Vocabulary Knowledge and Reading Comprehension

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ABSTRACT: *The article reports the results of an investigation conducted with a group of Algerian university students majoring in Microbiology. Data for this study came from a reading comprehension test administered to proficient and less-proficient readers. The study addresses the following questions: (i) To what extent do high-level students differ from low-level students as far as vocabulary knowledge and comprehension are concerned? (ii) To what extent do measures of readers' vocabulary knowledge correlate with measures of reading comprehension? As regards the first question, the findings indicated that there were more differences than similarities between the two groups. Concerning the second question, the results of the test yielded an interesting finding indicating that a high performance on one implies also a high performance on the other, and a low performance in one implies a low performance in the other.*

1. Introduction

The ability to read academic texts is considered one of the most important skills that university students need to acquire. Although a large portion of time at university is spent working with written sources of information, a significant proportion of ESP students struggle with reading comprehension. This study aims at shedding light on the comprehension difficulties that fourth year Microbiology students encounter when reading in their academic learning area, and depicting the connection between vocabulary knowledge and comprehension.

2. Defining Vocabulary Knowledge

Researchers and theorists have pointed to the fact that vocabulary knowledge is multi-faceted, "a disarmingly simple term for a complex multidimensional phenomenon" (Harley 1996). Various kinds of knowledge are associated with a word that a learner must know. Richards (1976) identified seven aspects of word knowledge including: syntactic behaviour, associations, semantic value, different meanings, underlying form and derivations. Nation (1990), on the other hand, distinguished eight types of word knowledge including form, grammatical pattern, meaning, function, relation with other words. Chapelle (1998) exposes four aspects of vocabulary knowledge: vocabulary size, knowledge of word characteristics, lexicon organization, and processes of lexical access.

Moreover, second language (L2) vocabulary researchers have agreed that lexical knowledge is constructed as a continuum, consisting of several

levels and dimensions of knowledge. These dimensions comprise: "breadth" versus "depth" and "receptive" versus "productive" vocabularies.

Receptive vocabulary "involves the ability to perceive a word while listening or reading and to retrieve its meaning"; whereas productive knowledge refers to "the ability to use a word in speech or writing" (Nation 2001: 25). Breadth of vocabulary knowledge entails vocabulary size or the quantity of words learners know at a particular level of language proficiency (Nation 2001). Depth of vocabulary knowledge, on the other hand, refers to the quality of lexical knowledge, or how well the learner knows a word (Meara 1996; Read1993). Depth of vocabulary deals with various aspects of a given word involving meaning, as well as morphology, phonology, syntax, sociolinguistic aspects, differences between written and spoken uses, and strategies for approaching unknown words.

3. Defining Comprehension

Comprehension is defined as "intentional thinking during which meaning is constructed through interactions between text and reader" (Harris &Hodges 1995). Kintsch and Rawson (2005) see comprehension as depending upon largely automatic processes. They distinguish two major levels of representation: a text base representation that corresponds to the linguistic structure of the text and its meaning, and a situation model, a more abstract representation which is not exclusively verbal and includes a wide range of world knowledge that may include imagery and emotional content and which is described by the text. Perfetti, Landi, and Oakhill (2005:228), on the other hand, argue that "comprehension occurs as the reader builds a mental representation of a text message. The comprehension processes necessary for meaning extraction occur at multiple levels across units of language.These processes involve letter identification, lexical access, concept activation, syntactic analysis, propositional encoding, sentence comprehension, intersentential integration and complete representations of extended text. These representations are not the result of exclusively linguistic processes, but are enhanced by other knowledge sources such as activation of prior knowledge, information storage, and comprehension monitoring.

4. Connection between Vocabulary Knowledge and Comprehension

Interest in the connection between vocabulary knowledge and successful reading has a long history in the research of foreign language reading. If we accept comprehension as the goal of reading, vocabulary knowledge is the foundation of reading proficiency and fluent reading (Daneman 1991; Stanovich 1991). Some researchers (Nation 1990; Grabe 1991) have shown the important role of vocabulary as a predictor of overall reading ability. They have also shown that measures of readers' vocabulary knowledge strongly correlate with measures of reading comprehension. Vocabulary difficulty, then, has consistently been shown to have an impact on comprehension (Freebody & Anderson 1983, cited in Alderson 2000). As Alderson (2000:35) expresses it, 'having to struggle with

reading because of unknown words will obviously affect comprehension and take the pleasure out of reading'. Lexical knowledge appears to be a prerequisite for comprehending text. Laufer (1989) found that the lexical "threshold level" is 95%; that is if the student understands less than 95% of the text lexis, his/her comprehension of the text will be unsatisfactory. In order for reading to be successful, then, the learners must have a solid lexical knowledge in place, must process word rapidly and automatically and approach new words strategically to learn content matter.

But the question remains: Is this relationship merely correlational? Is it simply the fact that people with larger vocabularies have good comprehension skills? Or is the relationship causal? Researchers have suggested several models to describe the relationship between vocabulary knowledge and reading comprehension. The three most common models are described below namely the causal, the reciprocal, and the indirect causal.

4.1. Causal Links Underlying the Vocabulary-Comprehension Relationship

Anderson and Freebody (1981) offered three hypotheses to describe the causal links that underlie the vocabulary-comprehension relationship labeled "instrumentalist", "aptitude" and "knowledge". *The instrumentalist hypothesis* (number of words) posits that there is a causal connection between vocabulary size and the ability to comprehend. On the other hand, *the aptitude hypothesis* (intellect) sees that vocabulary knowledge is one of many outcomes of having a good brain and that it results from having high intelligence or verbal aptitude. Other outcomes might include skill at non-verbal puzzles and the ability to understand oral explanation. *The knowledge hypothesis* (background knowledge) emphasizes the role of the readers' background knowledge in comprehension i.e. the readers must bring as much information to the text as they expect to get from it. Simply put, a large vocabulary is an indicator of a large knowledge base. Henceforth, the relationship between vocabulary and comprehension is accounted for by 'world' rather than 'word' knowledge.

Mezynski (1983) suggested a fourth *"access" hypothesis*. The access view, like the instrumentalist view, sees vocabulary as having a causal relationship with comprehension provided that the words that the students are taught are easily and quickly accessed. Access can be improved through practice. This access can involve several factors including fluency of lexical access, speed of coping with affixed forms, and speed of word recognition.

4.2. Reciprocal Links between Vocabulary and Reading Comprehension

While the hypotheses discussed above involve models in which the causal links between vocabulary and reading comprehension only go in one direction, the reciprocal view considers that the causal relationship between vocabulary knowledge and reading comprehension goes in both directions. Henceforth, having a big vocabulary does contribute to being a better reader, but being a good reader contributes to having a bigger vocabulary as well. Hence, the

amount of reading a person does plays an important role in the reciprocal relationship between vocabulary knowledge and reading comprehension.

4.3. Indirect Causal Links between Vocabulary Knowledge and Reading Comprehension

The indirect causal view suggests that vocabulary knowledge may have an impact on other abilities, which in turn contribute to reading comprehension. One such possible indirect link involves metalinguistic awareness. Broadly, metalinguistic awareness refers to the ability to manipulate the sounds and meanings of words, phrases, and sentences, and also the ability to reflect on the comprehension of a text more generally, and to repair comprehension problems. Evidence indicates that vocabulary knowledge may contribute to some types of metalinguistic awareness, which, in turn, can contribute to reading comprehension, either directly or indirectly, through the contribution of metalinguistic awareness to word recognition. Another possible indirect link involves the impact of vocabulary knowledge on word recognition (Nagy 2005).

5. Methodology

5.1. The purpose of the study

The current study seeks to answer the following questions:

1. To what extent do high-level students differ from low-level students as far as vocabulary knowledge and comprehension are concerned?
2. To what extent do measures of readers' vocabulary knowledge correlate with measures of reading comprehension?

5.2. Materials

A reading comprehension test, developed by the researcher, was administered to students.

5.3. Participants

The test was administered to a hundred and twenty one Algerian university students majoring in Microbiology, but due to a large number of absentees (23) during the second sitting of the test which took place a week later (the test was scheduled in the students' regular English class), the results of 88 out 121 students were appropriate for analysis. However, only 58 subjects were selected for this study. The referential criteria for selecting subjects were the mean scores in the reading comprehension test. The top 29 students were chosen as proficient readers (henceforth high-achievers), and the lowest 29 students were chosen as less-proficient readers (henceforth low-achievers).

5.4. Description of the Test

The Reading Passages

Given the variety of activities and test items, the test was divided into two parts with one reading passage for each part. Both texts were taken from specialized books, entitled *Biology of Microorganisms for* the first passage*, and*

Fundamental Food Microbiology for the second one. They are authentic in the sense that they are destined to a specialist readership. Thus, they exhibit as many salient features of the target situation texts for the population as possible; hence their form (syntactic and lexical features) has been kept intact. The texts fall within the expository type and involve definitions, descriptions, and classification.

Because it involves tasks requiring "identifying main ideas" (skimming), and "locating specific information" (scanning, which may call for passages up to 2000 words, according to Hughes (989), and other tasks involving "information transfer", the first selected text contains 751 words, i.e. it is neither too short, nor too long. In addition, we have been careful to give a self-contained text which does not necessitate knowledge of the previous and subsequent parts in the book. On the other hand, because of the limited number of activities (only three), the second text is relatively shorter than the first text; it contains 519 words.

Skills and Strategies

A number of skills and strategies on which there appears to be some consensus concerning their importance in academic reading are involved in the test; they include the ability to:

- locate specific details,
- identify main ideas,
- understand relationship between stated ideas, and
- understand academic vocabulary.

According to the test specifications, only 36.66% of this subtest was devoted to vocabulary items, while the other 63.34% to comprehension items. Based on Urquhart and Weir (1998) matrix of reading types which distinguishes between 'local' reading and 'global' reading, we grouped the vocabulary subtests under the 'local' reading section and the comprehension subtests under 'global' reading section obtaining the following layout:

- Local-reading Skills and strategies: They operate at the word level and involve understanding lexis and deducing meaning of lexical items as follows: Guessing words from text, determining word function, finding opposites, and finding synonyms. For the purpose of analysis, and because they are all related to vocabulary understanding, we will label the four above four tasks V1, V2, V3, and V4 respectively.
- Global-reading Skills and Strategies: They involve processing the text in order to establish an accurate comprehension as follows: Reading for main ideas, reading for details, information transfer (table completion, and figure completion), a multiple-choice exercise, a matching exercise, and a gap-filling exercise. Similarly, for the purpose of analysis, and because they are all related to text comprehension, we will label the above seven tasks as C1, C2, C3, C4, C5, C6, and C7, respectively.

Test Administration

Before administering the tests, the students were given several instructions as regards the sitting of the tests. They were reminded to work independently. The students were also briefed on how to answer the questions. Approximately ten minutes were given to the students to go through the test paper and to raise any question pertaining to the tests.

Scoring

Although the test contains two parts, the scores were calculated globally (minimum 0/maximum 60) and for each individual question: 1 point for the correct response; 0 points for an incorrect response. The vocabulary items received 22 points (36.66%) out of the total score; whereas, the comprehension items received 38 points (63.34%) out of the total score. Each activity is allocated a mark according to the number of item that it contains. For example, activity one was attributed four marks because it contains four items, and activity three was attributed seven marks because it contained seven items.

6. Analysis of the Results

An in-depth analysis of the tests scores obtained by the participants in both sub-groups was conducted to obtain more detailed information about whether there existed differences among the sub-groups as far as 'local' and 'global' reading are concerned.

6.1. Descriptive Statistics

Descriptive statistics includes the frequencies of distribution of scores, and the mean scores of the test items. The following tables summarize the results.

Frequency of Distribution of Test Scores

Based on the students' performance in every task which is calculated by adding up the percentages of the below and above average scores, we obtain the following visual display of the findings.

To start with, the assessment of vocabulary as it pertains to reading comprehension is exclusively based on the receptive dimension of vocabulary. The analysis of frequency of distribution of test scores computed on the two samples showed that the two most difficult items for both sub-groups were *finding synonyms (V4)* and *determining word function (V2),* but with varying degrees of difficulty. In terms of percentages, 58.6% of high-achievers received below average scores for *finding synonyms* against 100% for low-achievers. On the other hand, only 27% of high-achievers failed in *determining word function (V2) against 95.5% of low-achievers.* In addition to failing in finding synonyms, and determining word function, another 58.7% of low-achievers performed poorly on *guessing words from context (V1);* high-achievers made the largest percentage (100%) of above average scores in this task. Finally, with regard to 'finding opposites (V3), the frequency of below-average scores was higher for low-achievers than for high-achievers; 38% against 6.8%, respectively.

In sum, a comparison between the performances of the two sub-groups reveals many discrepancies between them as far as lexical knowledge is concerned, with high-achievers performing largely better than low-achievers in the four activities.

Figure 1: Performance in local reading (High-achievers)

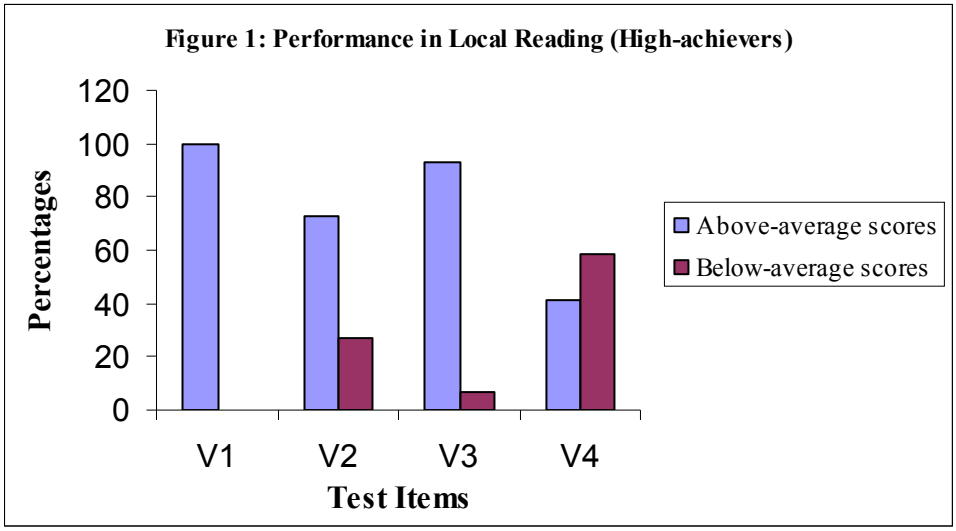
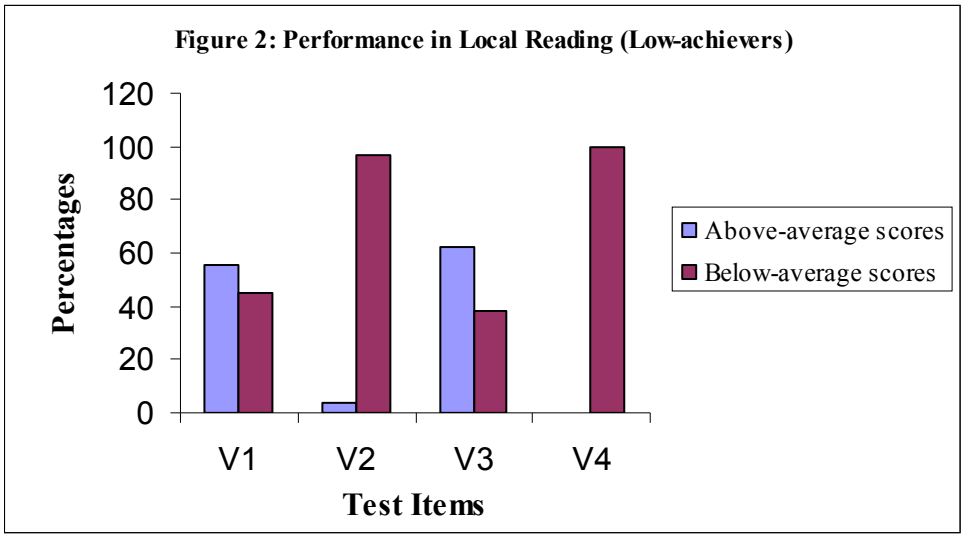
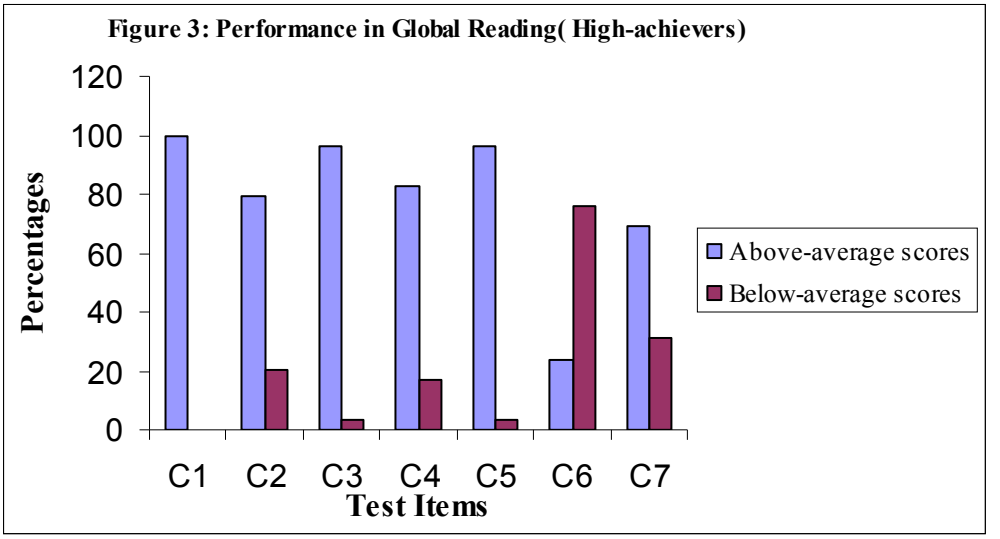


Figure 2: Performance in local reading (Low-achievers)



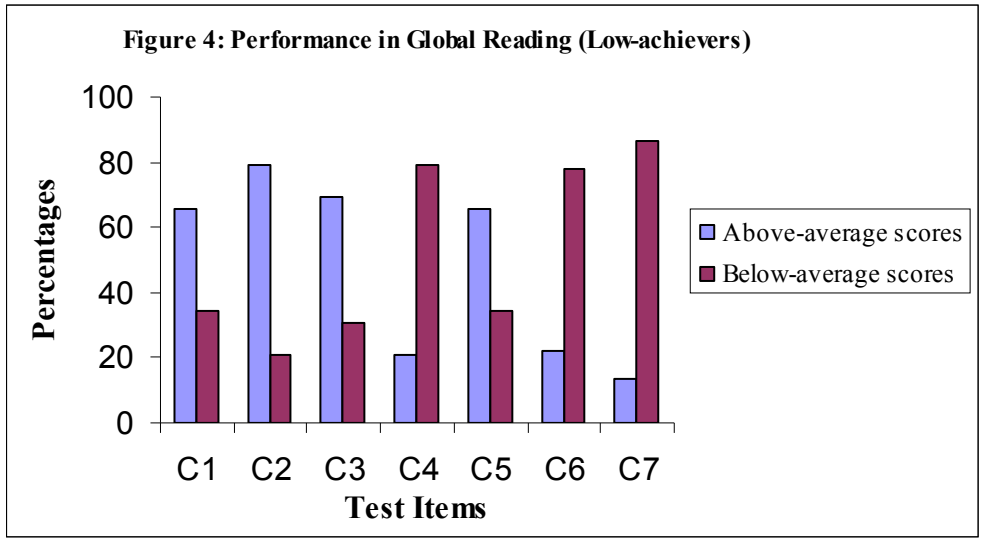
The frequency of distribution as well as the percentages of above-average scores is predominantly higher for high achievers in six out of seven tasks against four out of seven activities for low-achievers. The poorest performance for high-achievers was *matching sentence halves* (C6) with 76%. Meanwhile, very high percentages of above-average scores were observed especially for *identifying main ideas* (C1) with the totality of the sub-group obtaining average or above-average scores, followed by *table completion* (C3) and *multiple-choice exercise* (C5) with 96% for each. On the other hand, low-achievers performance poorly on *gap-filling* C7 (86%), followed by *figure completion* C4 (79%), and *matching* C6 (78%). The highest performance was observed in *reading for details* (C2) with 79%, followed by *identifying main ideas* (C1) and multiple-choice exercise (C5) with equal percentages (65%).

Figure 3: Performance in global reading (High-achievers)



Overall, the descriptive statistical analysis of the data does show a marked difference between the two sub-groups. On the whole, high-achievers did a very high performance in comprehension as well as vocabulary skills. On the other hand, low-achievers did an average performance in both global and local reading skills. However, both sub-groups performed better in comprehension than in vocabulary skills.

Figure 4: Performance in global reading (Low-achievers)



Means Scores

The table below shows the mean scores of the test main sections, namely 'local-reading' and 'global-reading sections of the two sub-groups as follows.

To start with, a comparison of the global mean scores across the two groups showed a significant difference (high-achievers 38.3, low-achievers 20.29), suggesting that low-achievers are confronted with reading comprehension difficulties in English. This finding is further reflected in the mean scores of both 'local' and 'global' reading sections of the test. As concerns the mean scores of high-achievers for both sections, they are above average and significantly higher than those of low-achievers, with the latter obtaining a considerably low mean score for the vocabulary section of the test (5.94) and a relatively higher mean score for the global reading section (14.29), but which is still comparatively low.

At this stage we can tentatively conclude that there is a correlation between global and local reading. In other words, the higher the performance is in '*local reading'* the higher it is in '*global reading'* and vice versa.

Table1: Mean scores of 'local' and 'global' reading strategies

	High-achievers (N=29)	Low-achievers (N=29)
	Mean	Mean
Global Score /60	38.03	20.29
Local Reading /22	14.31	5.94
Global Reading /38	23.75	14.29

A more detailed scrutiny of the individual tasks of the test results is given in the table below.

As illustrated by the data in Table 2, the descriptive summary of the data does show a marked difference in the total mean scores of both sub-groups. Overall, high-achievers obtained average and above average mean scores in all the tasks (both 'local' and 'global' reading tasks), except C6 which corresponds to the *matching* activity. As for low-achievers and except for *finding opposites* (V3), *table completion* (C3), and *multiple-choice exercise* (C5), which obtained average mean scores, all the other tasks received below average mean scores, particularly *finding synonyms* (V4), and *figure completion* (C4). In other words, high-achievers obtained above-average mean scores in ten out of eleven test items; however, low-achievers obtained average and above-average mean scores only in four out of eleven test items.

Now we will further examine the results in order to depict the connection between vocabulary knowledge and comprehension. Firstly, as regards 'local reading', a quick look at the mean scores clearly shows the dominance of high-achievers over low-achievers in that the former performed highly in the four tasks; whereas the latter obtained an average mean score in only one test item which is 'finding opposites'. This indicates that high-achievers have a more solid lexical base in place than low-achievers. Secondly, concerning 'global reading' activities, and except for the *matching* activity, the high-achievers' high performance is apparent in all the other test items. However, low-achievers seem to struggle with most activities namely reading for details, figure completion, matching, and gap-filling . This indicates that high-achievers comprehended the reading passages better than low-achievers.

Finally, it stands to reason that on the whole, there is a significant link between vocabulary knowledge and comprehension.

Table 2: Mean scores of 'local' and 'global' reading strategies

	High - achievers	Low-achievers
Local Reading		
	Mean	Mean
Guessing words from context (V1) /04	3.31	1.31
Determining word function (V2) /07	4.72	1.68
Finding Opposites (V3) /04	3.24	2.06
Finding synonyms (V4) /07	3.03	0.87
Global Reading		
Reading for Main Ideas (C1) /04	3.37	2.27
Reading for Details (C2) /05	3.20	1.43
Table Completion (C3) /05	3.86	2.87
Figure Completion (C4) /04	2.44	0.99
MCQ (C5) /08	5.24	4.03
Matching (C6) /06	2.37	1.65
Gap-filling (C7) /06	3.24	1.06

6.2. Structural Equation Modeling

In order to further measure the contribution of vocabulary to comprehension, we used a statistical method called Structural Equation Modeling (SEM). SEM is a statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions. Among its strengths is the ability to model constructs as latent variables latent variables, as opposed to observable variables, are variables that are not directly observed but are rather inferred from other variables that are observed and directly measured (observable variables are represented by enclosing the variable name within a rectangle) and are assumed to 'tap into' the latent variables. One advantage of using latent variables is that it reduces the dimensionality of data. A large number of observable variables can be aggregated in a model to represent an underlying concept, making it easier to understand the data.

Figure 5: Correlation between 'vocabulary knowledge' and 'comprehension'(High-achievers)

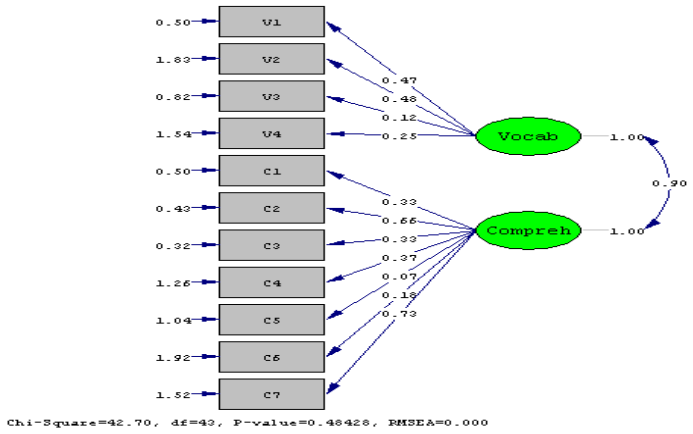
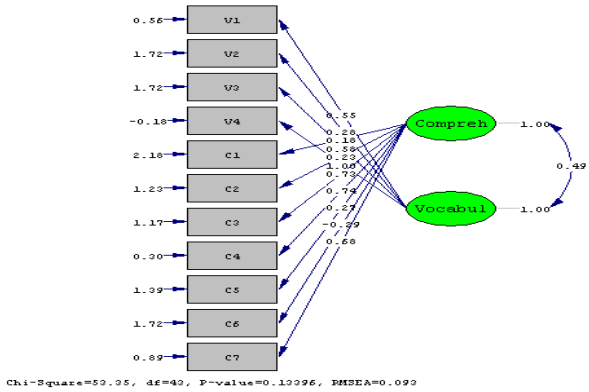


Figure 6: Correlation between 'vocabulary knowledge' and 'comprehension' (Low-achievers)



In the above path diagrams, the rectangles labeled V1 to C7 represent the eleven variables in the test. Each of these 11items has an arrow pointing toward a column of circles on the right of the figure. The circles on the right represent latent variables which we have labeled 'vocab' for vocabulary and 'compreh' for comprehension. The numbers from the items to the latent variables are analogous to factor loadings. The numbers on the arrows between the measured and latent variables show the weight each measured variable carries in defining the latent variable, just like a factor loading. They serve as validity coefficients

For high-achievers, measured items V1 (*Guessing words from text*), and V2 (*Determining word function*) contributed substantial weight (0.47, and 0.40 respectively) to the latent variable we have called 'Vocab'. In other words, these two items have a large correlation across respondents and we argue that this correlation is due to the fact that they address some aspect of vocabulary. To be exact, the assertion is that the latent variable, Vocabulary is the cause of the observed pattern of high correlation between these items. Similarly, measured items C7 (*Gap-filling*), and C2 (*Reading for details*), having a large correlation among respondents substantially contributed to the latent variable 'comprehension' with 0.73 and 0.55 respectively. In other words,

'comprehension' is the cause of the observed pattern of high correlations between these items.

Concerning low-achievers, measured items that contributed substantial weight to the latent variable 'vocab' were V4 (*Finding synonyms*), and V3 (*finding opposites*) with 1 and 0.58 respectively. Likewise, measured items C4 (*Figure completion*) (0.74) and C3 (*table completion*) (0.73) contributed to the latent variable, comprehension with 0.74 and 0.73 respectively.

The double headed arrows between the latent variables indicate that there is a correlation between each. The coefficients that appear on the path diagrams between the two latent variables indicate a significant correlation between vocabulary and comprehension for both sub-groups (0.90, for high-achiever, and 0.49 for low-achievers); that is, the higher (or the lower) the vocabulary knowledge, the higher (or the lower) the comprehension, and vice versa. In other words, we can say that there is a reciprocal relationship between vocabulary knowledge and reading comprehension.

7. Discussion

To what extent do high-level students differ from low-level students as far as 'local' and 'global reading' are concerned?

To start with, the findings regarding performance in global reading indicate that both high-achievers and low-achievers were able to derive the first passage *main ideas* (C1), both obtaining above-average and average mean scores respectively. But high-achievers did a largely better performance than low-achievers. Constructing main ideas –a late developing skill in most readers (according to Brown and Day 1983)– is generally considered as 'the most essential of reading skills' (Johnson and Afflerbach 1985: 207), and 'the essence of reading comprehension (Pearson and Johnson 1978). On the other hand, while *multiple-choice questions* generally are not seen as a typical springboard for higher-level thinking since they assess the literal level of comprehension, and their validity as measures of reading ability has been questioned (Cavalcanti 1987), the results of this format cannot be ignored. The students' mean scores reflect that both sub-groups did grasp specific information in the second passage.

Furthermore, performance on *matching* activity was below average for the test takers from the two sub-groups. Matching, which consists in reconstructing text meaning, tests the students' ability to sees how the paragraph is structured. This activity was a difficult task for the students; although the topic chosen for this activity was similar to that of the main reading text. In other words, a good understanding of the main reading passage would help the test takers in completing this activity. Nevertheless, a closer look at the test results reveals that both high-achievers and low-achievers did approximately the

same poor performance in 'matching' (76% vs. 78% respectively). In addition, the only test activity which received below-average mean score (2.37) for high-achievers was matching; the low-achievers mean score was also low (1.65). This may be because matching requires a variety of skills in order to be completed successfully such as skimming through the sentences to have a general idea; then reading carefully before sequencing segments of text, thinking about which sentence half might come where and predicting next events. In addition, the development of ideas can be seen in different lexical and grammatical relations inside and between sentences; therefore, careful attention should also be paid to both lexical words and phrases, and grammatical structures that may indicate such relations in the paragraph. As for the remaining comprehension test tasks involving short-response questions, information-transfer exercises, and gap-filling, the variation in the mean scores of the two sub-groups shows a clear dominance of high-achievers over low-achievers.

Regarding local reading performance, *finding synonyms* was a more difficult task than *finding opposites* for both sub-groups. This suggests that learners are more likely to confuse words that are similar in meaning than words that do not have close semantic links. This is congruent with other studies (Tinkham 1993; Waring 1997) which indicate that learning sets of semantically related words (synonyms) is more difficult than learning words that are not linked by meaning (non-synonyms).

As for '*guessing words from context'*, and '*determining word function'* the results suggest that performance varied according to the proficiency level of the students. Determining word function has an important contribution to comprehension in the sense being able to determine the word function enables readers to make the logical connections needed to understand what they were reading. In fact this finding reflects the observation made by other researchers (Golden and Murray 1992; Chung 2000; Cain 2003) that students' comprehension of conjunction is positively correlated to their reading performance. In other words a good command of conjunctions is the key to a successful understanding of the set of meaning relations that exist within the text. To be specific, higher proficiency level has lead to a greater guessing accuracy of the target words in context. On the other hand, it is clear that a critical level of vocabulary is essential for successful use of the guessing strategy. This is further evidenced by the results of SEM of high-achievers, where these two measured items loaded more heavily on the latent variable vocabulary than the other items.

In sum, the statistical analysis of the test scores did produce conclusive evidence that there were more differences than similarities between high-achievers and low-achievers as regards 'local' and 'global' reading skills and strategies. One major difference between them is that the former tend to possess better vocabulary skills than are the latter. Low-achievers scored poorly on a measure of reading comprehension skills because their word reading skills limited their performance. In other words, the high lexical and conceptual load of the text together with the insufficient word access of the test takers have

certainly contributed to texts difficulty and impeded the comprehension process resulting in a weak performance in the test. On the other hand, the high-achievers' superior decoding skills enhanced their comprehension skills.

To what extent do measures of readers' vocabulary knowledge correlate with measures of reading comprehension?

The study found that the dimension of 'local reading' is very important in predicting performance on reading comprehension test. For example, an interesting finding concerns the reading difficulties of low-achievers. By ranking the activities according to performance from the lowest to the highest one, we find that the four lowest performances correspond to: finding synonyms (100%), determining word function (96%), gap-filling (86%), and figure completion (79%). Although gap-filling and figure-completion test comprehension, they are word-based; that is, they can be said to overlap with 'local' reading section of the test in the sense that they load heavily on lexical knowledge on the part of the test-takers. In addition, the two items which contributed substantial weight to the latent variable 'comprehension' in SEM were figure and table completion activities which heavily depend on vocabulary knowledge. Henceforth, we can conclude that low performance in the reading test of the low-achievers was caused by lack of vocabulary knowledge which, in turn, has had an impact on comprehension.

Concerning the correlation between vocabulary knowledge and comprehension, the results of the SEM yielded an interesting finding indicating that a high performance on one implies also a high performance on the other, and a low performance in one implies a low performance in the other. This finding seems to support the view that measures of readers' vocabulary knowledge strongly, and positively correlate with measures of reading comprehension. It also adds to and confirms the literature on reading concerning the connection between vocabulary knowledge and comprehension (Nelson-Herber 1986; Nagy 1988; Baker1995; Nagy 2005). To conclude, there is a reciprocal relationship between vocabulary acquisition and reading comprehension. The better the students' vocabulary knowledge is, the better they perform with reading comprehension tasks. Similarly, the more the students read using the appropriate comprehension skills and strategies, the more their vocabulary develops.

On a practical level, the above findings may be used to determine instructional actions to be undertaken in this or similar teaching contexts. We can think of at least two classroom implications: 1) Specific instruction should be integrated into the ESP reading course to prepare students –especially the less skilled ones- become more successful readers and accommodated to the variety of reading styles of the learners to suit their needs and interests and 2) Vocabulary instruction should be targeted for students who struggle. Certainly, low-comprehending students could benefit from interventions in all reading comprehension areas, but our results suggest they could benefit most from instruction in vocabulary building.

8. Key components of a reading curriculum

Given the strong and established relationship between students' vocabulary knowledge and their ability to comprehend what they read, a heavy demand is placed on classroom teachers, curriculum planners, program developers, and reading researchers. One of the major issues facing them is how to determine the most efficient and effective instructional approach for reading improvement. (Grabe, 2009). For comprehension to occur then, teaching vocabulary should be integrated as an instructional intervention.

8.1. Teaching vocabulary: some instructional methods

Research on vocabulary instruction found that there is no one best method for vocabulary instruction (the National Reading Panel, 2000). In other word, no one single instructional method is sufficient for optimal vocabulary learning. Vocabulary instruction experts all recommend a multi-component approach and a variety of methods to help students acquire new words and increase the depth of their word knowledge over time. Effective instruction includes opportunities for both incidental (indirect) word learning and intentional (direct) word teaching. McNeil (1987:123) emphasizes on the 'active processing of new vocabulary so that vocabulary development enhances reading comprehension not just word knowledge.'

In this respect, a range of different methods can be used. Nation (1990) provides four ways that vocabulary teaching can be integrated into language learning. These methods are listed 'from most indirect to most direct as follows:

- Explicit preparation of language learning materials through carefully controlling the vocabulary presented in the text.
- Unfamiliar vocabulary is discussed as it naturally comes up.
- Vocabulary should be taught in connection with other language activities, for example as a pre-reading or a post-reading activity.
- Vocabulary is taught independent of other language activities. Typical classroom activities that fall into this last method involve: knowing spelling rules, analyzing word structure, mnemonic techniques, paraphrase activities and vocabulary puzzle.

Stahl's model (1999), on the other hand, sees vocabulary instruction as an ongoing process that involves using different approaches such as:

- including both definitional information and contextual information about each word's meaning.
- involving learners more actively in word learning.
- providing multiple exposures to meaningful information about the word.

Graves (2000) has advocated a four-part program that includes:

- wide reading,
- teaching individual words,

- teaching word learning strategies, and
- fostering word consciousness.

8.2. Strategies to increase vocabulary recognition

Classroom approaches for developing word recognition skills and coping with the vocabulary load of the texts may involve the utilization of a number of strategies. Research shows that students who master strategies have powerful ways of learning words independently (Baumann et al, 2002).

A variety of strategies of the treatment of unknown words in the text - critical to strategic learning of vocabulary- may involve the teaching of morphology (the study of word structure), context (the ability to infer word meaning from the meaning of surrounding text), and dictionary skills (Baumann, Kame'enui, & Ash, 2003; Nagy & Scott, 2000; Graves, 2000). Phakiti (2006) proposes two kinds of strategies: 'memory strategies' to store the new vocabulary as repetition, rehearsal, learning by heart, and 'retrieval strategies' to practice and revise existing vocabulary such as word meaning recall, and matching words with similar meanings.

Furthermore, using the student's personal experiences to learn vocabulary in the classroom is most effective because the students are directly involved in constructing meaning (Smith, 1997). This involves such strategies as 'semantic mapping' where students freely associate words on the list into categories and arranging them on the visual "map" so that relationships among the words become clearer or brainstorm words that are related to a given concept. 'Semantic Feature Analysis' also draws on students' prior knowledge and uses discussion to elicit information about word meanings. Here, the students group words according to certain feature to depict similarities and differences among features of different words.

Last but not least, vocabulary instruction should be accommodated to the variety of learning styles among second language learners (Anderson, 1994). According to him, 'all students do not learn vocabulary in the same way, nor do all vocabulary words lend themselves to one method of acquisition…Methods should be varied and combined according to the learner's individual needs and preferences' (p.181).

8.3. Strategies to increase reading comprehension

Reading comprehension and its development are very complex. Added to this complexity is the variety of instructional possibilities, teacher orientations, and student engagement. Research on strategy training revealed that reading strategies can be explicitly taught. Such training should be integrated into courses in order to help students monitor their reading processes and improve their reading comprehension. Strategic reading programme should be based on the examination of a number of variables including:

- existing use of strategies prior to instruction,
- levels of English proficiency,

- age of learners,
- L1 background,
- quality of pre-test post-test measures, and
- the length instruction (total hours per treatment and total time of overall instruction). Phakiti (2006),

8.4. Characteristics of strategic reading

Because of discrepancies in instructional settings and students' characteristics and needs, strategic reading instruction takes on many configurations. Nevertheless, four general principles can guide instructors in their teaching enterprise. The principles involve selecting texts, selecting strategies, planning lessons, and adapting materials.

Text selection demands a high degree of skill on the part of the teacher. The most important selection criteria suggested in the literature on text selection involve the learners' interest and background knowledge. Teachers should also consider texts in terms of vocabulary, grammatical complexity and organization. Moreover, the selected text should be at an appropriate level of difficulty to match the learners' proficiency level in L2.

On the other hand, when choosing strategies for direct instruction, teachers should consider 'the complexity of the reading process and the range of strategic thinking abilities that reading can and should evoke' (Janzen and Stoller, 1998: 225). Other factors for choosing appropriate strategies include students' characteristics such as language proficiency, experience in reading and purpose of reading. Finally, demands of reading texts in terms of content and genre and the goals of reading instruction should also be considered. For example in the context of this study, i.e. reading academic and professional texts we recommend that the following strategies be selected for direct instruction:

- use background knowledge to interpret text,
- discover author's purpose or theme,
- pick out main ideas,
- understand logical relationships between parts of a text,
- extract information relevant to a specific purpose,
- Guess at meanings of unfamiliar words, and
- Evaluate text.

To ensure an effective training, we suggest some steps for the reading teacher, based on Winograd and Hare, 1988. The steps involve:

- describing the nature of the strategy the learners are going to learn,
- explaining why a targeted strategy is important,
- pointing out when and where a particular strategy can be used,
- demonstrating how to use a strategy by teacher modeling strategic reading processes and behaviour with reading tasks and activities, and
- teaching them how to evaluate their successful use of strategy.

Finally, for reading strategy instruction to be effective, it should satisfy the demands dictated by the interaction between the reader and the text, and should be adapted to such factors as the reader's purpose, the reading task and the text genre.

8.5. A more general view of comprehension development

We conclude by taking a step back from the details of how skill in comprehension is acquired. We assume the following:
First, knowledge of word meanings is central to comprehension.
Second, word knowledge is incremental, that is it proceeds in different steps and occurs along a continuum, and readers need to have many exposures to a word in different contexts before they "know" it.
Third, word knowledge is multidimensional, that is it consists of qualitatively different types of knowledge and several components i.e. phonological, orthographic, morphological, syntactic, and semantic.
Fourth, effective reading comprehension increases with reading experience.
Fifth, effective reading comprehension instruction builds on vocabulary knowledge and development.
Sixth, higher levels of comprehension require the reader to apply higher-level comprehension skills and strategies that are strategic; for example, using background knowledge, monitoring comprehension, questioning, and making inferences.

9. Conclusion:

n sum, although the results of the study were conclusive, they should be viewed in the light of its limitations. Firstly, the variability of the test scores might have been affected by the question types so widely ranging between (cloze, matching, table/figure completion, and MCQ). Secondly, despite the familiarity of the test-takers with the texts topics, the test did not control the effect of text type on the variance of test scores. Moreover, a larger-scale study with more participants, and more test items would provide more data, and therefore a more reliable picture. More research needs to be done to determine the correlation between vocabulary and comprehension; nevertheless, the findings of the study indicate that the connection between vocabulary knowledge and comprehension is a topic that deserves attention in L2 reading research, and in an English for Specific Purposes (ESP) reading context, especially in the Algerian context, to determine comprehension difficulties.

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