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# The Application of Content and Language Integrated Learning to Improve Students' Achievements in Academic Vocabularies and Scientific Writing

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**Abstract**

*This study aimed to improve students' achievement in academic vocabulary and scientific writing through the implementation of the Content and Language Integrated Learning (CLIL) approach and to identify the challenges encountered by students at SMA Terpadu Pondok Pesantren Nurul Huda during its implementation. CLIL was selected because it integrates content learning with language development, allowing students to acquire academic language while engaging in meaningful subject-related tasks. The study employed a Classroom Action Research (CAR) design consisting of two cycles involving planning, action, observation, and reflection. The participants were senior high school students with basic English communicative competence. Data were collected through tests, classroom observations, and interviews and analyzed using quantitative and qualitative approaches. The findings revealed a statistically significant improvement in students' academic vocabulary mastery and scientific writing skills following the CLIL intervention. Mean scores increased from 60.5 in the pre-test to 71.7 in the progress test and 80.3 in the post-test, while the paired-samples t-test showed a significant difference between pre-test and post-test results ($p < 0.05$). Students also demonstrated greater confidence in using domain-specific vocabulary, organizing ideas, and constructing coherent scientific abstracts. Nevertheless, they continued to experience difficulties in comprehending more complex texts from Scopus-indexed journals due to limited vocabulary range and insufficient academic reading skills. The findings suggest that CLIL can serve as an effective pedagogical approach for English teachers seeking to strengthen students' academic literacy through integrated language and content instruction. Overall, this study*

*contributes to EFL teaching by providing evidence that structured CLIL implementation can enhance academic vocabulary development and support students' early engagement with scientific writing practices.*

## 1. Introduction

Content and Language Integrated Learning (CLIL) has gained increasing attention as an educational approach that integrates language learning with subject content to promote simultaneous development of linguistic competence and academic knowledge (Coyle, 2007, 2008; Coyle et al., 2010; Wolff, 2009). Rather than treating language as an isolated subject, CLIL positions language as a medium for constructing disciplinary understanding, enabling students to acquire communication skills while engaging with meaningful academic content.

In the Indonesian context, CLIL remains in an early stage of implementation and has mainly been applied in bilingual or international school programs (Dzulkurnain et al., 2024; Rachmajanti & Anugerahwati, 2019). Nevertheless, previous studies indicate that CLIL has considerable potential to improve students' language proficiency, academic engagement, and critical thinking abilities (Breezee & Azparren Legarre, 2021; Turner & Fielding, 2021). Through the integration of content and language objectives, CLIL also supports the development of higher-order thinking and prepares learners for increasingly globalized educational environments.

Despite these opportunities, English instruction in many Indonesian secondary schools continues to focus predominantly on general language competencies, such as grammar exercises, tenses, and everyday communication. While such instruction may support students' Basic Interpersonal Communication Skills (BICS), it often provides limited opportunities to develop Cognitive Academic Language Proficiency (CALP), which is necessary for understanding academic texts and producing formal academic writing (Cummins, 1999, 2017).

This challenge was evident at SMA Terpadu Pondok Pesantren Nurul Huda Tanah Merah. Based on preliminary observations and initial assessments, students demonstrated difficulties in mastering academic vocabulary and producing scientific writing. Most students possessed only basic English vocabulary and had little exposure to structured academic writing instruction. As a result, they encountered barriers in comprehending and generating academic texts required for future educational demands.

To address this issue, this study implemented CLIL as a Classroom Action Research (CAR) intervention by integrating scientific writing as content and academic English as language instruction. Students engaged with academic texts and writing tasks designed to strengthen vocabulary knowledge, develop scientific writing skills, and encourage critical engagement with information.

The novelty of this study lies in its attempt to bridge the transition from BICS

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to CALP through the integration of scientific writing and academic vocabulary instruction within a CLIL framework in a non-bilingual Indonesian secondary school setting. While previous studies primarily explored CLIL implementation in bilingual contexts or focused generally on language outcomes, this study specifically investigates how CLIL can support academic language development and scientific writing competence among students with limited prior exposure to academic English.

Therefore, this study aims to investigate how the implementation of CLIL improves students' achievement in academic vocabulary and scientific writing at SMA Terpadu Pondok Pesantren Nurul Huda Tanah Merah. The researcher has formulated one research question to guide the study as follows: How can students' achievement in scientific writing and academic vocabulary be improved through Content and Language Integrated Learning (CLIL)?

## Literature Review

### *Content and Language Integrated Learning (CLIL)*

CLIL is a dual-focused educational approach that combines content learning with language development through the use of a target language as the medium of instruction (Coyle et al., 2010). Unlike traditional language teaching, CLIL promotes language acquisition within meaningful academic contexts, enabling students to learn language and content simultaneously.

Coyle's 4Cs Framework-Content, Communication, Cognition, and Culture-serves as the foundation of CLIL implementation. Content refers to subject knowledge, Communication emphasizes language use, Cognition develops thinking skills, and Culture encourages intercultural understanding. Together, these dimensions support comprehensive academic learning.

CLIL can be implemented through two models including Hard CLIL and Soft CLIL (Luis Banegas, 2018). Hard CLIL prioritizes subject content, whereas Soft CLIL emphasizes language learning integrated with content themes. Considering students' proficiency levels, this study adopted a Soft CLIL approach.

### *BICS and CALP in Academic Language Development*

Cummins (1981, 2017) differentiates language proficiency into Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP). BICS refers to conversational language used in everyday social interaction and is generally developed through contextual support. In contrast, CALP involves higher-order academic language skills needed for reading scholarly texts, using discipline-specific vocabulary, and producing academic writing.

Developing CALP requires intentional instructional support because conversational English alone does not sufficiently prepare students for academic tasks. Therefore, approaches such as CLIL may facilitate students' progression from social communication toward academic literacy.

***Teaching Academic Vocabulary and Scientific Writing through CLIL***

The application of CLIL to academic vocabulary and scientific writing emphasizes three instructional principles.

a. Integration of Language and Content

Students learn academic vocabulary while simultaneously engaging with scientific content and writing activities.

b. Scaffolded Learning

Teachers provide structured support through guided reading, vocabulary instruction, writing models, and feedback to facilitate comprehension and production.

c. Collaborative Learning

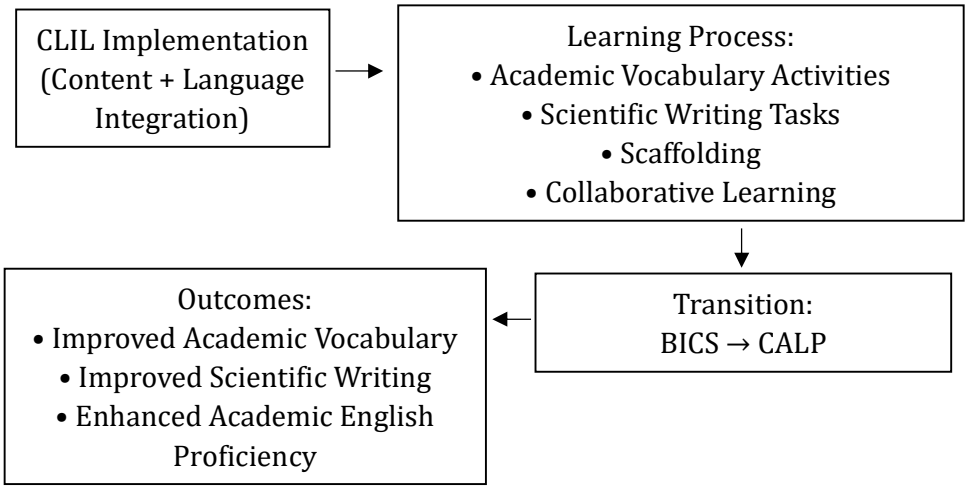
Group discussions and collaborative writing tasks encourage interaction and co-construction of academic understanding.

These principles enable students to gradually develop confidence and competence in academic English use.

***Conceptual Framework***

This study is grounded in the assumption that CLIL facilitates students' movement from basic communicative competence (BICS) toward academic language proficiency (CALP), resulting in improved academic vocabulary and scientific writing.

*Figure 1. Conceptual Framework*




This framework illustrates that CLIL serves as the instructional mechanism through which students develop academic language and writing competencies.

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## 2. Method

### Research Design

This study employed a Classroom Action Research (CAR) design to improve students' achievement in academic vocabulary and scientific writing through the implementation of Content and Language Integrated Learning (CLIL). The study adopted the cyclical model proposed by Stephen Kemmis & Robin McTaggart (2014), consisting of four stages: planning, action, observation, and reflection. Two action cycles were conducted to allow continuous refinement of instructional practices based on students' responses and learning outcomes.

CAR was selected because it enables teachers and researchers to systematically identify classroom problems, implement interventions, evaluate outcomes, and modify instructional strategies to achieve better educational practices.

### Participants and Research Setting

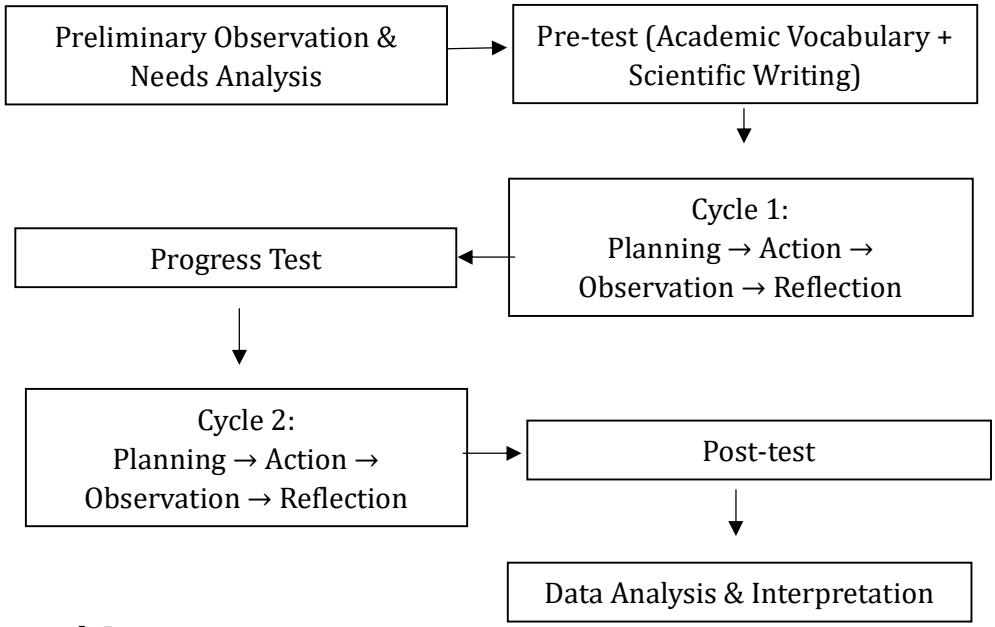
The participants consisted of 32 senior high school students at SMA Terpadu Pondok Pesantren Nurul Huda Tanah Merah. The school was selected purposively because of its relevance to the study's focus on academic vocabulary and scientific writing development.

Preliminary observations indicated that students had developed Basic Interpersonal Communication Skills (BICS) through daily English exposure in the boarding school environment. However, they demonstrated limited Cognitive Academic Language Proficiency (CALP), particularly in understanding academic texts and producing scientific writing.

### Research Procedure

The intervention was conducted across two cycles. Cycle 1 focused on introducing CLIL-based instruction and identifying students' initial strengths and challenges. Cycle 2 emphasized reinforcement, improvement, and refinement of instructional strategies based on reflections from Cycle 1.

*Figure 2. Research Flowchart*




**Research Instruments**

1. Academic Vocabulary Test

The academic vocabulary assessment was developed based on the Academic Word List (AWL) framework and adapted to students' English proficiency levels and scientific writing objectives. The test consisted of vocabulary recognition, contextual meaning identification, sentence completion, and academic word application tasks.

Content validity was established through expert judgment involving two English education lecturers and one experienced English teacher. Revisions were conducted based on their feedback regarding item relevance, language clarity, and difficulty level.

Instrument reliability was examined through pilot testing before implementation. Internal consistency was measured using Cronbach's Alpha, with a coefficient exceeding 0.70 indicating acceptable reliability.

2. Scientific Writing Assessment

Students completed guided scientific writing tasks requiring them to produce short scientific texts or abstracts based on selected topics. Scientific writing performance was evaluated using an analytic scoring rubric adapted from academic writing assessment frameworks.

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*Table 1. An Analytic Scoring Rubric*

| ***The rubric consisted of five dimensions*** | ***Percentage (%)*** |
|---|---|
| Content relevance | 20% |
| Organization and coherence | 20% |
| Academic vocabulary use | 20% |
| Grammar and language accuracy | 20% |
| Scientific writing conventions | 20% |

Each criterion was scored using a five-level scale ranging from 1 (very limited) to 5 (excellent). To improve scoring consistency, inter-rater agreement was established by involving an independent English teacher to assess selected samples.

3. Observation and Interview

Classroom observations were conducted using structured observation sheets to monitor student participation, interaction, vocabulary use, and engagement during CLIL activities. Semi-structured interviews were conducted with students, teachers, and school stakeholders after each cycle to obtain deeper insights into learning experiences and implementation challenges.

**Data Analysis**

A. Quantitative Analysis

Quantitative data from pre-tests, progress tests, and post-tests were analyzed descriptively and inferentially. Mean scores and standard deviations were calculated to identify performance changes. A paired-samples t-test was conducted to determine whether differences between pre-test and post-test scores were statistically significant.

B. Qualitative Analysis

Qualitative data were analyzed using thematic analysis adapted from Miles et al. (2014). The process consisted of;

1. Data reduction
   Interview transcripts and observation notes were transcribed and organized.
2. Coding
   Open coding was conducted to identify meaningful units from participants' responses. Examples of initial codes included difficulty understanding journal texts, improvement in vocabulary use, and increased confidence in writing.
3. Categorization and Theme Development
   Codes were grouped into broader categories such as language development, writing improvement, learning challenges, and student engagement.
4. Conclusion Drawing and Verification
   Patterns were interpreted and cross-checked across multiple data sources.

**Validity and Reliability**

The trustworthiness of the study followed Burns' (1999) action research

validity criteria, including democratic validity, outcome validity, process validity, catalytic validity, and dialogical validity. To strengthen reliability and credibility, three triangulation techniques were employed, consisting of time triangulation, investigator triangulation, and theoretical triangulation

**Ethical Considerations**

Ethical approval for conducting the study was obtained through formal permission from the school administration. Prior to data collection, participants and their guardians received information regarding the research objectives, procedures, confidentiality, and voluntary participation. Written informed consent was obtained from participants and school representatives. Students' identities were anonymized during data analysis and reporting to protect confidentiality.

## 3. Result

This section focuses on students' learning outcomes following the implementation of Content and Language Integrated Learning (CLIL). Detailed descriptions of instructional activities have been minimized because the intervention procedures have been presented in the Method section. Results are organized into quantitative and qualitative findings.

1. Quantitative Findings

1.1 Improvement in Academic Vocabulary

Students' academic vocabulary performance was measured through pre-test, progress test, and post-test assessments.

*Table 2. Improvement in Academic Vocabulary Achievement*

| Assessment | Mean Score | % Achieving ≥80 |
|---|---|---|
| Pre-test | 60.5 | 21.87% |
| Progress Test | 71.7 | 46.87% |
| Post-test | 80.3 | 71.88% |

The findings indicate continuous improvement in students' academic vocabulary mastery across the intervention cycles. The average score increased from 60.5 in the pre-test to 71.7 in the progress test and reached 80.3 in the post-test. Similarly, the percentage of students meeting the minimum mastery criterion increased substantially.

Observation notes and classroom records indicated that students gradually became more familiar with identifying and using academic words in context. Vocabulary acquisition improved particularly when students engaged with authentic academic texts and collaborative learning tasks. Representative student argued;

> *"At first, I only understood common English words, but later I started understanding words often used in journals and research."* (Student

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Interview, Cycle 2)

1.2 Improvement in Scientific Writing

Students' scientific writing ability was evaluated through abstract-writing tasks using the analytic rubric presented in the Method section.

*Table 3. Scientific Writing Improvement by Assessment Dimension*

| Dimension | Pre | Post |
|---|---|---|
| Content Development | 61 | 82 |
| Organization & Coherence | 59 | 80 |
| Academic Vocabulary Use | 58 | 84 |
| Grammar Accuracy | 62 | 75 |
| Scientific Writing Convention | 60 | 81 |

The results show improvement across all scientific writing dimensions. The greatest increase occurred in academic vocabulary use and organization of ideas. Students became more capable of structuring abstracts and applying formal academic language.

However, grammar accuracy remained the lowest-performing component, indicating that students still required additional support in sentence-level accuracy. Representative student suggested;

> *"Writing abstracts became easier because we learned which parts should come first and which vocabulary sounded academic."* (Student Interview, Cycle 2)

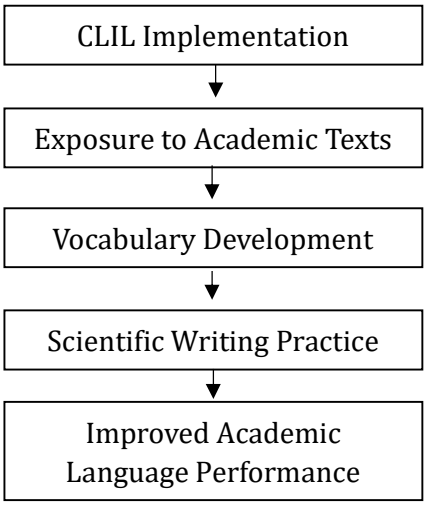
2. Qualitative Findings

Qualitative analysis was conducted through observations, interviews, and reflective notes. Data were coded and grouped into themes.

*Table 4. Summary of Qualitative Themes*

| Theme | Evidence |
|---|---|
| Increased Academic Vocabulary Awareness | Students recognized and applied more discipline-related words |
| Improved Scientific Writing Confidence | Students showed greater willingness to write abstracts |
| Enhanced Engagement Through CLIL | Students participated actively in discussions |
| Continued Difficulty with Complex Academic Texts | Students struggled with Scopus-level materials |

*Figure 3. Summary of Qualitative Findings*




Interview data revealed that students initially perceived academic English as difficult but later became more confident. The teacher stated;

> *"Students usually perform well in daily communication, but scientific writing was completely new for them. During the second cycle, they started using more formal expressions."* (Teacher Interview)

And a student claimed;

> *"Reading journal articles was difficult in the beginning, but group discussion helped me understand the meaning."* (Student Interview)

Nevertheless, challenges remained. Several students reported difficulty understanding research gap, novelty, and highly academic vocabulary. A representative emphasized;

> *"Scopus articles were harder because there were too many unfamiliar words."* (Student Interview)

3. Statistical Analysis
   3.1 Normality Test

*Table 5. Normality Test*

| Variable | Kolmogorov–Smirnov Sig. | Shapiro–Wilk Sig. |
|---|---|---|
| Pre-test | .200 | .743 |
| Post-test | .125 | .370 |

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Since all significance values exceeded 0.05, normal distribution assumptions were satisfied.

3.2 Paired-Samples T-Test

*Table 6. Paired-Samples T-Test*

| Comparison | Mean Difference | t | df | Sig. |
|---|---|---|---|---|
| Pre-test–Post-test | -20.28 | -76.09 | 31 | .000 |

The paired-samples t-test showed a statistically significant difference between pre-test and post-test scores ($p < 0.05$), indicating that CLIL contributed significantly to students' improvement.

3.3 Effect Size

To complement statistical significance testing, effect size analysis using *Cohen's d* was conducted.

*Cohen's d = Mean Difference ÷ Standard Deviation*
*= 20.28 ÷ 1.51*
*= 13.43*

*Table 7. Effect Size Interpretation*

| Statistic | Value |
|---|---|
| Cohen's d | 13.43 |
| Interpretation | Extremely Large Effect |

The effect size demonstrates that the intervention had a very strong practical impact on students' achievement. This suggests that CLIL contributed not only to statistically significant gains but also to meaningful educational improvement.

4. Integrated Findings

When quantitative and qualitative findings were considered together, the results suggest that CLIL supported the development of both academic vocabulary and scientific writing. Students demonstrated measurable score improvement and reported greater confidence in engaging with academic English.

However, difficulties persisted in processing more advanced journal texts and maintaining grammatical accuracy. These findings indicate that sustained scaffolding and continued exposure to academic language remain necessary for long-term academic language development.

## 4. Discussion

The findings of this study suggest that Content and Language Integrated Learning (CLIL) can function as an effective pedagogical approach to support the

development of academic vocabulary and scientific writing among senior high school students at SMA Terpadu Pondok Pesantren Nurul Huda. Through the integration of content learning and English language instruction, students engaged with academic language in meaningful contexts and gradually developed greater confidence in using academic discourse. These findings align with Coyle et al. (2010), who emphasize that the effectiveness of CLIL lies in the interaction among content, communication, cognition, and culture to support deeper learning.

The improvement observed in students' academic vocabulary and scientific writing supports previous international findings regarding the effectiveness of CLIL in promoting academic language development. Research conducted in European and Latin American contexts has consistently shown that CLIL contributes positively to vocabulary acquisition, disciplinary literacy, and academic performance (Breezee & Azparren Legarre, 2021; Luis Banegas, 2018; Nikula, 2015). Similarly, studies by Arnó-Macià & Mancho-Barés (2015) found that students exposed to CLIL demonstrated stronger academic language production because language learning occurred within authentic disciplinary contexts rather than isolated grammar instruction. The present study extends these findings into the Indonesian secondary school context, particularly within a non-bilingual and Islamic boarding school environment where exposure to academic English remains limited.

From a theoretical perspective, the findings also support Cummins' (2017) distinction between Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP). Students entered the intervention with relatively developed interpersonal communication abilities but experienced difficulty when required to engage with academic reading and scientific writing tasks. Through structured CLIL activities, students gradually moved beyond conversational English toward more cognitively demanding language use involving abstract reasoning, disciplinary vocabulary, and formal written expression.

One of the important findings concerns students' continuing difficulties when engaging with Scopus-indexed journal articles despite overall improvement. This challenge cannot be explained solely by limited vocabulary knowledge. Instead, several interconnected factors appeared to influence students' comprehension. First, Scopus-indexed articles typically contain high lexical density and nominalization, meaning that a large amount of information is compressed into complex academic structures. Second, students were unfamiliar with rhetorical conventions commonly found in international academic writing, including research gap identification, novelty statements, methodological justification, and evidence-based argumentation. Third, students demonstrated limited academic reading strategies such as inferencing, synthesizing information across paragraphs, and monitoring comprehension. Finally, students had minimal prior exposure to authentic scholarly texts, making the cognitive load substantially higher. These

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findings support Dalton-Puffer's (2007) argument that academic literacy development requires sustained and progressive exposure rather than short-term intervention.

Another significant contribution of this study is its implication for ordinary Indonesian secondary schools. Unlike many previous CLIL studies conducted in bilingual or international settings, this research demonstrates that CLIL may also be feasible in schools with limited resources and without formal bilingual programs. The implementation in this study relied on adapting existing English lessons rather than introducing new subjects. Teachers integrated academic themes into language instruction, selected accessible academic texts, used structured scaffolding, and gradually introduced students to scientific writing conventions. This suggests that CLIL implementation in Indonesian schools does not necessarily require advanced infrastructure or full curriculum redesign. Instead, gradual integration of content-based tasks into existing English instruction may serve as a practical starting point.

These findings also provide implications for curriculum development and classroom practice. For curriculum developers, greater attention should be given to strengthening academic literacy outcomes in secondary English curricula. Current instruction often prioritizes general communication skills while providing limited opportunities to engage with academic texts and disciplinary language. Integrating academic vocabulary instruction and guided scientific writing activities may better prepare students for higher education demands.

For English teachers, the findings indicate the importance of combining language instruction with meaningful content and structured support. Teachers may begin by selecting topics relevant to students' interests, introducing explicit academic vocabulary instruction, using scaffolded reading activities, and gradually increasing text complexity. Collaborative learning strategies and guided writing activities may further support students' transition toward academic English proficiency.

Although the findings demonstrate positive outcomes, several limitations should be acknowledged. The study involved a relatively small number of participants and was conducted over only two action cycles. Because academic writing development is typically gradual, longer intervention periods may produce more comprehensive changes. In addition, the present study relied primarily on classroom-based scaffolding without extensive technological integration.

Future studies are encouraged to involve larger and more diverse samples across different school contexts to improve generalizability. Longer intervention periods may also provide stronger evidence regarding the sustainability of academic language gains. Furthermore, future research may explore technology-supported CLIL approaches through digital reading platforms, vocabulary applications, artificial intelligence tools, or collaborative online writing environments to determine whether technology can further strengthen students'

academic vocabulary acquisition and scientific writing development.

Overall, this study contributes to the growing body of CLIL research by demonstrating that integrating language and content instruction can support students' transition from everyday English communication toward academic literacy, even within ordinary Indonesian secondary school settings.

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