

English Vocabulary Learning Strategies Used by Undergraduate Science Education Students

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Abstract

This study aims to explore the English vocabulary learning strategies used by undergraduate science education students and the challenges they face. A total of 53 students from various science education programs participated in the study. Using a descriptive quantitative and qualitative approach, data were collected through a questionnaire by Likert-scale items and open-ended questions. The quantitative data were analyzed using descriptive statistics, while the qualitative responses were examined through content analysis to identify recurring themes. The results showed that students most frequently used digital tools, particularly using Google Scholar, Wikipedia, or search engines to find word meanings and usage (mean score = 3.53; 70.6%), followed by rewriting new words (3.21; 64.2%) and verbal repetition (3.09; 61.8%). However, 41.5% of students reported that they rarely read scientific texts in English, and 22.6% said they very rarely do so. Common challenges identified included the complexity and unfamiliarity of scientific terms, difficulty in memorization, low motivation, and limited opportunities for practice and exposure. It is recommended that science education programs provide more structured exposure to English texts, apply contextual vocabulary teaching, and encourage the use of digital tools and collaborative learning.

INTRODUCTION

In the current landscape of science education, English plays a central role as the global language of academic and scientific communication. This linguistic reality necessitates a strong command of English, particularly in the understanding and use of scientific vocabulary, among undergraduate students pursuing science education (Razokovna et al., 2022). The ability to comprehend, retain, and use scientific terminology in English is critical not only for academic success but also for participation in international discourse and collaboration (Zaitun Qamariah & Hadma Yuliani, 2024)(Loubna HADDI, 2021). Within this context, vocabulary learning strategies (VLS) have emerged as essential tools to bridge the gap between language proficiency and scientific content mastery (Thiendathong & Sukying, 2021).

Scientific texts often contain specialized terminology that is uncommon in everyday English (Kohler, 2019). For students in science education programs, this creates a dual challenge: mastering complex scientific concepts while simultaneously acquiring the language in which those concepts are expressed (Kruawong & Soontornwipast, 2021). Effective strategies for learning vocabulary are therefore necessary to support comprehension, retention, and practical application (Mahapatra, 2020). Studies have identified a variety of VLS such as repetition, context-based learning, mnemonic techniques, dictionary use, and interaction with digital media as significantly beneficial for vocabulary acquisition (Zhang, 2021).

Scientific literacy is deeply connected with language proficiency, especially when students must read and produce scientific texts in English. In fields like physics education, language competence enhances students' ability to understand scientific literature and to participate in laboratory work, group projects, and scientific presentations—all of which require effective communication (Lee et al., 2019). As a result, it is vital for science education programs to implement teaching approaches that integrate English language development with the teaching of scientific content (Rutt et al., 2021).

Instructional frameworks that integrate content and language learning have gained widespread recognition, especially in multilingual classrooms. These frameworks support strategies that combine inquiry-based learning, content scaffolding, and vocabulary support to improve understanding among English learners (ELs) (De & Marpaung, 2022)(Lyon et al., 2018). For preservice science teachers, these models offer a foundation for inclusive teaching that addresses both linguistic and disciplinary learning goals. Research also highlights the significant of inquiry-based and student-centered learning in enhancing vocabulary acquisition. These methods promote critical thinking and active engagement with scientific terminology, which in turn deepens understanding of content and boosts long-term retention (Romero-Ariza et al., 2020) (Straková & Cimermanová, 2018). When students encounter vocabulary through problem-solving, experimentation, and peer collaboration, they are more likely to grasp both the meaning and usage of scientific terms.

Technology likewise plays a transformative role in vocabulary learning. Interactive tools such as online quizzes, digital flashcards, crossword puzzles, simulations, and multimedia glossaries allow learners to engage with content in varied, multimodal ways that cater to different learning styles (Mahapatra, 2020)(Kruawong & Soontornwipast, 2021). These platforms also provide opportunities for immediate feedback and autonomous learning, which are crucial for developing vocabulary in second-language contexts.

Another crucial dimension is differentiated instruction. Recognizing that students possess different backgrounds, prior knowledge, and language proficiencies, educators are encouraged to tailor vocabulary instruction using formative assessments and individualized strategies (Deunk et al., 2018). This approach ensures that students receive vocabulary instruction aligned with their cognitive readiness and learning preferences, thus optimizing their engagement and academic performance.

Furthermore, English for Specific Purposes (ESP) has been increasingly acknowledged in science education. ESP focuses on teaching English that is directly related to a learner's field of study, making vocabulary instruction more relevant and effective. Science students have expressed a preference for ESP courses that allow them to learn terminology and expressions used in academic texts, research articles, and professional communication within their disciplines (Sarifa & Jabeen, 2024). Preparing preservice teachers to apply these strategies is equally vital. Teacher education programs must include training on how to support vocabulary development in multilingual classrooms using inclusive and evidence-based methodologies. These programs should emphasize not only pedagogical content knowledge but also the ability to scaffold language learning through content delivery (Sukič Kuzma, 2022).

A growing body of research affirms the importance of equipping students with metacognitive awareness about the strategies they use. Encouraging learners to reflect on how they learn vocabulary, and what strategies are most effective for them, fosters greater autonomy and long-term language development (Thiendathong & Sukying, 2021). In the last, mastering scientific vocabulary in English is not a peripheral skill but a core component of scientific literacy for undergraduate students in science education. A deep understanding of vocabulary learning strategies—supported by inquiry-based teaching, digital tools, differentiated instruction, and content-language integration—can significantly improve students’ engagement and success. This study seeks to explore how undergraduate science education students approach English vocabulary learning, providing valuable insights that can inform curriculum design, teacher preparation, and future research in science education and language learning.

This study narrows its focus specifically to vocabulary learning strategies employed by undergraduate students in science education programs. Rather than addressing general English acquisition, the research centers on how students engage with science-specific terminology, which is often more technical and context-dependent. By concentrating on this niche, the study aims to provide targeted insights into strategy effectiveness within the intersection of language learning and scientific literacy. Such a focus is especially relevant for preparing students to operate in multilingual academic environments and engage with scientific content in English.

This study seeks to investigate the English vocabulary learning strategies employed by undergraduate students in science education programs, particularly focusing on how they learn and retain science-related terminology. Specifically, the research aims to identify the types of vocabulary learning strategies used by these students, to examine the frequency with which each strategy is applied in their learning process, and to explore the challenges they encounter as well as the strategies they perceive as most effective in enhancing their English vocabulary acquisition within scientific contexts. This study is expected to contribute both theoretically and practically. Theoretically, it aims to enrich the existing body of knowledge related to English for Academic Purposes (EAP), particularly in the area of vocabulary learning strategies among EFL students in science education. Practically, the findings may help undergraduate science education students become more aware of effective strategies for learning English vocabulary relevant to scientific contexts. Additionally, the results may assist instructors and curriculum developers in designing English language instruction—especially ESP courses—that better align with students’ academic needs. Lastly, the study may serve as a reference for future researchers interested in exploring vocabulary development in discipline-specific language learning.

Additionally, the results may assist instructors and curriculum developers in designing English language instruction—especially ESP courses—that better align with students’ academic needs. Lastly, the study may serve as a reference for future researchers interested in exploring vocabulary development in discipline-specific language learning. Despite the growing body of literature on vocabulary learning strategies, limited attention has been given to how students in science education programs—particularly those studying in English as a Foreign Language (EFL) contexts—develop strategies to acquire and retain science-specific terminology. Previous research has often generalized findings across disciplines or focused on general academic vocabulary without addressing the unique cognitive and linguistic challenges faced by science education students. This study seeks to address that gap by providing focused insights into the vocabulary learning experiences of EFL learners within the scientific education domain.

METHOD

Participants / subject / population and sample

To systematically explore how undergraduate science education students approach English vocabulary learning—particularly science-related terminology—this study employed a quantitative descriptive design. This approach was chosen to provide a clear, data-driven picture of students’ strategy use, frequency patterns, and perceived challenges, without manipulating any variables. By combining structured survey items with open-ended responses, the study aimed to offer both measurable trends and contextual insights into students’ vocabulary learning experiences.

The population of this study comprised undergraduate students enrolled in various science education programs, including Physics, Chemistry, Biology, and Integrated Science Education. Using purposive sampling, 53 students were selected based on specific inclusion criteria: they had to be currently enrolled in a science education program and possess prior exposure to English academic content—such as English-medium instruction, scientific texts, or modules requiring English vocabulary use. This sampling method ensured the inclusion of participants who were sufficiently experienced in engaging with science-related vocabulary and who could meaningfully reflect on their learning strategies.

Data were collected using a structured Google Form-based questionnaire, which consisted of three main sections. The first section included over 20 closed-ended items rated on a five-point Likert scale (1 = Never to 5 = Very Often), targeting five categories of vocabulary learning strategies: memory, cognitive, metacognitive, social, and determination strategies. The second section featured two open-ended questions that invited students to elaborate on their most effective strategies and their primary challenges in learning English vocabulary. The instrument was distributed online, and data collection occurred over a two-week period. Participation was voluntary, and informed consent was obtained through questionnaire completion. Anonymity and confidentiality were strictly maintained.

The quantitative data were analyzed using descriptive statistics to determine frequencies, percentages, mean scores, and standard deviations for each vocabulary learning strategy. These metrics helped identify the most and least frequently used strategies, revealing broader patterns in students’ learning behaviors.

The qualitative data from the open-ended responses were examined using content analysis, allowing the researcher to extract and categorize recurring themes related to students’ strategic preferences and perceived obstacles. This mixed analytical approach enabled the study to capture both measurable trends and personal experiences. All data were used solely for academic purposes and handled according to ethical research standards.

FINDINGS

The questionnaire used in this study contained 20 items, each representing a different English vocabulary learning strategy tailored to the context of science education. These strategies spanned various categories, including memory-based, cognitive, metacognitive, social, and determination strategies. While the full dataset provided a broad picture of how students approach vocabulary learning, this section focuses on the top five strategies most frequently used by students, as determined by their average scores. This selective presentation is intended to highlight key trends in student behavior while maintaining clarity and relevance in the analysis.

Table: 1 Percentage Tabel

Strategy	Mean Score	Standard Deviation (est.)	Usage Percentage (%)
Using Google Scholar, Wikipedia, or search engines to find meanings and usage	3.53	0.90	70.6%

Rewriting new words for practice and memorization	3.21	0.85	64.2%
Repeating vocabulary verbally to aid memorization	3.09	0.80	61.8%
Noting new vocabulary during reading/listening activities	3.06	0.75	61.2%
Asking lecturers or friends for clarification of scientific terms	2.92	0.78	58.4%

The analysis of the questionnaire responses revealed that the most frequently used English vocabulary learning strategy among undergraduate science education students was using Google Scholar, Wikipedia, or search engines to find meanings and usage, with a mean score of 3.53 and an estimated usage rate of 70.6%. This finding indicates a strong preference for digital tools in accessing and understanding scientific terminology. The convenience, speed, and vast range of information provided by search engines seem to support students' need for immediate clarification when encountering unfamiliar vocabulary, especially in the context of reading scientific articles or preparing academic assignments.

The second most frequently used strategy was rewriting new words for practice and memorization, which achieved a mean score of 3.21 and a usage rate of 64.2%. This shows that despite the availability of digital aids, traditional cognitive strategies such as writing remain relevant. Rewriting vocabulary is often linked with better retention, especially when students associate new terms with scientific concepts they are learning. It also suggests that learners engage actively with new words beyond passive recognition, attempting to internalize them through repeated written exposure.

53 responses

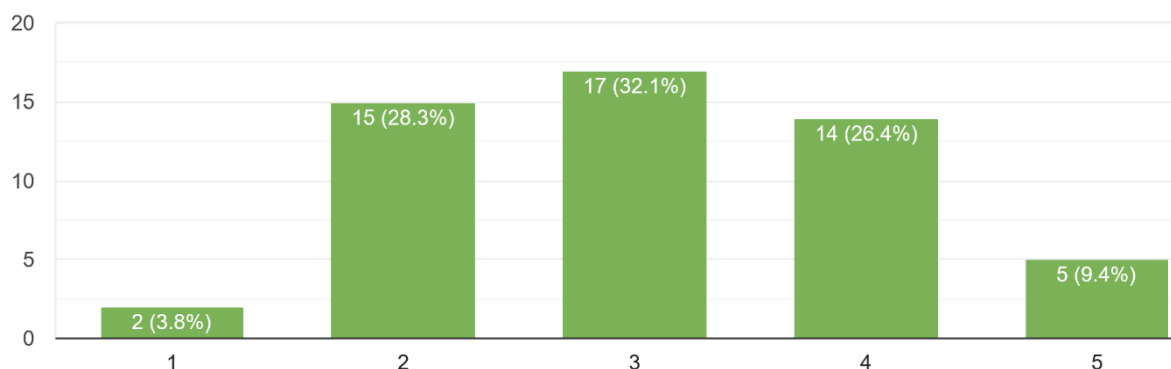


Figure 1: Percentage of students with correct responses

Another commonly adopted strategy was repeating vocabulary verbally to aid memorization, with a mean score of 3.09 (61.8%). This reflects students' effort to not only recognize and write new vocabulary but also pronounce and internalize terms orally, which may help reinforce long-term memory and improve spoken fluency. Similarly, noting new vocabulary during reading or listening activities had a mean of 3.06 (61.2%), indicating that students are attentive to acquiring new words in context. These findings suggest that students tend to notice vocabulary in authentic academic input, such as lectures, journals, and educational videos, and are intentional about recording it for later study.

In addition to individual strategies, students also demonstrated the use of social learning methods, such as asking lecturers or friends for clarification of scientific terms, which recorded a mean score of 2.92 (58.4%). Although slightly less frequent than digital and personal strategies, this suggests that collaborative learning still plays an important role in vocabulary development, especially when students encounter complex or abstract terms. It also highlights the value of interaction and communication in resolving confusion and deepening understanding.

In addition to analyzing students' vocabulary learning strategies, this study also examined their reading habits related to English scientific texts. Based on responses from 53 participants, the majority of science education students reported a low to moderate frequency of reading scientific articles in English. Specifically, 22 respondents (41.5%) selected category "2" on the scale, indicating that they rarely read scientific texts in English. This was followed by 18 students (34%) who chose category "3," suggesting occasional reading, and 12 students (22.6%) who selected category "1," indicating that they very rarely engage with such texts. Only one student (1.9%) reported reading English scientific articles frequently by choosing category "4." These results highlight a significant issue: most students are not yet accustomed to regularly reading academic texts in English, despite the importance of doing so for vocabulary acquisition and academic development. This limited exposure may hinder their ability to encounter and internalize domain-specific terminology, which in turn can affect their comprehension of scientific content and reduce the effectiveness of their vocabulary learning strategies. Consequently, increasing access to and engagement with English-language scientific materials should be considered a priority in science education programs aiming to enhance students' academic English proficiency.

The findings indicate that students adopt a balanced and flexible approach to English vocabulary learning, combining technology-based tools, cognitive reinforcement, oral repetition, contextual awareness, and social interaction. This variety reflects the diverse needs and learning preferences of science education students. More importantly, the integration of vocabulary learning strategies into science-specific contexts—such as academic reading, laboratory reports, and scientific presentations—appears to be essential in supporting both language development and academic success.

The Challenges in English Learning

In addition to the quantitative findings, open-ended responses provided valuable insights into the specific challenges faced by science education students in learning English vocabulary. These challenges can be categorized into four major themes: the complexity of scientific terminology, difficulty in vocabulary retention, lack of motivation and consistency, and limited opportunities for practice and exposure.

The most prominent challenge reported by students related to the complexity and specificity of scientific vocabulary. Respondents consistently noted that many scientific terms are technical, abstract, and rarely used in everyday English, making them difficult to understand and memorize. Students found it especially challenging when terms had multiple meanings depending on the context. Many expressed confusion when interpreting similar or overlapping terms in their field of study, and several highlighted that scientific language often includes complex word structures derived from Latin or Greek origins. The unfamiliarity of this specialized vocabulary, combined with its rare use in daily conversation, was seen as a major barrier to comprehension.

Another frequently mentioned issue was difficulty in retention and memorization. Students reported struggling to remember new vocabulary after initial exposure, and many expressed concern about their inability to recall terms accurately when needed. This difficulty was often linked with the challenge of applying vocabulary appropriately within specific academic or scientific contexts. The

gap between understanding a word in isolation and using it correctly in real-world communication or written assignments was repeatedly emphasized.

Motivational and consistency-related barriers also emerged as significant internal obstacles. Some students acknowledged a lack of motivation or discipline in actively studying English vocabulary. Inconsistent study habits and procrastination were frequently cited as hindrances, along with difficulties in establishing a regular practice schedule. Pronunciation challenges were also mentioned, particularly for scientific terms, which sometimes led to frustration and reduced confidence, further affecting students' willingness to engage with the language.

Lastly, several responses highlighted the limited access to meaningful practice and exposure as a key concern. Many students expressed that they lacked real-world opportunities to apply the vocabulary they were learning. They mentioned inadequate access to English learning resources, minimal use of English in classroom discussions, and a lack of authentic contexts in which to encounter and reinforce vocabulary. The absence of immersive or interactive environments was seen as a major limitation in achieving fluency and reinforcing learning.

The open-ended responses reveal a multifaceted set of challenges in acquiring English vocabulary within the domain of science education. These findings underscore the need for pedagogical interventions that not only address vocabulary content, but also support learners through increased contextual exposure, guided usage, motivational support, and the integration of scientific language into practical, real-life academic tasks.

DISCUSSION

The findings of this study offer meaningful insights into the English vocabulary learning strategies employed by undergraduate science education students, as well as the obstacles they encounter. The quantitative data revealed a clear reliance on technology-assisted strategies, with the use of search engines and platforms like Google Scholar or Wikipedia being the most frequently reported method. This reliance reflects a broader digital shift in educational practices, where students gravitate toward tools that provide fast, autonomous access to knowledge. This trend supports Mahapatra's (2020) argument that digital platforms enhance vocabulary development by offering multimodal and engaging learning experiences, especially in academic contexts.

Despite the prevalence of digital tools, students still frequently employed traditional methods such as rewriting new vocabulary and repeating words aloud. These approaches, aligned with Schmitt's (1997) classification of memory and cognitive strategies, demonstrate that foundational learning habits remain relevant in digital-era education. Rather than replacing older methods, digital tools appear to complement them, with students adopting a hybrid approach that adjusts to both the complexity of terms and their individual learning preferences. This hybridization highlights a flexible strategy selection process, reflecting metacognitive awareness among learners.

However, the finding that a majority of students reported low engagement with English-language scientific texts is concerning. With over 75% indicating they rarely read such materials, this limited exposure may significantly undermine vocabulary acquisition. Nation (2001) emphasized the importance of frequent and meaningful encounters with words in authentic contexts for robust vocabulary development. Without regular interaction with scientific texts, students may fail to internalize terminology effectively, no matter how strategic their learning methods are. This gap underlines the need to promote consistent academic reading habits within science education programs.

The qualitative data revealed four main challenges faced by students: the complexity of scientific terminology, retention difficulties, motivational issues, and limited exposure opportunities. The technical nature of scientific vocabulary—often abstract, polysemous, and etymologically rooted in Latin or Greek—posed a significant barrier to comprehension. These findings affirm Lee et al.'s

(2019) call for more explicit instruction in decoding and understanding scientific language, particularly through scaffolded learning experiences.

The theme of low motivation and inconsistent learning habits also emerged as a key barrier. Many students admitted to procrastination, avoidance, and anxiety in engaging with scientific English. To deepen this analysis, Self-Determination Theory (SDT) by Deci and Ryan (1985) provides a useful lens. According to SDT, motivation is enhanced when three psychological needs are fulfilled: autonomy, competence, and relatedness. In the current context, students' lack of regular engagement with vocabulary may reflect insufficient support in these areas. For instance, they may lack a sense of competence when dealing with technical language, feel isolated without peer collaboration, or perceive vocabulary learning as externally imposed rather than personally meaningful. Integrating SDT-informed strategies—such as student-centered tasks, collaborative projects, and personalized feedback—may foster greater intrinsic motivation and commitment to language learning.

Finally, limited opportunities for practice and exposure were widely reported. Many students felt that classroom environments did not provide enough space for real-world application of scientific vocabulary. Deunk et al. (2018) argue that differentiated instruction and contextual learning are essential in addressing such needs. If science education programs fail to incorporate vocabulary into hands-on, interactive academic tasks—like experiments, presentations, or collaborative problem-solving—students are less likely to transfer vocabulary knowledge into meaningful use. While students use a diverse set of strategies for learning English vocabulary, the impact of these strategies is moderated by systemic and motivational factors. To enhance vocabulary acquisition, science education programs must adopt a more integrated approach that includes regular exposure to authentic texts, scaffolding of complex terminology, and motivation-based pedagogy grounded in learner autonomy and engagement. Embedding vocabulary learning within the actual practice of science—not as an isolated language task—will be key to supporting both linguistic and academic success.

CONCLUSION

This study explored the English vocabulary learning strategies used by undergraduate students in science education programs and the challenges they encounter in acquiring discipline-specific terminology. The results showed that students employ a variety of strategies, with a clear preference for digital tools such as Google Scholar and search engines, followed by traditional techniques like rewriting vocabulary and verbal repetition. This pattern suggests a blended approach that combines digital convenience with cognitive reinforcement. Despite this diverse strategy use, many students reported low engagement with English-language scientific texts, a condition that may limit their exposure to authentic vocabulary and restrict opportunities for contextual learning.

In addition to the quantitative findings, open-ended responses revealed four recurring challenges: the complexity of scientific vocabulary, difficulties in retention and accurate recall, lack of motivation and consistent study habits, and limited access to real-life exposure or practice. These challenges suggest that vocabulary learning is not only a linguistic process but also a cognitive and motivational endeavor that is strongly influenced by both individual learner characteristics and institutional learning environments. Therefore, improving vocabulary acquisition in science education requires not just effective strategies but also systemic support through instruction, motivation, and exposure.

Based on these findings, several implications are recommended to improve both language learning and scientific literacy. First, science education programs should integrate more structured and regular engagement with English scientific texts. This could be achieved through annotated journal reading tasks, reflective vocabulary logs, and text-based discussions that help students internalize terminology in context. Second, teachers are encouraged to employ contextualized and

inquiry-based instructional approaches that embed vocabulary development into real-world problem-solving activities. Third, to overcome motivational barriers, learning environments should include collaborative vocabulary activities such as peer discussions, games, and group tasks to enhance engagement and make the process less intimidating.

Moreover, although students already rely on digital tools, they need more targeted guidance on how to use these tools effectively and critically for independent vocabulary development. Educational institutions should ensure equal access to these resources and train students to make strategic and ethical use of them. Lastly, future research is encouraged to investigate how vocabulary strategy use correlates with academic achievement or to explore differences across student demographics, such as major, gender, or prior English experience. Insights from such studies can inform more tailored and inclusive instructional practices. Overall, vocabulary learning in science education must be supported by thoughtful pedagogy, resource availability, and continuous engagement with authentic scientific language to ensure long-term success in both language acquisition and academic performance.

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