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The Roles of Vocabulary Knowledge and Semantic Knowledge in Reading Comprehension among Mining Engineering Students in the DR Congo

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Abstract

Purpose: This study examined the roles of vocabulary knowledge and semantic knowledge in reading comprehension among mining engineering students in an English for Specific Purposes (ESP) context in the Democratic Republic of the Congo.

Methodology: A descriptive–correlational design was adopted. Data were collected from thirty undergraduate mining engineering students at the University of Bunia using a reading comprehension test, a vocabulary knowledge test, and a semantic knowledge test. Pearson correlation analysis was used to examine relationships among the variables.

Findings: The findings revealed significant positive relationships between vocabulary knowledge, semantic knowledge, and reading comprehension. Learners with stronger lexical and semantic abilities generally demonstrated better comprehension of technical English texts. The findings suggest that successful comprehension depended not only on vocabulary recognition but also on learners' ability to interpret meaning within disciplinary discourse.

Unique Contribution to Theory, Practice and Policy: The study contributes empirical evidence from a multilingual African ESP context and highlights the importance of integrating vocabulary development and meaning-focused reading instruction in technical higher education.

Keywords: *Vocabulary Knowledge, Semantic Knowledge, Reading Comprehension, ESP, DRC*

JEL Codes: *I21, I23, Z13*

1. INTRODUCTION

Reading is widely recognised as one of the most important academic skills in higher education because it enables learners to access disciplinary knowledge, interpret specialised information, and participate effectively in academic discourse (Grabe, 2009). In English for Specific Purposes (ESP), reading becomes particularly important because learners are required to engage with texts characterised by technical terminology, conceptually dense information, and discipline-specific discourse patterns (Hyland, 2006). Reading in technical disciplines therefore extends beyond simple word recognition and requires learners to interpret specialised meanings within context.

In mining engineering, disciplinary knowledge is frequently encoded through specialised terminology and informationally dense discourse. Halliday and Martin (1993) observe that scientific and technical writing often compresses information into compact lexical structures, increasing conceptual complexity during reading. Learners may therefore recognise technical vocabulary while still experiencing difficulties interpreting the broader conceptual organisation of the text. In ESP contexts, comprehension consequently depends not only on recognising technical terms but also on understanding how specialised meanings are constructed within disciplinary discourse.

These challenges become more significant in multilingual educational contexts such as the Democratic Republic of the Congo (DRC), where French functions as the principal language of education while English is mainly learned as a foreign language. Although English increasingly serves as an important medium for scientific communication and professional advancement, many learners encounter English primarily within classroom settings and have limited opportunities for sustained exposure outside educational institutions (Kasanga, 2012). Mining engineering students are therefore expected to engage with English-language manuals, scientific publications, and technical reports despite restricted exposure to authentic English disciplinary discourse.

Research in second-language (L2) reading consistently identifies vocabulary knowledge (VK) as an important predictor of reading comprehension (RC). Learners with stronger VK are generally more capable of accessing textual meaning because they can interpret lexical information more efficiently during reading. While earlier studies established the importance of lexical knowledge for comprehension (Qian, 2002; Perfetti, 2007), more recent research continues to demonstrate that vocabulary breadth and depth contribute significantly to reading performance and meaning construction in academic contexts (Zhang & Koda, 2013; Zhang & Zhang, 2022). However, vocabulary recognition alone may not guarantee successful comprehension because readers must additionally establish semantic relationships between concepts and interpret meaning across textual units. Perfetti and Stafura (2014) argue that successful reading depends on the quality and integration of lexical knowledge during comprehension. Semantic knowledge (SK) further supports this process by enabling readers to interpret conceptual relationships and construct coherent understanding from disciplinary discourse.

Despite increasing research on ESP reading, comparatively limited studies have examined the roles of VK and SK in RC within multilingual African higher education contexts. Much of the existing literature focuses on general ESL or EFL environments rather than specialised disciplinary settings such as mining engineering. Consequently, limited empirical evidence exists concerning how vocabulary and meaning-related competencies contribute to ESP reading comprehension among university learners in the DRC. The present study therefore examined the roles of VK and SK in RC among mining engineering students in an ESP context in the DRC.

The study addressed the following research questions:

- i. What is the role of vocabulary knowledge (VK) in reading comprehension (RC) among mining engineering students in an ESP context?
- ii. What is the role of semantic knowledge (SK) in reading comprehension (RC) among mining engineering students in an ESP context?

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Lexical Quality Hypothesis

The study is guided by the Lexical Quality Hypothesis (LQH) proposed by Perfetti (2007). The hypothesis argues that successful reading comprehension depends on the quality, precision, and integration of lexical representations in memory. Readers comprehend texts more effectively when word forms, meanings, and contextual associations are accurately specified and strongly interconnected. High-quality lexical representations facilitate efficient access to meaning, support the integration of information across discourse, and promote the construction of coherent mental representations during reading. Conversely, weak or incomplete lexical representations may result in fragmented comprehension because readers experience difficulties accessing, interpreting, and integrating meaning.

The LQH is particularly relevant to the study of vocabulary knowledge (VK) and semantic knowledge (SK). Vocabulary knowledge supports comprehension by providing access to lexical meanings, while semantic knowledge facilitates the interpretation of conceptual relationships and the integration of meaning across textual units. Perfetti and Stafura (2014) further argue that successful comprehension depends not only on knowledge of individual words but also on the interaction between lexical quality and higher-level meaning construction processes. Readers with richer and more precisely specified lexical and semantic representations are therefore generally better able to construct coherent interpretations of texts.

The theory is especially applicable to ESP reading because technical texts rely heavily on specialised vocabulary, conceptual precision, and discipline-specific meanings. In disciplines such as mining engineering, vocabulary frequently encodes specialised knowledge rather than everyday meanings. Readers must therefore interpret lexical items within broader conceptual and contextual frameworks rather than simply recognise isolated technical terms. The Lexical Quality Hypothesis

consequently provides an appropriate theoretical framework for understanding how vocabulary knowledge and semantic knowledge contribute to reading comprehension in specialised ESP contexts.

2.2 Vocabulary Knowledge and Reading Comprehension

Research on vocabulary knowledge (VK) frequently distinguishes between vocabulary breadth and vocabulary depth. Vocabulary breadth refers to the number of lexical items known by a learner, whereas vocabulary depth concerns the quality of lexical understanding, including semantic associations, contextual interpretation, collocational knowledge, and conceptual integration (Read, 2000). Previous studies consistently indicate that vocabulary depth demonstrates a stronger relationship with reading comprehension (RC) than vocabulary breadth because deeper lexical representations enable readers to interpret meanings more flexibly and accurately across contexts. Similarly, Qian (2002) found that depth of vocabulary knowledge contributes uniquely to academic reading performance beyond vocabulary size alone. Zhang (2012) further demonstrated that VK significantly predicts second-language (L2) RC, highlighting the central role of lexical knowledge in textual interpretation.

VK plays a particularly important role in L2 reading because learners rely heavily on lexical information during textual interpretation. According to Grabe (2009), limitations in VK frequently constrain comprehension because readers cannot process textual information efficiently when lexical access remains slow or incomplete. In English for Specific Purposes (ESP) contexts, this challenge becomes even more significant because disciplinary texts contain specialised terminology, technical collocations, and conceptually dense expressions that differ substantially from general language use. Learners may therefore recognise general English vocabulary while still experiencing difficulties interpreting technical and academic terminology associated with specialised disciplinary discourse.

Empirical research further supports the contribution of VK to RC. Proctor et al. (2012) found that learners with stronger vocabulary depth generally demonstrate superior comprehension because they are more capable of interpreting lexical information appropriately within context. Similarly, Zhang and Zhang (2022), in a meta-analytic review, reported that vocabulary knowledge contributes significantly to L2 reading comprehension by facilitating efficient meaning construction and textual interpretation. Furthermore, Zhang and Koda (2013) found that deeper linguistic knowledge supports comprehension by enabling learners to establish meaningful connections among lexical items and textual information. These findings are consistent with the Lexical Quality Hypothesis (Perfetti, 2007), which proposes that high-quality lexical representations support efficient comprehension. Collectively, the evidence suggests that successful comprehension depends not merely on vocabulary recognition but on the quality, accessibility, and contextual integration of lexical knowledge during reading. In ESP environments, where technical terminology frequently carries specialised disciplinary meanings,

limitations in VK may therefore restrict learners' ability to interpret textual information accurately and construct coherent understanding from specialised discourse.

2.3 Semantic Knowledge and Reading Comprehension

Semantic knowledge (SK) complements vocabulary knowledge (VK) by supporting meaning construction beyond isolated lexical recognition. Kintsch and van Dijk (1978) explain that readers construct coherent mental representations of texts by integrating propositions across clauses, sentences, and broader discourse units. Semantic processing therefore involves establishing conceptual relationships, identifying textual coherence, drawing inferences, and linking incoming information with prior knowledge structures. In reading comprehension (RC), SK enables learners to move beyond surface-level decoding and engage in deeper interpretation of conceptual meaning within texts.

In ESP contexts, SK becomes particularly important because technical discourse frequently distributes meaning across informationally dense and conceptually compressed structures. Readers may recognise individual technical terms while still experiencing difficulties interpreting how concepts interact within disciplinary discourse. Successful comprehension therefore depends not only on recognising specialised vocabulary but also on constructing coherent conceptual representations from textual information. This becomes especially significant in scientific and technical disciplines where meaning is often embedded within abstract relationships, procedural explanations, and specialised conceptual frameworks.

Previous research further indicates that semantic processing contributes significantly to RC. Perfetti and Stafura (2014) argue that successful comprehension emerges from the interaction between lexical quality and higher-level meaning construction during reading. Readers who demonstrate stronger semantic processing abilities are generally more capable of establishing conceptual relationships, integrating textual information, and interpreting disciplinary discourse effectively. Similarly, Oakhill et al. (2015) observe that learners with stronger inferential and semantic integration abilities tend to demonstrate superior comprehension because they are better able to construct coherent representations of textual meaning. More recently, Perfetti and Stafura (2014) and Zhang and Zhang (2022) emphasised that successful comprehension depends not only on lexical knowledge but also on the ability to integrate semantic information across textual units and construct coherent meaning representations. Collectively, these findings suggest that SK plays an important role in supporting comprehension in specialised academic reading contexts where learners must interpret complex conceptual information rather than isolated lexical items alone.

2.4 Reading in ESP Contexts

Research in English for Specific Purposes (ESP) indicates that technical and disciplinary discourse creates specialised linguistic and conceptual demands for learners. Hyland (2006) explains that disciplinary writing relies heavily on specialised lexical choices and discourse conventions that organise knowledge within professional communities. Technical texts often contain dense

informational structures, abstract terminology, nominalised constructions, and discipline-specific concepts that increase the complexity of reading comprehension. Reading in ESP contexts therefore extends beyond general language proficiency and requires learners to interpret specialised meanings embedded within disciplinary discourse.

In multilingual educational contexts such as the Democratic Republic of the Congo (DRC), these challenges become more pronounced because English is primarily encountered as a foreign language within formal educational settings (Kasanga, 2012). Mining engineering students are consequently required to engage with English-language manuals, scientific publications, technical reports, and professional documentation despite relatively limited exposure to authentic disciplinary discourse outside the classroom. Reading comprehension in such contexts therefore depends substantially on learners' ability to interpret specialised vocabulary and construct coherent conceptual understanding from technically dense texts.

Although previous studies have established important relationships between vocabulary knowledge (VK), semantic knowledge (SK), and reading comprehension (RC), much of the existing literature has focused primarily on general English as a Second Language (ESL) or English as a Foreign Language (EFL) contexts rather than specialised ESP environments. Studies such as Proctor et al. (2012), Perfetti and Stafura (2014), and Zhang and Zhang (2022) demonstrate that lexical and semantic competencies contribute significantly to comprehension; however, these studies largely examine general academic reading populations outside multilingual African higher education contexts. Moreover, comparatively limited research has explored how VK and SK support comprehension of technically specialised discourse among university learners in disciplines such as mining engineering. Consequently, little empirical evidence exists concerning the contributions of lexical and semantic competencies to ESP reading comprehension among university students in the DRC.

The present study addresses this gap by examining the roles of VK and SK in RC among mining engineering students in a multilingual ESP context. In doing so, it contributes evidence from an under-researched African higher education setting where English increasingly functions as a medium for accessing specialised disciplinary knowledge, technical information, and professional opportunities within the mining sector.

3. METHODOLOGY AND MATERIALS

The study adopted a descriptive–correlational design to examine the roles of vocabulary knowledge and semantic knowledge in reading comprehension within an English for Specific Purposes (ESP) context. The design was considered appropriate because it enabled the study to investigate naturally occurring relationships among the variables without experimental manipulation (Creswell & Creswell, 2018). The study was conducted at the University of Bunia (UNIBU) in Ituri Province, Democratic Republic of the Congo, where English for Specific Purposes forms part of the mining engineering curriculum.

Thirty undergraduate mining engineering students participated in the study following a stratified random sampling procedure designed to ensure representation across academic cohorts. Participants were eligible if they were officially registered in the programme, had completed at least one ESP course, and voluntarily agreed to participate in the study. These criteria ensured relative consistency in disciplinary background and exposure to English-medium academic materials.

Reading comprehension was assessed using a mining-related passage adapted from educational and professional materials associated with the mining sector in the DRC. The passage was followed by comprehension questions designed to evaluate learners' ability to identify explicit information, interpret implied meanings, establish conceptual relationships, and integrate information across textual units.

Vocabulary knowledge was measured through contextual vocabulary tasks adapted to the mining engineering context. The tasks included technical terminology and contextual interpretation items designed to evaluate learners' understanding of specialised lexical items within disciplinary discourse. Semantic knowledge was assessed using sentence interpretation and conceptual meaning tasks that evaluated learners' ability to establish semantic relationships and interpret meaning within technical texts.

The reliability of the study instruments was assessed using Cronbach's alpha coefficient. The VK Test demonstrated good reliability ($\alpha = .88$), indicating high internal consistency among the items. The SK Test yielded an acceptable reliability coefficient ($\alpha = .76$), while the RC Test demonstrated good reliability ($\alpha = .85$). These coefficients exceeded the minimum acceptable threshold of .70 recommended for educational research (Cohen et al., 2018), indicating that the instruments were sufficiently reliable for data collection and analysis.

A pilot study involving five students was conducted prior to the main data collection process in order to evaluate clarity, timing, and contextual appropriateness of the instruments. Minor revisions were subsequently made to task instructions and wording. Data collection was conducted under controlled classroom conditions during a single session. Participation was voluntary, informed consent was obtained before data collection, and confidentiality was maintained throughout the study.

The data were analysed using SPSS Version 25. Descriptive statistics were calculated to summarise learner performance, while Pearson product-moment correlation coefficients were used to examine relationships among vocabulary knowledge, semantic knowledge, and reading comprehension.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics for vocabulary knowledge (VK), semantic knowledge (SK), and reading comprehension (RC). All variables were approximately normally distributed, with skewness and kurtosis values falling within acceptable limits (± 2.0), supporting the use of parametric analysis. RC displayed the greatest variability ($SD = 4.50$; variance = 20.25), indicating noticeable differences in comprehension performance across participants. By contrast, SK showed comparatively lower variability, while VK demonstrated moderate dispersion across scores. Slight negative skewness was observed for VK and RC, suggesting relatively balanced learner performance with a small concentration of higher scores. Overall, the distributions did not indicate violations of normality assumptions and were therefore considered suitable for further correlational analysis.

Table 1: Descriptive Statistics for Study Variables (N = 30)

Variable	N	Range	Min	Max	M	SD	Var	Sk	Ku
Vocabulary Knowledge (VK)	30	13.00	7.00	20.00	13.60	4.02	16.18	-0.46	-0.86
Semantic Knowledge (SK)	30	9.00	2.00	11.00	6.60	2.39	5.70	-0.09	-0.46
Reading Comprehension (RC)	30	13.00	6.00	19.00	12.43	4.50	20.25	-0.07	-1.43

These patterns indicate moderate variability across the variables, with RC showing the widest spread of scores among participants. Performance on vocabulary- and meaning-related tasks appeared comparatively more consistent. The distributional characteristics therefore provide an appropriate basis for examining relationships among the variables.

4.2 Correlation Analysis

Pearson product-moment correlation coefficients were calculated to examine the relationships among VK, SK, and RC. The results are presented in Table 2.

Table 2: Pearson Correlations among Study Variables (N = 30)

Variable	RC	VK	SK
Reading Comprehension (RC)	1	.459*	.456*
Vocabulary Knowledge (VK)	.459*	1	.841**
Semantic Knowledge (SK)	.456*	.841**	1

Note. $p < .05$, $p < .01$ (two-tailed).

The analysis revealed positive and statistically significant relationships between the variables and RC. VK demonstrated a moderate positive relationship with RC ($r = .459, p < .05$), suggesting that learners with stronger vocabulary knowledge generally performed better on reading comprehension tasks. Similarly, SK was positively associated with RC ($r = .456, p < .05$), indicating that learners who demonstrated stronger semantic interpretation abilities also tended to achieve higher comprehension scores. Overall, the findings indicate that both vocabulary knowledge and semantic knowledge contributed positively to learners' comprehension of technical English texts.

4.3 Vocabulary Knowledge and ESP Reading Comprehension

4.3.1 Word Decoding and Initial Lexical Access

At the level of word decoding and initial lexical access, most learners demonstrated relatively adequate recognition of frequently occurring academic and mining-related lexical items. Many participants successfully identified words such as *cobalt*, *mineral*, *significant*, *currently*, and *proficient*, suggesting that they possessed functional lexical access to commonly encountered technical vocabulary. These lexical items, particularly nouns and adjectives, carry substantial propositional meaning in disciplinary discourse and therefore support initial textual processing during reading.

From the perspective of reading theory, this pattern suggests that lexical access itself was not the principal obstacle to comprehension. Learners generally demonstrated the ability to retrieve basic lexical meanings rapidly enough to support surface-level reading. This finding aligns with previous research indicating that adult second-language (L2) learners often develop adequate recognition of high-frequency academic and technical vocabulary through repeated exposure in educational settings (Nation, 2013; Schmitt, 2010). However, the findings further revealed that successful word recognition did not consistently translate into accurate disciplinary interpretation. For example, several learners interpreted *significant* merely as “important” without recognising its quantitative or evaluative meaning within technical discourse. Such responses suggest that learners frequently possessed lexical familiarity without sufficiently precise semantic specification for specialised comprehension.

These findings indicate that word decoding supported initial lexical access but did not necessarily guarantee interpretive adequacy during reading. In other words, learners were often able to recognise lexical forms while still struggling to interpret the disciplinary meanings encoded within them. This pattern supports previous research showing that vocabulary breadth contributes to reading comprehension (RC) only when lexical knowledge is sufficiently detailed to support integration at sentence and discourse levels (Qian, 2002).

4.3.2 Using Words in Context and Lexical Selection

The contribution of vocabulary knowledge (VK) became more complex in tasks requiring contextual interpretation and lexical selection. Learners were required to interpret lexical combinations characteristic of technical and mining discourse, including expressions such as *substantial deposits*, *mining resources*, and *investment risks*. These expressions involve conventional lexical patterns frequently used in academic and disciplinary communication, where meaning depends not only on individual words but also on their contextual relationships.

The findings revealed that several learners experienced difficulties selecting contextually appropriate lexical interpretations despite recognising individual lexical items. In some cases, participants confused semantically related alternatives such as *legal*, *financial*, and *security* risks, even though the lexical items themselves appeared familiar. These patterns suggest limitations in contextual lexical processing, where multiple semantically related meanings compete during interpretation but only one is licensed by the discourse context. Such difficulties indicate that learners frequently relied on broad semantic similarity rather than precise contextual selection during reading.

The findings further revealed that many learners struggled to process collocational and phraseological units as integrated meaning-bearing structures. Although participants often recognised words such as *substantial*, *deposits*, *resources*, and *risks* individually, they did not always interpret combinations such as *substantial deposits* or *investment risks* as specialised disciplinary expressions carrying conventional technical meaning. This suggests that lexical knowledge was frequently stored at the level of isolated lexical items rather than as interconnected phraseological patterns. Research in ESP reading similarly demonstrates that successful comprehension of technical discourse depends substantially on learners' understanding of collocations and recurrent lexical bundles because disciplinary meaning is often compressed within predictable lexical patterns (Nation, 2013).

These findings help explain why VK demonstrated only a moderate relationship with reading comprehension despite its positive association with RC. When comprehension depends heavily on rapid recognition of conventional lexical patterns and contextual lexical integration, vocabulary knowledge that remains primarily item-based rather than phraseologically integrated may contribute only partially to successful disciplinary reading.

4.3.3 Word Meaning and Vocabulary Depth

The most substantial limitations in VK emerged at the level of vocabulary depth and specialised meaning interpretation. Several lexical items in the assessment required learners to suppress dominant everyday meanings and access more specialised disciplinary interpretations associated with mining discourse. For example, some participants interpreted *exploitation* primarily in moral or social terms rather than as the systematic extraction of mineral resources. Similarly,

infrastructure was often interpreted broadly as national development rather than as the systems supporting mining operations and industrial activity.

These findings suggest that learners frequently possessed lexical representations that were broad but insufficiently differentiated for technical comprehension. In many cases, participants appeared able to recognise lexical items without fully understanding the disciplinary meanings those words encoded within specialised contexts. Such patterns indicate limitations in vocabulary depth rather than vocabulary absence alone. Learners therefore experienced difficulties not only in accessing lexical meaning but also in distinguishing between general and technical semantic interpretations during reading.

The findings strongly support the Lexical Quality Hypothesis (Perfetti, 2007), which proposes that successful reading depends on the quality, precision, and integration of lexical representations. According to the theory, efficient comprehension requires close integration between orthographic form, semantic meaning, and contextual usage constraints. In the present study, many lexical representations appeared only partially integrated, allowing surface-level lexical recognition while limiting precise disciplinary interpretation. As a result, VK contributed to RC primarily through interaction with broader semantic and contextual processing mechanisms rather than functioning independently.

The findings are also consistent with previous empirical research emphasising the contribution of lexical depth to L2 comprehension. Proctor et al. (2012), working with English monolingual and Spanish–English bilingual learners, found that vocabulary depth significantly predicted RC because learners with richer lexical representations were better able to interpret contextual meaning during reading. Similarly, Zhang (2012) demonstrated that vocabulary knowledge is a significant predictor of L2 reading comprehension, highlighting the central role of lexical knowledge in textual interpretation. More recently, Zhang and Zhang (2022) reported a strong positive relationship between vocabulary knowledge and L2 reading comprehension, concluding that richer lexical knowledge facilitates more effective meaning construction during reading. These findings are also consistent with Perfetti and Stafura's (2014) argument that successful comprehension depends on the interaction between lexical quality and higher-level meaning construction processes. The present findings therefore suggest that successful ESP reading depends not merely on vocabulary recognition but on learners' ability to construct precise and contextually appropriate lexical interpretations within disciplinary discourse. These patterns may also reflect the broader linguistic context of the DRC, where English is primarily learned as a foreign language and opportunities for sustained engagement with specialised English discourse remain relatively limited (Kasanga, 2012). Consequently, learners may acquire familiarity with technical vocabulary without developing the depth of lexical knowledge required for accurate disciplinary interpretation.

4.4 Semantic Knowledge and Reading Comprehension

4.4.1 Word-Level Semantic Processing

At the word level, many learners demonstrated relatively adequate understanding of frequently encountered lexical items associated with mining and economic discourse. Several participants correctly interpreted expressions such as *rich in minerals* as referring to the abundance of natural resources rather than financial wealth or population size. Similarly, many learners correctly understood *substantial deposits* as indicating large quantities of valuable minerals. These findings suggest that participants generally possessed functional semantic representations for common disciplinary vocabulary encountered within ESP texts.

However, semantic difficulties became more visible when lexical items required interpretation beyond their most common everyday meanings. For example, in the sentence *The production of cobalt has increased significantly over time*, several learners focused primarily on concrete lexical items such as *production* or *time* while failing to interpret *significantly* as an indicator of magnitude or degree. Likewise, some participants interpreted *mining operations* as referring to business management or economic strategies rather than mineral extraction activities. These patterns suggest that learners often possessed surface-level semantic familiarity without sufficiently precise conceptual understanding of disciplinary meanings.

Such findings align with previous research demonstrating that learners may recognise familiar vocabulary while lacking sensitivity to the specialised semantic meanings required for academic reading (Nation & Snowling, 2004). The findings therefore indicate that semantic knowledge (SK) at the word level contributed to initial textual understanding but did not consistently support deeper conceptual interpretation during ESP reading.

4.4.2 Sentence-Level Semantic Integration

Semantic difficulties became more pronounced at the sentence level, where learners were required to integrate individual lexical meanings into coherent propositional interpretations. In the statement *Cobalt is used in the production of electric vehicles*, some learners focused on peripheral information, such as the novelty of electric vehicles or the scarcity of cobalt, rather than identifying the primary proposition that cobalt plays an essential role in electric vehicle manufacturing. Similarly, in the sentence *The government is promoting foreign investment in mining*, some participants redirected interpretation toward agriculture or local mining rather than recognising the intended meaning concerning external investment in the mining sector.

These patterns suggest that several learners processed sentences primarily through isolated lexical cues rather than through integrated semantic interpretation of the entire propositional structure. In other words, learners often identified individual keywords without successfully constructing coherent sentence-level meaning. Such findings indicate limitations in semantic integration across syntactic units during reading.

This interpretation is consistent with previous research demonstrating that effective sentence comprehension depends on coordinated interaction between lexical, semantic, and syntactic processing rather than isolated word-by-word interpretation (Perfetti et al., 2005). In ESP contexts, sentence-level comprehension therefore appears to depend substantially on learners' ability to integrate specialised vocabulary into coherent disciplinary propositions.

4.4.3 Text-Level Semantic Processing and Inferencing

The most substantial semantic difficulties emerged at the discourse level, particularly in tasks requiring inferencing and integration of background knowledge across textual units. For example, successful interpretation of the statement concerning the Democratic Republic of the Congo (DRC) as *the world's largest producer of cobalt* required learners to infer broader economic implications related to global supply, industrial demand, and international markets. However, several learners recognised the topic without integrating its wider conceptual significance. Some responses focused on unrelated themes such as farming or tourism, suggesting recognition of isolated topical information without successful discourse-level meaning integration.

Similar difficulties appeared in items requiring interpretation of causal and evaluative relationships within technical discourse. In tasks examining the importance of managing security risks in mining activities, some learners failed to establish the intended relationship between security conditions, operational stability, and economic profitability. Likewise, expressions describing mining investment as *high-risk but potentially profitable* created difficulties because successful interpretation depended on understanding the concessive relationship encoded by *but*. Some learners interpreted the statement as either guaranteeing profitability or discouraging investment entirely, indicating limitations in integrating evaluative contrast across discourse.

These findings suggest that many learners experienced difficulties constructing coherent text-level representations from technically dense informational passages. The findings are consistent with Kintsch and van Dijk's (1978) proposition that comprehension depends on integrating textual information into coherent conceptual representations rather than processing isolated propositions independently. Similarly, Perfetti and Stafura (2014) argue that successful comprehension requires readers to establish meaningful semantic relationships across discourse during reading. Oakhill et al. (2015) likewise observe that successful readers are better able to generate inferences, integrate information across textual units, and construct coherent mental representations of meaning. The difficulties observed in the present study therefore suggest limitations not only in semantic knowledge itself but also in the inferential processes required for successful ESP reading comprehension.

The findings further explain why SK demonstrated a positive relationship with RC while appearing closely interconnected with broader contextual and inferential processing during reading. In mining engineering discourse, meaning is frequently distributed across specialised terminology, conceptual relationships, and complex informational structures. Consequently, SK appears to

support comprehension primarily through interaction with other linguistic processes rather than functioning as an entirely independent predictor of RC. These patterns may also reflect the broader linguistic context of the DRC, where English is typically learned as a foreign language and opportunities for sustained engagement with specialised English discourse remain limited (Kasanga, 2012). As a result, learners may develop basic understanding of technical vocabulary while experiencing difficulties integrating meanings across sentences and discourse structures required for specialised academic reading.

5. CONCLUSION AND IMPLICATIONS

The study examined the roles of vocabulary knowledge (VK) and semantic knowledge (SK) in reading comprehension (RC) among mining engineering students in the Democratic Republic of the Congo (DRC). Concerning the first research question, the findings revealed that VK was positively associated with RC, indicating that learners with stronger lexical knowledge were generally more successful in interpreting specialised disciplinary texts and understanding technical vocabulary within context. However, the findings further showed that vocabulary recognition alone was insufficient for successful comprehension because several learners experienced difficulties interpreting specialised lexical meanings, collocations, and context-dependent disciplinary terminology. Regarding the second research question, the findings demonstrated that SK was also positively associated with RC, suggesting that successful comprehension depended substantially on learners' ability to establish conceptual relationships, integrate textual information, and construct coherent meaning from technically dense discourse. Difficulties frequently emerged in tasks requiring inferencing, sentence-level integration, and discourse-level interpretation. Overall, the study suggests that successful ESP reading comprehension is fundamentally a lexical-semantic process in which vocabulary depth, contextual interpretation, and semantic integration interact to support understanding of specialised disciplinary texts.

First, the findings have important implications for ESP pedagogy in multilingual higher education contexts. Instruction in technical English should move beyond isolated vocabulary memorisation and place greater emphasis on vocabulary depth, contextual lexical interpretation, semantic integration, and disciplinary discourse processing. ESP instructors should incorporate meaning-focused reading activities that support learners in interpreting collocations, technical lexical bundles, inferential relationships, and specialised conceptual meanings within authentic disciplinary texts. In mining engineering contexts, learners may particularly benefit from instructional approaches that integrate vocabulary development with guided interpretation of technical discourse, conceptual mapping, and contextual reading strategies in order to strengthen deeper comprehension of specialised academic materials.

Furthermore, the findings provide support for the Lexical Quality Hypothesis (Perfetti, 2007) by demonstrating that successful RC depends on the quality, precision, and integration of lexical representations rather than vocabulary recognition alone. The study further suggests that VK and

SK operate interactively during comprehension, particularly in technically specialised ESP environments where meaning is distributed across lexical, syntactic, and conceptual structures. The findings therefore extend lexical-semantic models of reading by illustrating how disciplinary discourse in multilingual ESP contexts places substantial demands on contextual meaning construction, inferencing, and semantic integration during reading.

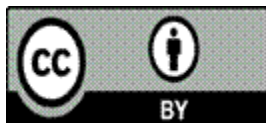
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