 2001, 2006; Qian, 1999, 2002; Qian & Lin, 2020) have demonstrated this empirically from different perspectives including the correlation of both vocabulary breadth and depth with performance in skills such as reading. Lexical coverage, or the extent to which the vocabulary of a text is known, and its impact on text comprehension has also been subject of investigation (Ait Hammou & Ech-Charfi, 2024; Hu & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010; Nation, 2006; Schmitt, 2008; Schmitt et al., 2011; Song & Reynolds, 2022). Generally, coverage of approximately 98% of the text is accepted as a threshold for unassisted comprehension.

While previous research focused mainly on literal comprehension of informational texts and the results are usually overgeneralized, it is important to examine the extent to which the findings of previous studies apply to performing critical, rather than literal, reading skills. Hence, the current study examines the relationship between two aspects of vocabulary knowledge (vocabulary size and text coverage) and critical, rather than literal, reading skills. A text of the argumentative genre is used to examine the role of the two aspects of vocabulary knowledge (i.e. vocabulary size and coverage) in enhancing learners' ability to perform 12 critical reading skills.

Literature Review

First, it is important to highlight how vocabulary knowledge is operationalized. One common operationalization is that which was adopted by Nation (2001; 2013), who maintains that knowledge of a word comprises knowledge of its form, meaning and use. Each of these aspects is further divided into the receptive and productive dimensions. Similarly, researchers such as Anderson and Freebody (1981) classified vocabulary knowledge into vocabulary breadth, or the size of known words, and vocabulary depth, which reflects the quality of the word in terms of its contextual uses, formality, collocations, synonyms, antonyms, etc. Following this categorization, tests of vocabulary knowledge have often been classified into tests that measure the speaker's vocabulary breadth and tests that measure vocabulary depth. An example of the former category is Vocabulary Levels Test (Nation, 1983; Schmitt et al., 2001), while an example of vocabulary depth tests is the Vocabulary Depth Task (DVT) (Richard, 2011). These tests have been extensively used to examine the relationship between vocabulary knowledge and different language skills. This review will mainly focus on the relationship between two aspects of vocabulary knowledge (size and lexical coverage) and critical reading.

Generally, previous studies agree that there is a close connection between vocabulary and reading (e.g. Anderson & Freebody, 1981; Cain & Ouakhill, 2014; Hu & Nation, 2000; Laufer, 1992; Nation 2001, 2006; Qian, 1999, 2002; Sabag-Shushan et al., 2024; Zhang & Zhang, 2020). Cain and Oakhill (2014) examined the relationship between vocabulary breadth and depth and two types of reading: inference making and literal comprehension. The correlational analysis showed that none of these vocabulary measures was associated with understanding literal details. Similarly, the measures were weakly associated with the local cohesion inferences. However, they strongly correlated with the global coherence inferences. The study showed that vocabulary is an important contributor to inference making than to literal comprehension of the text. Read (2017) examined how vocabulary breadth and depth were related to reading comprehension performance among college students. The study showed that both vocabulary breadth and depth correlated significantly with comprehension. However,

only breadth could explain variance in reading comprehension. This indicates that knowing a large amount of vocabulary items facilitates reading through speeding word processing. Rahman and Iqbal (2019) examined the relationship between both vocabulary breadth and depth and reading comprehension. Unlike the results which are highlighted by Read (2017), this study reported a high correlation between depth of vocabulary knowledge and reading comprehension, while vocabulary breadth correlated only moderately with reading comprehension. Dagnaw (2023) examined the relationship between vocabulary breadth (using VLT) and depth (using DVK) and reading comprehension among non-native university students who have been studying English for 12 years, using the Internet-Based Test (IBT) reading section of TOEFL. Of relevance to us in this study is the reported significant relationship between vocabulary breadth and reading comprehension (r. = .74, p. < 0.01). In this study, vocabulary breadth could explain 55% of variance in reading comprehension. Tong et al. (2023) examined the relationship between four aspects of vocabulary knowledge and reading comprehension among Chinese university students. The study reported a medium correlation between vocabulary breadth and reading (r. = 0.48, p. < 0.001), while vocabulary depth showed a stronger correlation.

Related to vocabulary size is the aspect of text coverage, which is another vocabulary variable that has been examined for its contribution to reading comprehension. Laufer (1989) reported that with a coverage level of 95%, the participants in her study could only obtain a comprehension level of 55%, indicating that this level is not enough for adequate comprehension. In a subsequent study, Laufer (1992) reported that for this comprehension level (55%) a vocabulary size of 3,000 word families is needed, while for a 70% reading ability, a size of 5,000 word families is required. This indicates that there is a close connection between vocabulary size and the amount of known vocabulary in a text. Examining the relationship between coverage and comprehension among foreign adults studying English in a pre-university course, Hu and Nation (2000) reported that reading was really weak at the level of 80% coverage, and that very few learners could read adequately at 90% and 95% coverage. The researchers concluded that for adequate text comprehension a minimum of 98% coverage is necessary. Nation (2006) concluded that a vocabulary size of 2,000-3,000 word families provides 95% coverage in everyday conversation, while knowledge of 6,000-7,000 words offers 98% coverage. Consistent with this, Laufer and Ravenhorst-Kalovski (2010) reported that for a coverage of 98% a size of 8,000 word families is required for adequate text comprehension.

Zhang and Anual (2008) used the VLT to measure English secondary school students' vocabulary knowledge and its relationship to reading comprehension. The study reported that students' vocabulary knowledge at the 2000- and 3000-word levels correlated with reading comprehension. The researchers concluded that vocabulary knowledge of 2,000 and 3,000-word levels is probably predictive of comprehension. These figures are lower compared to those of Nation (2006) and Laufer and Ravenhorst-Kalovski (2010). They are, however, close to the results of Milton and Hopkins (2006) who concluded that learners need a vocabulary of around 4,500-5,000 word families to read at the highest level (C2) on the Common European Framework of Reference (CEFR) reading descriptors.

Qian (1999) investigated the relationship between vocabulary knowledge and reading comprehension in English. The study reported a high and positive correlation (r. = .78) between

scores for vocabulary size and the reading subset of TOEFL. Similar results about the correlation between vocabulary and reading were reported in another study by the same researcher (Qian, 2002). In this study, Qian reported that vocabulary size alone could explain 54% of the variance in basic reading comprehension tasks. Also, Schmitt, Jiang and Grabe (2011) found a linear relationship between the 92% and 100% lexical coverage levels and reading. The study reported a significant medium effect-size correlation (r. = .40) between lexical coverage and reading comprehension. Alavi and Akbarian (2012) examined the impact of vocabulary size on various TOEFL-related reading skills. The study reported a moderate, positive correlation between VLT and the two items which required direct understanding of the words, mainly 'guessing vocabulary' (r. = .58, p <.001) and 'understanding stated detail' (r. = .44, p <.001). In this study, VLT correlated weakly with the skills of 'main idea', 'inference' and 'reference'. Engku, Isarji and Ainon (2016) studied the relationship between vocabulary size and reading comprehension among post-secondary English students in a Malaysian university. The study reported a strong and positive relationship (r. = .64) between reading and vocabulary test sores, further indicating that better vocabulary size is connected with better reading performance. Of equal importance is that the study reported a high correlation between reading comprehension scores and the 2,000-word level (r. = .63), a moderate correlation (r. = .49) with the 3,000-word level and 5,000-word level (r. = .41). These results emphasize the importance of the high-frequency vocabulary in understanding written texts.

Benson and MadarbakusRing (2021) analyzed the vocabulary in two English for Academic Purposes textbooks. The researchers compared the vocabulary lists to the British National Corpus and Corpus of Contemporary American English (BNC/COCA) 25,000 (Nation, 2012) and JACET8000 (JACET, 2016) word lists. The study reported that only 95% coverage of a commercial textbook used at the university level could be achieved with the first 3,000 words of the BNC/COCA. This coverage level is at the lower level of the threshold which is set in most studies (59% - 98%). Ludewig et al. (2022) investigated the relationship between text coverage and reading among 4th graders in German schools. The study reported a strong relationship between vocabulary knowledge and text comprehension. Moreover, coverage explained comprehension better than vocabulary size. In their study, Ludwig et al. reported a high correlation (r. = .61) between vocabulary knowledge (i.e. size) and text comprehension. The study reported a strong association between both aspects of vocabulary knowledge (size and coverage) and reading. However, coverage outperformed vocabulary size as a predictor of comprehension. A similar result is reported by Laufer and Ravenhorst-Kalovski (2010) who found that coverage could predict 64% of the variance in the reading score. Song and Reynolds (2024) examined the contribution of 7 lexical coverage levels (90%, 95%, 96%, 97%, 98%, 99%, and 100%) to the comprehension of narrative and expository texts for Chinese EFL undergraduate students. The study concluded that lexical coverage could explain variance in reading comprehension in an incremental way.

The studies which examined the relationship between vocabulary and reading have on the whole established a strong relationship between these two variables. Also, previous research has established a coverage level ranging from 95% to 98% as a level of lexical coverage which is necessary for successful comprehension. Despite the proliferation of vocabulary-reading research in the recent years, most of the studies focused mainly on the relationship between

vocabulary and literal comprehension or text-based inferencing. To our knowledge, no previous research tried to examine the relationship between vocabulary knowledge and critical, rather than literal, reading. Therefore, the objective of the present study is to examine the relationship between vocabulary knowledge and the performance of critical reading skills. To this end, the present study deals with the following research questions:

RQ1: Is there any significant relationship between vocabulary size and students' performance in critical reading?

RQ2: Is there any significant relationship between text coverage and students' performance in critical reading?

RQ3: Which of the two types of vocabulary knowledge (i.e. size or text coverage) significantly contributes to performance in critical reading?

Materials and Methods

Sampling and Data Collection Procedures

Seventy-six students of English, majoring in education at the Faculty of Education in Morocco participated in this study. As Table 1 shows, 61 (80.3%) participants are females and 15 (19.7%) are males. This distribution of gender follows the natural demographics of the students in the institution where data was collected.

Table 1
The Distribution of the Participants in the Study

		Demographics			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	61	80.3	80.3	80.3
	Male	15	19.7	19.7	100
	Total	76	100	100	

This study used three instruments for data collection: The Vocabulary Levels Test (VLT) (Schmitt et al., 2001) to measure receptive vocabulary knowledge in terms of size, a lexical coverage test to assess the participants' knowledge of the vocabulary of the reading text and, finally, a critical reading test to assess the participants' ability to perform critical reading tasks based on an argumentative text. The two vocabulary tests were administered one week before the reading test to ensure a reasonable distance between the coverage test and reading and to minimize the effect of activating any text-related background knowledge.

The participants took the coverage test first. The test includes 189 words which are sampled from the reading text based on a word-family procedure as explained below. The participants were asked to tick 'Yes' or 'No' for each word depending on whether they know it or no. The participants were instructed that in the test, knowing a word simply means having some knowledge of its meaning irrespective of any contextual occurrence.

To extract the target words of the coverage test from the reading text, we followed some procedures. First, the researchers used the online computer program Vocabprofiler (available on Cobb's Lextutor.ca website) to generate word families from the text. We then checked the word families for accuracy and we made some adjustments since our objective was to test text-related vocabulary rather than testing knowledge of the whole family or its base form. Therefore, we considered the words 'hyper-connected', 'well-being', 'profit-driven', face-to-

face', 'long-term' and 'self-expression' as independent words. We also tested knowledge of both 'teens' and 'teenagers' although they would be put within the same word family by the automatic profiler.

Our decision to test knowledge of these words as they are in the text is related to the objective of our vocabulary coverage test: testing knowledge of the vocabulary of the text. Hence, we decided to test these words because testing them as families (i.e. as they are generated by the Vocabprofiler) might lead to some bias as learners might indicate that they know the meaning of, for example, 'long' although they may not really know what 'long-term' means; hence leading to test unreliability. Ultimately, the coverage test is composed of 189 word families. The chart below (Table 2) indicates the number of word families, word tokens and word types in the reading text as generated by the computer program.

Table 2

Number (and Percentage) of Word Families, Types and Tokens in the Text Based on Frequency Levels

Freq. Level	Families (%)	Types (%)	Tokens (%)
K-1	105 (55.2)	118 (55.14)	214 (60.623)
K-2	41 (21.5)	46 (21.50)	68 (19.263)
K-3	27 (14.21)	31 (14.49)	49 (13.881)
K-4	7 (3.68)	7 (3.27)	7 (1.983)
K-5	3 (1.57)	3 (1.40)	6 (1.700)
K-6	5 (2.63)	6 (2.80)	6 (1.700)
K-7	1 (0.52)	1 (0.47)	1 (0.283)
K-12	1 (0.52)	2 (0.93)	2 (0.567)
Total	190	214 (100)	353 (100)

After the coverage test, the participants took the vocabulary size test. In this study, the version of the Vocabulary Levels Test which was updated by Webb et al. (2017) was used. Originally, the test was developed by Nation (1983) and updated by Schmitt et al. (2001). For the objectives of the present study, we administered only the first 5 levels in the VLT. First, based on our analysis of the vocabulary in the reading text using Vocabprofiler, the reading text includes 64% of K1 words, 9.34% of K2 words and the rest is 14% of the words from the other bands or from the Academic Word List. Consequently, this large percentage of highly frequent words in the text is the reason why the researchers decided not to exceed the 5,000-word level in the VLT since our primary objective was to examine the link between vocabulary knowledge and critical reading skills, rather than the participants' vocabulary size per se.

Similarly, unlike the original versions of the test, the adapted version includes the first most frequent 1,000 (K1) words of English. This band alone accounts for 65% to 85% of the words produced both in the spoken and written forms of English. Including the first 1,000 words serves the purpose of the current study since we are examining the relationship between vocabulary knowledge and critical reading in a text which mainly contains words from the first frequency level. Second, the VLT adopts the word family rather than the lemma in its word measurement. As our students are specialized English language learners at a somehow advanced level (Semester 5 at university), we assume that they have developed enough lexical and morphological knowledge to allow them to infer the meaning of the words in the family if they know the base word or even any other word in the family. Finally, we opted for the new

version of the test because, unlike previous versions, it is based on recent word lists (Nation, 2012) which are derived both from the British National Corpus and the Contemporary Corpus of American English (Davies, 2012).

To explain the procedure of taking the VLT to the participants, a demonstration was done with the example which is given in the test. Each level of the VLT is composed of 30 words of 6 clusters (3 key answers and 3 distractors) and 3 definitions. The test-taker is required to tick the box which matches each word to its definition. For each correct response the test-taker is awarded 1 point, which makes a total of 30 points for each level. Since each level represents 1,000 words (1K), we multiplied the score (i.e. number of correct hits) of each level by 33.33 in order to normalize the participants' scores to 1,000 words. To complete the VLT test, the participants were given 45 minutes, which was enough for all the test-takers.

The critical reading test was administered one week later. The reading text is composed of 353 word tokens (214 word types). Besides the text, there are 12 multiple choice questions targeting the following critical reading skills: 'recognizing text structure', 'inferring the author's point of view', 'understanding cause-effect relationships', 'identifying the purpose of the author', 'identifying the intended values', 'understanding feelings/emotions', 'drawing conclusions', 'distinguishing fact from opinion', 'evaluating author credibility', 'identifying unrelated information', 'evaluating text premises' and 'forming an opinion about the text'. We opted for multiple choice questions in order to ensure the consistency of scoring the test.

The reading text is about the impact of the excessive use of social media platforms on teenagers. The text is generated using ChatGPT. The researchers have resorted to the use of AI for two reasons: First, we asked AI to generate a text which is within C1 level of the Common European Framework of Reference (CEFR). We prompted ChatGPT with clear instructions about our target level and we further checked later by asking AI to justify why the text is within C1 level. ChatGPT provided justifications and examples related to the sophistication of vocabulary (e.g., 'hyper-connected', 'curated lives', 'self-expression' and 'instant gratification'), sentence complexity (e.g., "Exposure to the curated lives of others fosters unhealthy comparisons, leading teenagers to measure their value through the number of likes and followers."), complexity of ideas and nuanced discussions about social media, and finally a level of argumentation which is expected at a C1 level. Second, the researchers used AI to generate the reading questions following the structure of the reading assessments in PISA (Program for International Student Assessment). We followed a PISA training document and we extracted a set of similar target critical reading skills. Then, we instructed ChatGPT to use the reading text and prepare questions which target the given cues. We further revised the text and made some necessary adjustments to make the questions clearer and straightforward. We also examined the different options within each question to ensure that only one item is correct for each question.

Data Processing Procedures

Three types of instruments were used to collect data for the present study: the reading test (the text and the questions), the coverage test and the vocabulary size test (VLT). For the reading test, we collected data from 81 participants. However, data from 2 participants was discarded because they didn't take the vocabulary tests. For the VLT and coverage test, data was collected from 80 participants, and we discarded 2 participants who did not finish the last level

of the VLT. We also automatically eliminated the reading test of the two participants who didn't take or finish the vocabulary tests. Vocabulary coverage data from 1 participant was also missing as they didn't return the coverage test paper. Nevertheless, we used this participant's VLT and reading test data for the analyses which involved only critical reading and VLT, and they were considered as missing data in the analyses which involved text coverage. This means that for the analyses which concerned reading and VLT we had 76 participants and for the analyses which concerned text coverage and reading we included only 75 participants. SPSS© statistics package (Version 21) was used for all the tests and correlational analyses.

Results

This section presents the results of our analyses with regards to the three research questions of this study. First, we conducted a correlational analysis to examine the relationship between the two vocabulary variables of VLT and text coverage on the one hand and students' performance (i.e. scores) in critical reading on the other. Then, a multiple linear regression analysis was used to test the contribution of the two (predictor) vocabulary variables to variability in the reading scores.

The Relationship between Vocabulary Size and Performance in Critical Reading

This section answers the first research question of the study. It examines the relationship between the participants' vocabulary size and critical reading. The research question was stated as: Is there any significant relationship between vocabulary size and students' performance in critical reading?

To answer this question, we first provide descriptive statistics related to the participants' receptive vocabulary size and also their performance in critical reading skills. The results (Table 3) indicate that within the range of 5,000 words, the participants had a mean vocabulary size of 4,343 words. This indicates that, on the whole, learners have an excellent mastery of the first most frequent 5,000 words of English. The standard deviation suggests that learners are not very different from each other in their performance on the test and, consequently, in their vocabulary knowledge. The minimum vocabulary size is 2,900 words, meaning that the participants, as a group, knew about 3,000 word families.

Looking at each frequency level separately, we observe that there is a decrease in the scores of the test takers as we compare lower to upper levels. The mean vocabulary size for Level1 is 990 words compared to Level5 (773 words). These results indicate that, on average, learners know more high-frequency words compared to less frequent ones. The increasing standard deviations as we move from lower to upper frequency bands suggest that as the vocabulary becomes more challenging, learners demonstrate wider differences in their performance.

Table 3

Descriptive statistics: Vocabulary Levels Test (VLT)

	N	Min.	Max.	M	SD
Level 1		867	1,000	990.69	27.538
Level 2		733	1,000	943.77	74.669
Level 3		500	1,000	851.67	122.359
Level 4		367	1,000	784.13	171.207
Level 5	76	0	1,000	773.17	205.389
Total Size (VLT)		2,900	5,000	4,343.43	519.327
Valid N (listwise)			76		

To test the significance of the difference between the 5 vocabulary levels, we used a repeated measures anova. Because sphericity was not assumed (p. < .05), we opted for the interpretation of Greenhouse-Geisser test. The repeated measures test yielded a statistically significant difference between the 5 levels of the VLT: $F_{(2.25, 169.35)} = 72.52$, $p < 0.0005$, $\eta^2 = .49$. This indicates that the levels reflect the difference in the frequency of the words across different levels. The partial eta squared value ($\eta^2 = .49$) indicates that quite a large proportion (49%) of the difference between the 5 frequency levels could be explained by the difference in word frequency.

It is also important to examine the performance of learners in critical reading before we conduct the correlational analyses. Concerning the performance of the participants in critical reading, they obtained a mean points of: M = 8.57, sd. = 1.59. both the median and the mode equal 9. This shows that the participants managed to perform well in critical reading, bearing in mind that the maximum possible score is 12 (12 questions; 1 point each). For their performance in each critical reading skills, as the results on Table 4 show, the participants exceeded the average mean (.50; each skill is scored out of 1 point) in most critical reading skills, except in two skills: 'forming an opinion about the text' (M = .34, sd. = .47) and 'distinguishing fact from opinion' (M = .30, sd. = 46). These two skills showed the lowest performance, with learners getting a mean below the average. Both skills require the participants to recognize/evaluate an opinion in the text or to select the most appropriate opinion about the issue being discussed in the text.

Table 4

Critical Reading Skills: Descriptive Statistics

	Descriptive Statistics				
Critical reading skill	Mean	SD	Critical reading skill	Mean	SD
Inferring the author's view	.96	.196	Identifying unrelated information	.74	.443
Identifying the purpose of the author	.97	.161	Evaluating author credibility	.66	.478
Recognizing text structure	.92	.271	Understanding cause-effect relationships	.64	.482
Drawing conclusions	.92	.271	Evaluating text premises	.64	.482
Understanding feelings/emotions	.88	.325	Forming an opinion about the text	.34	.478
Identifying intended values	.76	.428	Distinguishing fact from opinion	.30	.462
N = 76					

To answer the first research question (RQ1) about the relationship between learners' vocabulary size and performance in critical reading, we used a correlational analysis. The

results (Table 5) indicate that there is a meaningful and medium effect size relationship between learners' vocabulary size and critical reading (r. = .47, p. < .01). This suggests that vocabulary size is related to the performance of learners in critical reading. The results also indicate that for a successful performance in critical reading tasks, a vocabulary size of 4,000-5,000 words is required. The mean size for our group is 4,300 words.

Table 5

Correlations between Vocabulary Size and Critical Reading

	Correlations	
		Critical Reading
Vocab Size (VLT)	Pearson Correlation	.471**
	Sig. (2-tailed)	.000
	N	76

**. Correlation is significant at the 0.01 level (2-tailed).

To further check this overall correlation between vocabulary size and the critical reading score, we also analyzed the correlation between the frequency bands and the reading score. The results (Table 6) indicate that all the frequency bands significantly correlated with the performance of students in critical reading. It is important to mention that only band 1 showed a weak correlation (r. = .27, p. < .05) with the reading score, indicating that it probably did not contribute a lot to students' performance. All the other four bands showed moderate and significantly meaningful correlations with the reading score. The four bands approximated or exceeded a correlation of r. = .40 with a significance level of less than .01. These results indicate that knowledge of less frequent vocabulary is probably more important in performing critical reading tasks. When the text is composed of mainly high-frequency vocabulary (i.e. K1) as is the case in our text, it is likely that the vocabulary which contributes most to performing critical reading skills is mainly those few rare words in the text.

Table 6

Correlations between the Frequency Bands and Critical Reading

		Correlations					
		Critical Reading	Level 1	Level 2	Level 3	Level 4	Level 5
Critical Reading	Pearson Correlation	1	.271*	.396**	.462**	.390**	.410**
	Sig. (2-tailed)		.018	.000	.000	.001	.000
	N				76		

To answer the first research question, we conducted a correlational analysis between the holistic vocabulary size score and the twelve critical reading skills targeted in this study.

The results (Table 7) indicate that 7 critical reading skills showed significant correlations with vocabulary size. First, three critical reading skills showed moderately significant correlations with the vocabulary size. 'identifying intended values' showed a significant and moderate relationship with vocabulary size (r. = .42, p. < .001), 'drawing conclusions' significantly correlated with vocabulary size (r. = .37, p. < .05), and, finally, 'inferring the author's view' correlated significantly with the vocabulary size (r. = .31. p. < .05). These moderate correlations suggest that learners with better receptive vocabulary knowledge are

more likely to perform better in these critical reading skills. Probably, these skills depend more on knowledge of lexical clues in the text.

Four other skills showed significant but weak correlations with vocabulary size. First, 'identifying the purpose of the author' correlated significantly but weakly with vocabulary size (r. = .27, p. < .05). Similarly, 'understanding feelings/emotions' (r. = .26, p. < .05) correlated significantly, though weakly, with the vocabulary size. Also 'understanding cause-effect relationships' moderately correlated with the vocabulary size (r. = .24, p. < .05). The variable of 'evaluating the author's credibility' (r. = .23, p. < .05) showed a weak correlation with vocabulary size. These weak, but significant, correlations probably indicate that these skills may not directly link to vocabulary size, and that, besides vocabulary knowledge, there might be other aspects of knowledge which support learners' performance on these skills.

Five critical reading skills didn't show any significant correlation with vocabulary size. These are: 'recognizing text structure', 'distinguishing fact from opinion', 'identifying unrelated information', 'evaluating text premises' and 'forming an opinion about the text'. Unlike the variables which showed significant correlations with vocabulary size, it seems that these variables don't involve direct inferencing from the vocabulary of the text or reading between the lines. Probably, for these skills more evaluations than inferences based on the text are involved.

Table 7

Correlation between Vocabulary Size and Critical Reading Skills

Variable	Vocabulary Size (VLT)		Variable		
	Pearson Correlation	Sig. (2-tailed)		Pearson Correlation	Sig. (2-tailed)
Identifying intended values	.425**	.000	Evaluating author credibility	.232*	.044
Drawing conclusions	.372**	.001	Forming an opinion about the text	.156	.180
Inferring the author's view	.318**	.005	Recognizing text structure	.101	.387
Identifying the purpose of the author	.274*	.017	Identifying unrelated information	.070	.547
Understanding feelings/emotions	.263*	.022	Distinguishing fact from opinion	-.012	.921
Understanding cause-effect relationships	.248*	.031	Evaluating text premises	-.171	.139
			N = 76		

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

The Relationship between Text Coverage and Critical Reading

In this section, we deal with the second research question. Before examining this relationship, we present the descriptive statistics relating to the variable of 'text coverage'. The results (Table 8) indicate that a mean coverage of approximately 97% is attained by the participants in this test. This means that the participants know around 4 in each 5 words in the text. By approximating a coverage level of 97%, the participants, taken together, are close to an adequate level of text comprehension, based on previous research which set 98% as the level of adequate text comprehension (e.g. Hsueh-Chao & Nation, 2000; Hu & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010; Nation, 2006).

Table 8

Text Coverage: Descriptive Statistics

	Descriptive Statistics			
	Min.	Max.	Mean	SD
Text Coverage (%)	87	99	96.71	2.57
Valid N (listwise)			N = 75	

By having a look at the detailed frequencies of students' performance in critical reading based on their coverage levels as demonstrated in the cross-table below (Table 9), we observe that the best performance of students in reading is witnessed at or beyond 97% ($\geq$ 97%) coverage level. At this level and beyond, the participants had a mean coverage of 98.08 (sd. = .90), reflecting the minimum effective coverage level based on previous research. At this level, the participants (68%) managed to get really higher scores in reading (M = 8.98, sd. = 1.42). The remaining participants (32%) had a coverage score which is less than 97% (< 97%) with a mean coverage of 93.81 (sd. = 2.55), and they performed comparatively lower in their critical reading (M = 8.21, sd. = 1.84).

Table 9

Crosstab for the Different Coverage Levels and Performance in Reading

		Text Coverage (%) * Critical Reading Crosstab								
		Critical Reading (Total scores)								Total (students)
		4	5	6	7	8	9	10	11	
Text	87%	0	0	1	0	0	0	0	0	1
Coverage	89%	1	0	0	0	0	0	0	0	1
(%)	91%	0	0	0	0	0	1	2	0	3
	93%	0	0	1	1	2	0	1	0	5
	94%	1	0	0	0	0	0	1	0	2
	95%	0	1	0	0	0	2	0	0	3
	96%	0	0	0	3	0	4	3	0	10
	97%	0	0	0	2	3	3	1	5	14
	98%	0	1	0	2	5	9	3	2	22
	99%	0	0	0	0	3	4	6	1	14
Total (students)		2	2	2	8	13	23	17	8	75

Using an independent samples t-test to check the significance of the difference between the two coverage levels (i.e. coverage score <97% versus coverage score $\geq$97%), the results showed a statistically significant and meaningful difference between the two groups in their coverage levels (t (73) = -7.97, p = .001, d = 2.23). Similarly, to check if this meaningful coverage difference translates into a significant difference in critical reading, we used a t-test. The results turned a significant difference in the critical reading mean scores for the two groups (t (73) = -1.99, p = .05, d = 0.46). The difference between the two groups is moderate but substantially meaningful based on Cohen's d value.

We now look at the relationship between text coverage and the performance of students in the critical reading score. The results of the correlational analysis (Table 10) indicate that there is a significantly moderate and meaningful correlation (r. = .34, p.< .01) between text coverage and performance in critical reading as a whole. This suggests that although learners showed that they knew almost all the vocabulary in the text, their knowledge of some key, probably

less frequent, items is important for the performance of critical reading tasks. It is important to note that in our previous analysis (Table 6), only band 1 showed the lowest correlation with critical reading, indicating that when the text is composed mainly of high-frequency vocabulary, rare words might be more important in performing critical reading tasks.

Table 10

The Relationship between Text Coverage (%) and Critical Reading

Correlations		
		Critical Reading
Text Coverage (%)	Pearson Correlation	.343**
	Sig. (2-tailed)	.003
	N	75

**. Correlation is significant at the 0.01 level (2-tailed).

We now examine the relationship between text coverage and independent critical reading skills, as we did with the VLT. The results of the correlational analysis between text coverage and critical reading skills (Table 11) indicate that only four critical reading skills significantly correlated with text coverage. First, the variable of 'inferring the author's view' correlated meaningfully and moderately with text coverage (r. = .44, p. < .01). This moderate relationship indicates that having excellent coverage might facilitate inferring the author's view from the text. This suggests that this skill may require understanding and relying on some lexical clues in the text. Second, a moderate relationship (r. = .41, p. < .01) was observed between the variable of 'understanding feelings/emotions' and text coverage. This correlation may also suggest that 'understanding the feelings and emotions' which are expressed through the text might require some knowledge of the text vocabulary as learners might trace lexical clues which show the author's feelings or emotions.

Two weak correlations appeared in our analysis. The variable of 'understanding cause-effect relationships' correlated with text coverage (r. = .23, p. < .05), though weakly. The variable of 'identifying intended values' also correlated weakly (r. = .26, p. < .05) with text coverage. These weak correlations suggest that although coverage might be important for the performance of these two critical reading skills, knowing the text's vocabulary does not translate into a strong relationship with these two skills. The other critical reading variables in this study did not show any significant correlation with text coverage.

Table 11

The Relationship between Text Coverage and Critical Reading Skills

	Text Coverage %				
Variable	Pearson Correlation	Sig. (2-tailed)	Variable	Pearson Correlation	Sig. (2-tailed)
Inferring the author's view	.442**	.000	Forming an opinion about the text	.160	.17
Understanding feelings/emotions	.417**	.000**	Identifying unrelated information	.080	.497
Identifying intended values	.266*	.021	Recognizing text structure	.038	.747
Understanding cause-effect relationships	.237*	.040	Drawing conclusions	.007	.950
Evaluating author credibility	.188	.105	Evaluating text premises	-.148	.204
Identifying the purpose of the author	.164	.159	Distinguishing fact from opinion	-.162	.164
			N = 75		

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

The Contribution of Vocabulary Knowledge to Performance in Reading

After having conducted the correlational analyses, we now examine the contribution of vocabulary knowledge to variability in students' critical reading scores. This is dealt with in our answer to the third research question.

To answer this question, we first opted for a multiple linear regression analysis between the two predictor variables (i.e. Vocabulary size & Vocabulary coverage) and the dependent variable 'Critical reading'. However, when checking the assumptions of regression, it was observed that the variable of 'coverage' did not show a linear relationship with the outcome variable (critical reading), which led to excluding it from the analysis. Therefore, only the variable of 'Vocabulary size' (VLT) remained in the regression model.

The results indicate that 'Vocabulary size' significantly contributed to variance in the participants' critical reading scores ($R^2 = .22$, Adjusted $R^2 = .21$), indicating that vocabulary size alone accounts for 22% of variance in the scores in critical reading. The model is statistically significant ($F(1. 73) = 21.65$, p. $< .01$). Taking into consideration all the other skills which are involved in (critical) reading, this contribution of vocabulary size to variability in critical reading seems important.

Discussion

This study set out to examine the relationship between vocabulary knowledge and reading. The current study aimed at exploring this relationship with critical reading skills that do not entirely depend on comprehending literal information from the text; rather, the reader is required to make inferences, evaluate, and react to the text critically while exploiting the vocabulary and ideas in the text.

The results highlight the central role of vocabulary knowledge to the performance of critical reading skills, confirming the role of vocabulary as established in research dealing with literal reading tasks (e.g., Ait Hammou & Ech-Charfi, 2024; Cain & Oakhill, 2014; Hirsh & Nation, 1992; Hu & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010; Nation 2001, 2006; Qian & Lin, 2020). In the present study, approximately a coverage level of around 97% is

enough and necessary for critical reading of argumentative texts. Below this level, learners' performance drops significantly. At this level and beyond, the performance of learners is significantly outstanding, indicating that the established coverage thresholds for literal reading is also enough and appropriate for the performance of critical reading skills. This coverage level is not far from the threshold of 98% which is reported in most previous studies as a level of successful reading performance. We can, therefore, conclude that even in cases where learners are not required to understand the literal information as stated in the text, they still need a high level of text coverage. This suggests that to perform critical reading skills probably requires a whole understanding of the information in the text first, hence requiring similar coverage levels.

The analysis of the learners' vocabulary size indicates that their receptive vocabulary development follows a linear progression from lower to upper frequency levels. This study suggests that a mean vocabulary size of around 4,000-5,000 words may support successful performance in critical reading skills. With this size, learners will lexically cover 97% of the text vocabulary. Taking into consideration that we are talking here about 97%, rather than 98%, text coverage, the required size is a bit lower than those which are set by previous studies (Nation, 2006; Ravenhorst-Kalovski, 2010) as required for a coverage of about 98%. However, the reported coverage level in our study is close to that of studies such as Zhang and Anual (2008) and Milton and Hopkins (2006).

The statistically significant relationship (r. = .47, p. <.01) between vocabulary size and learners' overall performance in critical reading indicates that vocabulary size plays a significant role in dealing with critical reading skills. The reading text is mainly composed of high frequency vocabulary: Almost 90% of the words belongs to the first three bands. Hence, we can maintain that having good mastery of vocabulary improves performance in critical reading as a whole. The correlational analysis showed that all the five frequency bands correlated with the overall critical reading score. This suggests that although the text is composed of over 90% of highly frequent vocabulary (bands 1 to 3), all the frequency levels, with some differences, are equally important in helping learners make sense of the text and perform critical reading skills. It is, however, important to indicate that band 1, which contributed 54.7% of the vocabulary of the text, showed the lowest correlation with the critical reading score (r. = .27, p. < .01). The importance of vocabulary size for the performance of critical reading is also attested by a regression analysis which showed that vocabulary size alone contributed considerably to variance in the reading score (22%). These results are consistent with previous research about the importance of vocabulary size in literal reading (e.g., Laufer, 1989; Laufer & RavenhorsKalovski, 2010; Milton & Hopkins, 2006; Nation, 2006; Sabag-Shushan et al., 2024; Song & Reynolds, 2024; Zhang & Anual, 2008; Zhang & Zhang, 2020). This suggests that when the text is mainly composed of highly frequent vocabulary, those fewer less frequent words are probably more important in performing critical reading skills.

However, it seems from the results of this study that vocabulary size is not equally important for all the critical reading skills we targeted in this study. Three skills ('drawing conclusions', 'identifying intended values' and 'inferring the author's view' showed moderate and significant relationship with vocabulary size. The skills of 'identifying the purpose of the author', 'understanding feelings/emotions', 'evaluating the author's credibility' and

'understanding cause-effect relationships' showed weak correlations with the vocabulary size. The significant correlations between these skills and vocabulary size might indicate that these skills are more related to better vocabulary size. Hence, learners with larger vocabulary size might also show good performance in critical reading skills which are closely linked to the vocabulary of the text.

For text coverage, out of 12 skills, only four ('inferring the author's view', 'understanding feelings/emotions', 'understanding cause-effect relationships' and 'identifying intended values') showed significant, moderate to weak, correlations with this aspect of vocabulary. These results suggest that for these critical reading skills, knowledge of text vocabulary is important. It is important to note that these four critical reading skills also showed significant correlations with vocabulary size, which may indicate that for these skills vocabulary knowledge is important for their performance.

Based on these results, it is important for teachers to aim at least at a coverage level of 97% and a vocabulary size of at least 4,000 words for their students to perform critical reading tasks successfully. Although, critical reading can be taught and targeted in reading classes in at a basic level at an early grade levels, targeting more advanced critical reading skills such as 'drawing conclusion', 'understanding intended values', 'identifying the purpose of the text', 'understanding text structure', etc., may require a more solid mastery of vocabulary. Below the level of 4,000 words and 97% coverage, learners might find it difficult to deal with advanced critical reading skills. Hence, teachers should make sure first that students have attained these vocabulary levels before they deal with critical reading skills.

Conclusion

The results of this study indicate that both vocabulary size and text coverage are important for performance in critical reading. The study suggests that there are some critical reading skills which build on, and probably require, better vocabulary knowledge. Although the text we used in this study is straightforward and is composed of over 90% of highly-frequent words, both vocabulary size and coverage showed an important relationship with learners' performance in critical reading. This suggests that there are always some key, probably rare, words which play an important role in performing critical reading tasks. The study has concluded that vocabulary size of about 4,000 to 5,000 word families might be required to perform critical reading tasks successfully. This will make the text comprehensible at a coverage level of around 97%. At this level, learners successfully perform critical reading skills.

Further research is needed to confirm the results of the present study. It is important to further examine the importance of vocabulary knowledge both with argumentative texts and with other text genres. This study collected data only from homogenous groups in one institution. Further research is needed with a more homogenous sample of participants in order to further examine the relationship between vocabulary knowledge and critical reading.

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