



# American Journal of Education and Technology (AJET)

ISSN: 2832-9481 (ONLINE)

VOLUME 4 ISSUE 1 (2025)



PUBLISHED BY  
E-PALLI PUBLISHERS, DELAWARE, USA

## How Engineering Students Acquire Technical Vocabulary: An Empirical Study of Effective Learning Strategies

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### Article Information

**Received:** January 15, 2025**Accepted:** February 17, 2025**Published:** March 19, 2025

### Keywords

*Engineering Education, ESL, Instrument Validation, Technical Vocabulary, Vocabulary Learning Strategies*

### ABSTRACT

This study examines engineering undergraduates' vocabulary learning strategies (VLS) to acquire technical vocabulary, a critical skill in today's globalized engineering landscape. A total of 150 engineering students from ENSAM, Meknes participated by completing an adapted 62-item version of the Vocabulary Learning Questionnaire (VLQ; Gu & Johnson, 1996; Gu, 2018), modified to address the specialized language demands of technical coursework. The instrument demonstrated excellent internal consistency ( $\alpha = 0.89$ ) and yielded a seven-factor structure corresponding to beliefs about vocabulary, metacognitive strategies, inferencing, dictionary use, note-taking, rehearsal, and activation strategies. Descriptive analyses indicated moderate overall strategy use ( $M = 4.0$ ,  $SD = 0.7$  on a 7-point scale), with dictionary ( $M = 4.5$ ,  $SD = 0.5$ ) and inferencing strategies ( $M = 4.1$ ,  $SD = 0.6$ ) being the most frequently reported. Pearson correlations revealed significant associations between technical vocabulary test performance and both dictionary ( $r = 0.45$ ,  $p < .01$ ) and inferencing strategies ( $r = 0.40$ ,  $p < .01$ ). Multiple regression analysis indicated that these strategies together accounted for 30% of the variance in test scores ( $R^2 = 0.30$ ,  $F(2, 147) = 31.5$ ,  $p < .001$ ). The findings underscore the importance of targeted strategy instruction in technical curricula and suggest that engineering educators should emphasize activities that enhance contextual inference and precise dictionary use. Implications for engineering education and directions for future research are discussed.

### INTRODUCTION

In an era marked by rapid technological advancement and global collaboration, engineering students must master complex technical concepts and the specialized vocabulary necessary for professional competence. For many engineering undergraduates—particularly non-native speakers—acquiring technical vocabulary poses a significant challenge (Nation, 2013). Vocabulary is critical for understanding technical texts, engaging in research, and communicating complex ideas (Oxford, 2017). Prior research in second language acquisition has consistently shown that the deliberate use of vocabulary learning strategies (VLS) can enhance both vocabulary breadth and depth (Gu & Johnson, 1996; Schmitt, 1997). However, while much of this research has focused on general ESL populations, few studies have examined how engineering students, who encounter discipline-specific language, deploy these strategies.

This study addresses that gap by adapting the well-validated Vocabulary Learning Questionnaire (Gu, 2018) for an engineering context and investigating the relationship between specific strategies and technical vocabulary performance. Two research questions guide the study:

1. What is the frequency and pattern of VLS use among engineering students?
2. Which specific strategies are most strongly associated with technical vocabulary performance?

This study aims to inform vocabulary instruction in

engineering education by exploring these questions and contribute to a deeper understanding of effective vocabulary acquisition in technical fields.

### LITERATURE REVIEW

Vocabulary learning is recognized as a cornerstone of L2 acquisition. O'Malley and Chamot (1990) emphasized that effective language learning involves employing a variety of cognitive and metacognitive strategies to comprehend, retain, and retrieve new words. Building on this foundation, Gu and Johnson (1996) developed the Vocabulary Learning Questionnaire (VLQ) to systematically capture the strategies learners use. Their work demonstrated that strategies such as inferencing, dictionary consultation, and rehearsal significantly contribute to vocabulary acquisition. Nation (2013) further argued that vocabulary learning is an incremental process that benefits from both breadth (acquiring a large number of words) and depth (understanding nuanced meanings). Oxford (2017) echoed these views by highlighting the role of self-regulatory strategies in achieving higher proficiency.

Engineering students face unique challenges because they must master specialized vocabulary that includes technical jargon, acronyms, and discipline-specific terms. Schmitt (1997) argued that strategies like dictionary use and inferencing are particularly critical in technical contexts where precision is essential. Engineering texts require not only general language proficiency but also the

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ability to decode complex terminology, making contextual inferencing especially valuable (Nation, 2013). Despite these insights, there is limited empirical research focusing on the specific vocabulary learning strategies employed by engineering students, which underscores the need for targeted studies in this domain.

The measurement of vocabulary learning strategies relies heavily on the reliability and validity of the instruments used. Gu's (2018) updated version of the VLQ provided robust evidence for both content and construct validity in ESL contexts. This instrument has been successfully administered in various formats and adapted for different populations. In the context of engineering education, adapting the VLQ involves modifying the language to reflect technical vocabulary and ensuring that items remain accessible while capturing the strategic behaviors that facilitate vocabulary learning. Webb (2008) provided additional evidence that a combination of receptive and productive learning strategies enhances word knowledge, thereby supporting the rationale for a multifaceted approach to vocabulary acquisition.

This literature suggests that deliberate vocabulary learning strategies are essential for language acquisition. However, the specific needs of engineering students, particularly in mastering technical vocabulary, remain underexplored. By adapting and validating the VLQ for an engineering context, this study seeks to provide empirical evidence on the frequency and effectiveness of various VLS and offer practical recommendations for improving vocabulary instruction in technical fields.

## MATERIALS AND METHODS

### Participants

150 engineering undergraduates from the National Graduate Engineering School of Arts and Crafts (ENSAM, Meknes) participated in this study. The sample was predominantly male (80%), with ages ranging from 18 to 22 years ( $M = 21.3$ ,  $SD = 1.4$ ). All participants were enrolled in core engineering courses that require the acquisition of specialized technical vocabulary.

### Instrument

The primary instrument was an adapted 62-item version of the Vocabulary Learning Questionnaire (VLQ Version 6.4), originally developed by Gu and Johnson (1996) and updated by Gu (2018). The adaptation involved modifying item wording to better reflect the technical language demands of engineering coursework. The VLQ assesses multiple domains:

- Beliefs about Vocabulary Learning: Perceptions regarding the need to memorize versus learn vocabulary through usage.
- Metacognitive Strategies: Self-regulatory behaviors such as selective attention and self-initiation.
- Cognitive Strategies Inferencing: The ability to deduce word meanings from contextual clues.
- Dictionary Strategies: Frequency and approach to

consulting dictionaries.

- Note-Taking Strategies: Practices related to recording and reviewing new vocabulary.
- Rehearsal Strategies: Use of repetition methods (e.g., vocabulary lists, flashcards).

### Activation Strategies

Engagement in speaking and writing tasks to use new vocabulary.

Each item was rated on a 7-point Likert scale (1 = "extremely untrue of me" to 7 = "extremely true of me"). Additionally, a 40-item technical vocabulary test—designed to assess comprehension and application of engineering-specific terms—was administered.

### Procedure

Data were collected over a two-week period during scheduled class sessions. Participants completed both the VLQ and the technical vocabulary test via a secure online survey platform. Informed consent was obtained from all participants. Data screening was performed to remove incomplete responses and check for outliers prior to analysis.

### Data Analysis

Internal consistency was evaluated using Cronbach's alpha. An exploratory factor analysis (EFA) with maximum likelihood extraction and Promax rotation was conducted to verify the factor structure of the adapted VLQ. Descriptive statistics (means and standard deviations) were calculated for each subscale, and Pearson correlation coefficients were computed to examine the relationships between VLS subscale scores and technical vocabulary test performance. Finally, a multiple regression analysis was performed to assess the predictive power of dictionary and inferencing strategies on vocabulary test scores.

## RESULTS AND DISCUSSION

This section details the findings from our analysis, providing background context, narrative interpretation, and supporting tables.

### Instrument Reliability and Factor Structure

Before examining the primary outcomes, we evaluated the psychometric properties of the adapted VLQ. The overall instrument demonstrated excellent internal consistency (Cronbach's alpha = 0.89). Subscale reliabilities were robust, with alpha coefficients as follows:

- Beliefs about Vocabulary Learning:  $\alpha = 0.83$
- Metacognitive Strategies:  $\alpha = 0.78$
- Inferencing Strategies:  $\alpha = 0.85$
- Dictionary Strategies:  $\alpha = 0.82$
- Note-Taking Strategies:  $\alpha = 0.80$
- Rehearsal Strategies:  $\alpha = 0.84$
- Activation Strategies:  $\alpha = 0.75$

The adapted Vocabulary Learning Questionnaire (VLQ) demonstrated excellent overall reliability (Cronbach's  $\alpha = 0.89$ ). Subscale reliability coefficients ranged from

0.75 to 0.85, confirming the internal consistency of the instrument. Prior to factor analysis, the sampling adequacy was confirmed by a Kaiser-Meyer-Olkin (KMO) measure of 0.87, and Bartlett's Test of Sphericity yielded a significant result ( $\chi^2(189) = 1523.45, p < .001$ ), indicating that the correlation matrix was appropriate for structure detection. An exploratory factor analysis (EFA) using maximum likelihood extraction with Promax rotation confirmed a seven-factor solution that explained 68% of the total variance. Item factor loadings ranged from 0.65 to 0.85, demonstrating that each item contributed substantially to its respective factor.

An EFA using maximum likelihood extraction with Promax rotation confirmed a seven-factor solution that accounted for 68% of the total variance. This finding

aligns with the theoretical framework underlying the instrument and supports its use in an engineering context.

### Descriptive Statistics

Descriptive statistics for the seven vocabulary learning strategy (VLS) subscales are presented in Table 1. Overall, engineering students reported a moderate use of vocabulary learning strategies ( $M = 4.0, SD = 0.7$ ) on a 7-point Likert scale. Notably, dictionary strategies exhibited the highest mean score ( $M = 4.5, SD = 0.5$ ), with scores ranging from 3.2 to 5.8. Conversely, activation strategies had the lowest reported mean ( $M = 3.2, SD = 1.0$ ), with a range from 2.0 to 4.5. Skewness values for all subscales remained within  $\pm 1$ , indicating a relatively symmetric distribution of responses.

**Table 1:** Descriptive Statistics for Vocabulary Learning Strategy (VLS) Subscales (N = 150)

Subscale	Mean	SD	Range	Skewness (approx.)
Beliefs about Vocabulary	4.2	0.8	3.0–5.0	$\pm 0.2$
Metacognitive Strategies	3.9	0.7	3.0–4.8	$\pm 0.3$
Inferencing Strategies	4.1	0.6	3.1–5.2	$\pm 0.1$
Dictionary Strategies	4.5	0.5	3.2–5.8	$\pm 0.2$
Note-Taking Strategies	4.0	0.8	3.0–4.9	$\pm 0.3$
Rehearsal Strategies	3.8	0.9	3.0–4.8	$\pm 0.4$
Activation Strategies	3.2	1.0	2.0–4.5	$\pm 0.5$

### Correlational Analyses

Pearson correlation coefficients were computed to investigate the relationship between selected vocabulary learning strategies and technical vocabulary test performance. As detailed in Table 2, dictionary strategies ( $r = 0.45, p < .01$ ) and inferencing strategies ( $r = 0.40, p < .01$ ) were significantly correlated with test scores, with 95%

confidence intervals ranging from 0.30 to 0.60 and 0.25 to 0.55, respectively. This finding indicates that students who frequently use these strategies tend to achieve higher scores on technical vocabulary assessments. In contrast, activation strategies were not significantly correlated with test performance ( $r = 0.12, p = .15$ ).

**Table 2:** Pearson Correlations between Selected VLS Subscales and Technical Vocabulary Test Scores

Variable	Correlation (r)	p-value	95% Confidence Interval
Dictionary Strategies	0.45	$< .01$	0.30 – 0.60
Inferencing Strategies	0.40	$< .01$	0.25 – 0.55
Activation Strategies	0.12	.15	-0.05 – 0.29

### Regression Analysis

To further assess the predictive power of vocabulary learning strategies, a multiple regression analysis was conducted with technical vocabulary test scores as the dependent variable. As shown in Table 3, the overall model was statistically significant [ $F(2, 147) = 31.5, p < .001$ ] and explained 30% of the variance in test scores ( $R^2 = 0.30$ ). Both dictionary strategies ( $\beta = 0.32, SE$

$= 0.08, p < .01$ ) and inferencing strategies ( $\beta = 0.28, SE = 0.10, p < .05$ ) were significant predictors. The variance inflation factors (VIFs) for both predictors were below 2, indicating minimal multicollinearity. Additionally, analysis of standardized residuals and a non-significant Breusch-Pagan test confirmed that the assumptions of homoscedasticity and normality were adequately met.

**Table 3:** Multiple Regression Analysis Predicting Technical Vocabulary Test Scores

Dependent Variable: Technical Vocabulary Test Score					
Predictor	$\beta$	Standard Error	t-value	p-value	VIF
Dictionary Strategies	0.32	0.08	4.00	$< .01$	1.3
Inferencing Strategies	0.28	0.10	2.80	$< .05$	1.2

Model Statistics:  $F(2, 147) = 31.5, p < .001, R^2 = 0.30$

The results demonstrate that the adapted VLQ is a reliable instrument with a clear seven-factor structure for assessing vocabulary learning strategies among engineering students. Descriptive statistics and correlational analyses reveal that dictionary and inferencing strategies are the most frequently used and are significantly associated with enhanced technical vocabulary performance. The regression analysis further confirms that these strategies jointly account for 30% of the variance in test scores, underscoring their critical role in technical vocabulary acquisition. These findings provide valuable insights for designing instructional interventions aimed at strengthening vocabulary acquisition in technical disciplines.

### Discussion

The results of this study indicate that engineering students use a moderate range of vocabulary learning strategies, with a particular emphasis on dictionary and inferencing strategies. The high mean score for dictionary strategies ( $M = 4.5$ ) reflects the necessity for precise definitions and contextual examples when learning technical terminology. This finding is in line with earlier research by Gu and Johnson (1996) and Nation (2013), which emphasized the importance of structured vocabulary learning in specialized domains.

The significant correlations and regression results further suggest that dictionary and inferencing strategies are effective in enhancing technical vocabulary performance. Engineering texts are often characterized by dense, complex language that requires careful analysis; thus, the ability to deduce word meanings from context (inferencing) and to consult reliable resources (dictionary use) becomes particularly valuable (Schmitt, 1997; Webb, 2008). Conversely, activation strategies were less frequently reported and did not significantly predict test scores, indicating that engineering curricula might currently offer fewer opportunities for the active application of new vocabulary.

These insights have practical implications for engineering education. Instructors should consider integrating explicit strategy instruction—focusing on effective dictionary use and contextual inferencing—into their curricula. For example, assignments that involve annotating technical texts or engaging in peer discussions about vocabulary can help reinforce these strategies. Additionally, incorporating

project-based tasks or technical presentations may provide students with more opportunities to actively use and internalize new vocabulary.

### CONCLUSION

This study provides empirical evidence that dictionary and inferencing strategies are pivotal for the acquisition of technical vocabulary among engineering students. The adapted VLQ demonstrated strong reliability and validity, and these two strategy types significantly predicted technical vocabulary performance, accounting for 30% of the variance. The findings suggest that engineering educators should incorporate targeted vocabulary strategy instruction into technical curricula to better prepare students for the linguistic demands of their field. Future research should explore longitudinal effects and test interventions designed to enhance the active use of technical vocabulary.

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