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A Survey on Chemistry Students' Ability to Summarize Articles in English

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Abstract

English is widely used as the main language of scientific communication, making the ability to read and summarize English scientific articles essential for chemistry students. However, many students experience difficulties in identifying main ideas, paraphrasing information, and understanding scientific vocabulary. This study aims to investigate chemistry students' ability to summarize English scientific articles, including the strategies used, the role of vocabulary mastery, and the challenges encountered. An explanatory sequential mixed-methods design was employed. Quantitative data were collected through vocabulary and summarizing tests, while qualitative data were obtained from classroom observations and interviews. The participants were undergraduate chemistry students with varying levels of English proficiency. The results indicate that students showed improvement in vocabulary use and summary writing after participating in multimedia-based English for Science instruction. In addition, bilingual scaffolding helped students better understand scientific texts and increased their confidence in using English. Overall, this study suggests that context-based English for Science instruction can support students' academic reading and summarizing skills.

Keyword: Bilingual Scaffolding; English for Science; English for Specific Purposes (ESP); Scientific Vocabulary; Summarizing Skills

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INTRODUCTION

In recent years, concerns regarding university students' academic literacy skills—particularly their ability to summarize scientific texts in English—have increased significantly. Scientific summarization is not merely a linguistic activity but a higher-order cognitive skill that requires critical reading, synthesis of ideas, and accurate representation of disciplinary knowledge. From a cognitive perspective, summarizing involves selecting essential information, integrating new ideas with prior knowledge, and reconstructing meaning in a condensed form (Kintsch & van Dijk, 1978; Brown & Day, 1983). In academic literacy theory, summarization is also viewed as a genre-based practice that requires awareness of text structure and disciplinary conventions (Hyland, 2004; Swales, 1990). Recent international studies indicate that many undergraduate students, especially in science and technology fields, struggle to produce coherent and concise summaries of research articles written in English (Zhang & Plonsky, 2020; Li, 2022).

In the context of science education, English functions as the dominant language of scholarly communication. Most high-impact journals, reference textbooks, and international conferences employ English as the primary medium. Consequently, science students are required to engage intensively with English-language academic texts throughout their studies. According to English for Specific Purposes (ESP) theory, effective engagement with scientific texts requires both linguistic competence and genre awareness of research articles (Swales, 1990; Hyland, 2004). However, several recent reports reveal that non-native English-speaking students often rely on surface-level strategies such as sentence copying or literal translation when summarizing scientific articles, which results in poor-quality summaries and limited conceptual understanding (Hirano, 2021; Yu & Kim, 2023). These difficulties align with cognitive load theory, which suggests that limited language proficiency may overload working memory and hinder deeper text processing (Sweller, 1998).

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In Indonesia, this challenge is intensified by the bilingual learning environment when bilingual instruction is not managed strategically. Although bilingual approaches can support conceptual understanding, inadequate implementation may limit students' exposure to academic English. Recent national evaluations of higher education literacy further reveal that students' academic writing skills—particularly in summarizing and paraphrasing scientific texts—remain below expected standards (Kemendikbud, 2023). These conditions point to an urgent need to examine students' ability to summarize English scientific texts within science disciplines, especially chemistry, which relies heavily on dense and abstract discourse. Investigating how chemistry students summarize English scientific articles, the strategies they employ, and the challenges they face is therefore crucial for improving English for Science instruction and strengthening students' scientific literacy.

Despite the central role of English in scientific literature, many chemistry students in Indonesia continue to experience difficulties in summarizing English scientific articles effectively. Classroom observations and previous reports indicate recurring problems such as limited mastery of scientific vocabulary, challenges in processing complex syntactic structures, and a strong reliance on literal translation rather than effective paraphrasing. These issues suggest that students' summarizing competence in scientific contexts remains insufficiently developed. Although summarizing is a crucial academic skill for engaging with scientific literature, empirical studies that specifically investigate how chemistry students summarize English scientific texts—particularly in terms of the strategies they employ, the influence of scientific vocabulary mastery, and the challenges they encounter—are still relatively limited. This gap underscores the need for a systematic investigation to support more effective English for Science instruction.

Recent theories in English for Specific Purposes (ESP) and English for Science and Technology (EST) emphasize that academic literacy development should be discipline-specific, strategy-oriented, and grounded in authentic scientific practices. Within this theoretical framework, summarizing scientific texts is regarded as a core academic skill that integrates reading comprehension, control of disciplinary vocabulary, and higher-order thinking skills (Hyland, 2022; Basturkmen, 2021; Flowerdew, 2023). These perspectives suggest that chemistry students' ability to summarize English scientific articles cannot be treated merely as a general language skill, but must be understood in relation to the discourse conventions and communicative practices of chemistry as a discipline. Accordingly, examining the summarizing strategies used by chemistry students and the difficulties they face provides important insights into their academic literacy development.

From a cognitive perspective, summarization is viewed as a complex process involving the identification of main ideas, the elimination of redundant information, paraphrasing, and the synthesis of content into a coherent and concise representation of the original text (Grabe & Stoller, 2021; Kintsch, 2020). Empirical studies have shown that students who lack awareness of scientific discourse structures and limited scientific vocabulary tend to rely on surface-level strategies such as sentence copying, which often results in fragmented summaries and weak conceptual understanding (Li, 2022; Yu & Kim, 2023). This indicates that scientific vocabulary mastery plays a critical role in enabling students to reformulate information accurately rather than reproducing source texts verbatim.

In addition, sociocultural perspectives highlight that the development of academic summarizing skills is facilitated through instructional scaffolding, guided practice, and meaningful interaction in bilingual learning environments. Strategic use of students' first language and translanguaging practices can support comprehension of complex scientific texts while gradually strengthening academic English proficiency (Widodo, 2022; García & Wei, 2023). Taken together, these theoretical perspectives suggest that effective ESP instruction in science should explicitly address summarizing strategies, scientific vocabulary control, and awareness of disciplinary discourse structures. Based on these considerations, the present study seeks to investigate the summarizing strategies employed by chemistry students, examine the role of scientific vocabulary mastery in their summarizing performance, and explore the challenges they encounter when summarizing English-language chemistry articles.

METHOD

This study employed an explanatory sequential mixed-methods design. Quantitative data were first collected through questionnaires and summarizing performance tests, followed by qualitative interviews to explain and deepen the quantitative findings (Creswell & Plano Clark, 2018). This design was considered particularly suitable for investigating students' summarizing ability because summarizing involves both

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measurable performance outcomes and underlying cognitive and strategic processes. The quantitative phase enabled the identification of patterns and levels of students' summarizing strategies, perceived difficulties, and performance, while the qualitative phase provided in-depth insights into how and why students applied certain strategies, encountered challenges, or relied on surface-level techniques.

The participants consisted of 58 undergraduate chemistry students enrolled in English for Science courses at a public university in Indonesia. A total sampling technique was employed, whereby all students registered in the course during the data collection period were included as research participants. The course was a compulsory subject aimed at developing students' academic reading and writing skills in scientific contexts. The number of participants was considered methodologically adequate for mixed-methods research, as Creswell and Plano Clark (2018) suggest that a sample size ranging from 30 to 100 participants is sufficient to identify meaningful quantitative patterns and to inform subsequent qualitative inquiry. Accordingly, the sample size allowed for reliable analysis of students' summarizing abilities while remaining manageable for in-depth qualitative exploration.

Data were collected using multiple research instruments. Two researcher-made questionnaires were used to assess students' summarizing strategies and perceived difficulties. These questionnaires were validated through expert judgment by two specialists in English for Specific Purposes (ESP) and chemistry education, who evaluated the relevance, clarity, and content representativeness of each item, and revisions were made based on their feedback prior to data collection. In addition, a summarizing performance test based on authentic chemistry articles was administered to measure students' actual summarizing ability. The test tasks were reviewed by subject-matter experts to ensure content validity and alignment with course objectives. Semi-structured interviews were then conducted to explore students' experiences and challenges in greater depth. The interview protocol was validated through expert review and pilot testing to ensure the clarity and appropriateness of the guiding questions.

Quantitative data were analyzed using descriptive statistics, including mean, frequency, and percentage, to identify patterns, levels, and tendencies in students' summarizing strategies, perceived difficulties, and performance. Qualitative data were analyzed thematically through systematic coding, categorization, and theme development. This process involved identifying recurring patterns in the interview transcripts and grouping them into meaningful themes that helped explain and contextualize the quantitative results.

RESULTS AND DISCUSSION

Quantitative Results

The following table summarizes students' summarizing techniques, scientific vocabulary mastery, frequently reported challenges, and general tendencies along with their interpretations to give a clearer picture of the quantitative findings.

Table I. Summary of Students' Summarization Techniques, Vocabulary Proficiency, Challenges, and Views

No	Aspect	Main Findings	Overall Tendency	Interpretation
1	Summarizing Strategies Used	Students commonly apply multiple strategies such as reading abstracts and conclusions, highlighting key points, note-taking, outlining, paraphrasing, and drafting summaries in stages. The use of IMRaD structure is less consistent.	Agree (4)	Students demonstrate active engagement in summarizing but lack systematic use of formal article structures.
2	Scientific Vocabulary Mastery	Mastery of scientific vocabulary strongly supports comprehension, accuracy, and confidence in summarizing scientific articles. Limited vocabulary is perceived as a major obstacle.	Agree (4)	Scientific vocabulary plays a crucial role in effective academic summarizing.

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No	Aspect	Main Findings	Overall Tendency	Interpretation
3	Common Difficulties in Summarizing	Students face linguistic and strategic challenges, including complex language, article length, paraphrasing difficulties, time constraints, and fear of plagiarism.	Agree (4)	Difficulties indicate a need for targeted instruction in paraphrasing and academic reading strategies.
4	Self-Perception and Practice	Students show moderate confidence and practice frequency in summarizing. They frequently seek feedback and strongly express the need for structured training.	Neutral–Agree (3–4)	Students are aware of their limitations and are motivated to improve through guided instruction.

Overall, the data shows that chemistry students use a variety of summarizing techniques, but these techniques are still mostly simple, and there is still little systematic use of formal article structures like IMRaD. According to ESP perspectives on genre awareness and discourse competence, this indicates that students are involved in the task but have not yet attained a level of synthesis typical of competent academic summarization.

The results also show that mastery of scientific vocabulary is a key factor in performance. Theoretical claims that lexical knowledge underpins effective academic reading and writing are supported by the fact that students with stronger lexical control paraphrase more accurately and succinctly while those with limited vocabulary translate and copy sentences.

Students also report ongoing difficulties, such as lengthy texts, intricate sentence structures, worries about plagiarism, and trouble telling main ideas from details. According to cognitive load theory, these difficulties are a result of increased processing demands that limit deeper understanding.

When combined, the findings demonstrate that summarizing scientific articles written in English is more than just a language exercise; it is a sophisticated academic literacy practice. In order to promote more analytical and synthesized summaries, English for Science instruction should specifically incorporate strategy training, methodical vocabulary development, and scaffolded support.

Qualitative Results

Qualitative data from semi-structured interviews support the quantitative findings. Most students reported difficulty paraphrasing complex sentences and maintaining scientific accuracy. Several participants admitted relying on translation and copying due to limited vocabulary knowledge. However, students also expressed that guided practice and explicit instruction in summarizing strategies helped improve their confidence.

Discussion

Regarding the first research question, the findings reveal that chemistry students still rely mainly on basic summarization strategies rather than producing synthesized summaries. Their summaries typically consist of identifying key points and making slight paraphrasing attempts, yet they continue to copy original sentences verbatim, showing limited genre awareness and weak integration skills. This pattern reflects the tendency observed in recent ESP research, which indicates that when students lack sufficient knowledge of academic summarization conventions, they reproduce text rather than restructure or synthesize it (Li, 2022; Yu & Kim, 2023). Taken together, these findings suggest that students have not yet fully mastered the skills required to independently construct coherent and concise summaries. In response to the second research question, the results show that students' mastery of scientific vocabulary plays a crucial role in their ability to summarize effectively. Learners with strong discipline-specific vocabulary demonstrated greater capability in paraphrasing scientific concepts accurately and condensing key information without changing the intended meaning.

Conversely, those with limited technical vocabulary faced considerable challenges in reformulating terminology and complex ideas, which hindered their summarization performance. These results align with recent research emphasizing that lexical proficiency in scientific terminology greatly influences students' summarizing competence in academic contexts (Hyland, 2022; Flowerdew, 2023). Thus, vocabulary knowledge can be considered a determining factor affecting the quality and accuracy of students' summaries. Addressing

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the third research question, the analysis identifies several major obstacles experienced by students when summarizing scientific texts.

They struggled with unfamiliar terminology, complex sentence structures typical of academic writing, and difficulty distinguishing central ideas from supporting details. These challenges demonstrate that students still face both linguistic and cognitive barriers, affecting comprehension and decision-making when selecting relevant information. Moreover, the difficulties identified mirror findings from prior research on science academic reading, which similarly reported that learners encounter barriers when working with specialized texts at the tertiary level (Grabe & Stoller, 2021; Widodo, 2022). Therefore, addressing these challenges requires targeted instructional support focusing on vocabulary development, genre awareness, and summarization strategies.

CONCLUSION

This study reveals that chemistry students employ a variety of summarizing strategies when summarizing English scientific articles, with the most frequently used strategies being identifying main ideas and partial paraphrasing, while sentence copying remains prevalent due to limited scientific vocabulary mastery. In relation to the second research objective, the findings indicate that scientific vocabulary knowledge plays a crucial role in determining the quality of students' summaries, as students with stronger vocabulary control are better able to paraphrase information and synthesize ideas accurately. Addressing the third objective, the study also identifies major challenges faced by students, particularly difficulties with technical terminology and complex syntactic structures commonly found in chemistry texts. Collectively, these findings suggest that summarizing skills in English for Science contexts require explicit and systematic instruction, including strategy-based summarizing practice, focused scientific vocabulary development, and guided engagement with authentic chemistry texts to enhance students' academic literacy and support their participation in global scientific discourse.

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