STEM-ESL Integration through a CSR Module in Malaysian Secondary Education

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ABSTRACT

This study explores the implementation of an integrated module that bridges scientific literacy and language competence, developed through a corporate social responsibility (CSR) initiative at a local boarding school. The module, which combines hands-on experiments and engaging and language-based tasks, was used as the intervention. 80 Form 2 students took part in a sequence of STEM demonstrations (Newton's law, acid and base, and simple circuits), followed by language-focused activities designed to reinforce STEM vocabulary and promote their creative use through a structured story-plot expansion in short-story writing. A self-rating pictogram-based self-reported checklist comprising 68 words relating to STEM concepts and thematic vocabulary was used to assess students' vocabulary knowledge before and after the intervention. For triangulation purposes, data were also derived from four language instructors' observation checklists and students' feedback forms. Results revealed considerable vocabulary gains, with students reporting improved recognition and confidence in using STEM vocabulary, enjoyment, and perceived relevance of the activities following the intervention. Instructor observations highlighted active participation, strong engagement, and the feasibility of a wider use of the integrated STEM-ESL lessons with some adjustment. The quantitative and qualitative data triangulation supports the effectiveness of the module in promoting conceptual understanding and language development. This study contributes to interdisciplinary learning research by presenting a CSR-driven pedagogical innovation integrating STEM literacy and ESL writing competence.

Keywords: STEM-ESL interdisciplinary learning, CLIL, creative writing, CSR in education, Malaysian secondary education

INTRODUCTION

Proficiency in Science, Technology, Engineering, and Mathematics (STEM) and English as a Second Language (ESL) has become crucial for global competitiveness. The ability to think scientifically and communicate effectively in English is recognised as a critical 21st-century competency. Many countries are investing significantly to strengthen education to produce students who master scientific concepts and communicate them successfully in English. In Malaysia, where English is taught as a second language and STEM subjects are delivered predominantly in Bahasa Melayu and English in Dual Language Programme (DLP) schools, meeting the demand for this competency presents significant challenges. Even though there are efforts to strengthen STEM education, many secondary school students still struggle with the specialised vocabulary required to comprehend and express STEM concepts when the language of instruction is not the native language (Macaro et al., 2018). Othman's (2024) study similarly highlighted that students learning science subjects in English face difficulties "due to unfamiliar scientific terminology, abstract concepts, and

limited prior exposure to the subject matter." This is especially so as the students are still developing their general English proficiency.

There is a growing need in Malaysia for new and innovative pedagogical models that connect STEM and ESL in ways that are both meaningful and intriguing. Nevertheless, well-designed, replicable integrated models are scarce. Moreover, the efforts focus mainly on improving English proficiency through literature and general writing activities and developing STEM knowledge through experiments, with limited overlap between the two domains. The absence of structured STEM-ESL integration prevents the opportunities for students to develop both scientific literacy and expressive writing skills through intriguing hands-on and engaging activities. This is reiterated from 2013 studies by the Ministry of Education (MOE), which indicate that teaching and learning of STEM subjects are mostly teacher-centred, depriving students of the opportunities to be critical, creative, and innovative.

The project 'From Imagination to Inspiration: Bridging STEM Concepts to ESL Creative Writing' was designed to address this gap. It was conducted among Form 2 students in a secondary boarding school in Putrajaya, Malaysia. The key STEM concepts and vocabulary in English were introduced, and then students were guided to apply the knowledge creatively in short-story writing. By integrating STEM enrichment with narrative expressions, the initiative sought to enhance students' STEM-related vocabulary, improve their English writing skills, and increase their engagement and motivation through innovative, cross-disciplinary activities.

This paper reports on the development and implementation of the project and explores the following research questions:

1. To what extent does the STEM-ESL integration module improve students' STEM-related vocabulary knowledge as measured by a pictogram-based self-rating checklist?

2. What are the instructors' observations of students' engagement, participation, and language use during the implementation of the STEM-ESL integration module?

3. What aspects of the STEM-ESL integration module do students find the most valuable?

This project is supported through a CSR initiative to demonstrate a replicable model to foster scientific literacy while contributing to Malaysia's ongoing efforts to strengthen both STEM and English proficiency. It is also an educational innovation with potential global relevance.

LITERATURE REVIEW

This review synthesises research on (1) STEM in language education through integrated approaches, (2) vocabulary development and creative writing, (3) STEM–ESL integration, and (4) corporate social responsibility (CSR) in education. Together, these strands highlight the need for tested integration modules that combine hands-on STEM activities with ESL writing.

STEM in Language Education: CLIL and Integrated Approaches

Content and Language Integrated Learning (CLIL) provide a framework for merging subject content with language instruction (Arús-Hita & Bárcena, 2024). CLIL advocates for the purposeful use of the target language, ensuring that disciplinary knowledge and linguistic competence reinforce each other. In line with this, Pazilah et al. (2025) pointed out that STEM students often lack specialised vocabulary, academic writing skills, and oral proficiency, expressing a need for targeted support and interactive, contextualised learning experiences. Similarly, Balqis (2018) contended that vocabulary is an essential component in second or foreign language learning, and STEM learners who lack sufficient vocabulary struggle to express concepts fluently or understand English texts. Halik and Jayasundara (2021) further observed that such deficiencies reduce learners' effectiveness in both oral and written communication. Meanwhile, Therova (2022) noted that written tasks remain a primary mode of assessment, making writing support vital for STEM students' academic success.

Creative Writing, Storytelling, and Vocabulary Development

Recent research reinforces creative writing and storytelling as a powerful means for vocabulary acquisition in ESL contexts. Jan and Aziz (2022) established that incorporating short stories into writing instruction enhanced students' creative expression and expanded their vocabulary, while Lim and Noor (2019) likewise showed that digital storytelling improved secondary school learners' writing skills by situating new vocabulary in meaningful contexts. Extending these insights to STEM education, Fitri et al. (2022) emphasised that digital storytelling tasks fostered motivation, idea generation, and peer collaboration, thereby supporting the acquisition of a specialised vocabulary essential for engaging with scientific and technical content.

In a related study, Karim and Mustapha (2020) found that creative tools such as digital mind maps stimulated critical and creative thinking in ESL writing courses, thereby indirectly strengthening vocabulary learning. Seng et al. (2020), who share the same notion, concluded that integrating the 21st-century learning skills, such as creativity, collaboration, and critical thinking, into ESL classrooms enhances students' linguistic and cognitive growth. Together, these findings posit that narrative-based pedagogies, whether through short stories, digital storytelling, or creative mapping, are not only effective for general ESL learning but are also crucial for preparing STEM students to access and communicate disciplinary knowledge through enriched vocabulary.

STEM–ESL Integration: Emerging but Limited Evidence

Despite the clear theoretical alignment between CLIL and STEM language learning, empirical work on integrated STEM-ESL modules remains limited. This limitation was also highlighted by Pazilah et al. (2025), who reported that STEM students' lack of specialised vocabulary, academic writing skills, and oral proficiency pointed to the importance of language support tailored to disciplinary contexts. To complement this, Warr and West (2023) emphasised that targeted writing instruction in STEM would improve academic performance and foster critical thinking when embedded in inquiry-based learning.

However, studies on technology-mediated integration provide broader perspectives. For example, Yang and Baldwin (2020) postulated that web-based inquiry environments within STEM frameworks can promote English practice through collaborative problem-solving. By the same token, Khanal (2023) and Wagle et al. (2024) stressed the value of contextualised language learning, where English use is embedded in authentic STEM tasks such as lab reports, simulations, and project presentations. Taken together, these studies suggest real promise for integrated approaches, but they also reveal the scarcity of robust, replicable models that explicitly link hands-on STEM activities with English language outcomes, particularly in Malaysian lower-secondary contexts, where such innovations are most needed.

Collaborative initiatives have been recognised as valuable enablers for educational innovation, particularly when schools partner with external organisations. These enhance resources and expertise, where structured collaboration can directly strengthen classroom learning. Among others, Owens and Hite (2022) documented that global collaboration projects in STEM settings enhance students' communication competencies and offer real-world opportunities to apply English in technical contexts. This report shows how partnerships through instructional collaboration models and industry-linked projects can support interdisciplinary efforts like STEM–ESL integration by providing authentic contexts and additional resources for language development.

The reviewed literature points to several converging insights. CLIL and integrated approaches indicate that content and language learning can reinforce each other, with studies showing the value of embedding English into STEM-related contexts (Pazilah et al., 2025; Warr & West, 2023). Creative writing and storytelling research has also accentuated their roles in enhancing vocabulary and creativity. Jan and Aziz (2022) stated that short stories support writing development, while Lim and Noor (2019) and Fitri et al. (2022) asserted that digital storytelling fosters vocabulary growth, motivation, and collaboration. However, limited studies have combined these strands into a tested, replicable module that combines hands-on STEM exploration, targeted STEM vocabulary instruction, and creative writing tasks, particularly within the Malaysian ESL context. Moreover, although collaboration and partnership models are often discussed as enabling factors, empirical evidence of their roles in sustaining integrated STEM–ESL innovations remains scarce (Owens & Hite, 2022). Therefore, in response to this scarcity, the replicable STEM-ESL module in the current study is potentially the

first that directly links hands-on STEM activities with the acquisition of related thematic vocabulary in English. The present project addresses this gap by designing and evaluating a STEM–ESL integration module that introduces STEM concepts and vocabulary in English and then challenges students to embed these elements into original short stories. Supported through collaborative partnerships, the project seeks to provide evidence of how such a module can enhance vocabulary acquisition and student engagement.

METHODOLOGY

Research Design

This study employed a mixed-methods pre-post design combining quantitative (pictogram-based self-rated vocabulary checklist, instructor Likert items) and qualitative (open-ended evaluation and comments in short structured feedback from the four instructors and participants) data to evaluate the STEM-ESL integrated module. These allow triangulation across student self-report, instructor observation, and student feedback to infer the effects of the module, used as the intervention, on the students' understanding of STEM concepts and thematic vocabulary, as well as classroom engagement. Creswell and Plano Clark (2018) asserted that combining numeric evidence and descriptive accounts ensures a comprehensive understanding of the module's impact on language learning and engagement.

Participants and Sampling

This study involved a total of 80 Form 2 students from a public boarding secondary school in Malaysia and integrated a CSR-funded module through a 5-hour STEM-ESL Creative Writing workshop. The selection of the participants considered a single cohort that learns most subjects (including STEM) predominantly in Bahasa Melayu, as in the case of most schools in the country, using a convenience sampling technique, as they were accessible within the CSR programme. The 80 sample size was deemed adequate for statistical analysis based on prior CLIL and STEM-ESL intervention studies that highlighted medium to large effect sizes for vocabulary acquisition (Sun et al. 2025), while acknowledging the limitations of convenience sampling and potential sampling bias. Four language instructors (n = 4) delivered the module and completed the structured observation checklists for triangulation purposes.

The STEM-ESL Integration Module (Intervention)

The module comprises two phases. The first phase of the module integrates three hands-on STEM demonstrations (Newton's law of motion, acid-base reactions, and simple electrical circuits) with language-based activities that foster STEM concept comprehension and vocabulary enhancement. The second phase of the module consisted of language-focused lessons that involved the application of STEM concepts and consolidation of their thematic vocabulary. The dual-phase design is grounded in Content and Language Integrated Learning (CLIL) principles (Coyle et al., 2010), allowing students to engage with STEM content while enabling them to acquire thematic vocabulary and engage in meaningful language use. In other words, the design leverages the content, communication, cognition, and culture, contextualising English learning within the authentic STEM content for a deeper understanding of the concepts and narrative competence (Mehisto et al., 2008).

Pedagogical scaffolding included multimodal supports with pictograms, visual aids, and structured writing templates to reduce cognitive load and promote semantic processing (Nation, 2013). Formative assessment was ongoing through pictogram self-ratings and instructor observations, aligning with CLIL's emphasis on responsive feedback and adaptive learning (War & West, 2023). Collaboration between STEM content and language instructors fostered interdisciplinary curriculum alignment and effective delivery (Owens & Hite, 2022).

Instruments

A self-rating vocabulary checklist with pictograms was used to assess students' recognition and understanding of STEM terms, administered before and after the intervention. The scoring scale ranges from 0 (unknown), 1

(recognise), 2 (can explain briefly), and 3 (can explain and use in a sentence) for research question 1. For triangulation purposes and additional data retrieval, the instructor observation checklist, completed by four language instructors, comprised 17 items (with open-ended spaces for qualitative notes) that covered the dimensions of student engagement, STEM-language integration, creativity, and collaboration, and qualitative notes for research question two. Student feedback was collected to gauge their perspectives on the aspect(s) of learning experiences they found most valuable (research question 3).

Data Collection and Analysis

Data collection was carried out in three stages: the pre-test STEM concepts and thematic vocabulary checklist, intervention delivery with demonstrations of STEM experiments and language activities, and post-test vocabulary checklist and student feedback. The four language instructors also completed their observation checklists and reflective comments. The quantitative data were analysed for descriptive statistics to summarise vocabulary scores, which included means, standard deviations (SDs), and Cohen's *d*. A paired-samples *t*-test assesses the pre-post vocabulary gains, while effect size (Cohen's *d*) quantifies the magnitude of improvement. The instructor and student open responses were coded thematically (Braun & Clarke, 2006) for engagement, challenges, creativity, and feasibility, as well as valuable learning aspects. The data were anonymised, stored securely, and used solely for research purposes. The school administration and the participants also granted their permissions.

Limitations of this study include the use of convenience sampling that reduces generalisability and potential instructor bias in the observation checklists. Therefore, data triangulation from multiple sources is ensured to control bias. Meanwhile, randomised, controlled designs with larger samples and longitudinal follow-ups should be considered for future studies.

Results

Impact of STEM-ESL Module on Students' Vocabulary Scores

This section details the analysis of the pre- and post-intervention vocabulary scores, followed by instructors' observational data on participation and language application, as well as student feedback. The scores from the pictogram-based self-rating checklist were analysed and presented as tables.

Table 1 shows that students' STEM thematic vocabulary knowledge improved significantly after participating in the STEM-ESL creative writing module. The pre-intervention mean score was 1.94 (SD = 0.45), which increased to 2.75 (SD = 0.46) post-intervention. The paired-samples *t*-test confirmed the statistically significant improvement, $t(df) = 35.12$ (79) and $p < 0.001$, with a significantly notable effect size (Cohen's $d = 3.86$).

Table 1. Descriptive Statistics for Students' STEM Thematic Vocabulary Knowledge Scores Before and After the Integrated Module

Measure	STEM Concepts and Thematic Vocabulary Knowledge
Pre-Intervention, *M*	1.94
Pre-Intervention, *M*	2.75
Pre-Intervention, *SD*	0.45
Pre-Intervention, *SD*	0.46

t (df)	35.12 (79)
p-value	< 0.001
Cohen's *d*	3.86

Note. M = mean; SD = standard deviation; *t* = paired samples t statistics; df = degrees of freedom; *p* = significant level; Cohen's *d* = effect size.

The data indicate significant improvement in their familiarity, understanding, and correct usage of the vocabulary after the intervention, confirming the effectiveness of the STEM-ESL creative module in effectively boosting students' vocabulary knowledge. The statistically significant and notable increment in STEM vocabulary gains underscores the module's success in fostering STEM-ESL integration in a creative writing context. The integration of STEM experiments and language-focused activities helped to improve students' mastery of related vocabulary, as captured by the pictogram-based self-rating checklist that provided an accessible and effective measure for this development.

Instructors' Observations

Table 2 displays the instructors' responses regarding students' engagement, participation, and language use after the implementation of the STEM-ESL integrated module. They were retrieved using the Likert-scale ratings (1 = low; 5 = high), which comprehensively captured the above-stated dimensions. High mean scores (>4.4) and high percentages of the rating of 4 or 5 (>75%) across all items revealed positive observations. Attentiveness and motivation (M=4.75; 93% rating 4 or 5), understanding of STEM concepts and thematic vocabulary (M=4.75; 93%), as well as collaboration and peer support (M=4.70; 91%). Meanwhile, active participation in vocabulary-building and application of STEM concepts and thematic vocabulary in writing were also rated highly, with both scored at M=4.63, and at least 89% of the high rating of 4 or 5. Enthusiasm in creative writing, use of instructional materials, and practical sequence of activities received positive but with lower ratings, suggesting the instructors' general satisfaction with the aspects. Time allocation for tasks received the lowest mean rating of M=4.10 and 70% of the high ratings, indicating that they faced challenges with time and pacing of the activities. It is important to note that the instructors strongly supported the module's feasibility for wider classroom use (M=4.60, 90%).

Table 2. *Language Instructors' Ratings of the STEM-ESL Module*

Aspect	Mean Rating	% Rating 4 or 5
Attentiveness and motivation	4.75	93%
Active participation in vocabulary-building	4.63	89%
Enthusiasm in creative writing	4.50	85%
Understanding of STEM concepts	4.75	93%
Application of STEM thematic vocabulary in writing	4.63	89%
Collaboration and peer support	4.70	91%
Effective use of instructional material	4.55	88%
Practical sequence of activities	4.40	83%
Time allocation for tasks	4.10	75%

Feasibility for wider classroom use	4.60	90%

In addition to the quantitative measure, the thematic qualitative analysis was also done to investigate instructors' opinions and comments on the same aspects after the implementation of the STEM-ESL integration module. The results presented in Table 3 highlight four main themes.

Table 3. *Themes from Language Instructors' Open-Ended Feedback on the STEM-ESL Module*

Theme	Summary
Engagement	Students were highly motivated and attentive, showing eagerness and positive learning attitudes.
Challenges	Some variation in proficiency levels led to uneven participation, while time constraints affected writing depth.
Creativity	Students applied STEM thematic vocabulary creatively in short stories and supported peer collaboration.
Feasibility	The module is practical and well-supported by instructional materials and can potentially be widely implemented with some adjustments made to time allocation.

Instructors' observations corroborate quantitative evidence by highlighting high engagement and enthusiasm, active participation in vocabulary-building and story-writing tasks, as well as effective application of STEM concepts and their thematic vocabulary. Engagement emerged as the most agreed-upon theme, with instructors noting students' high motivation, attentiveness, and positive learning attitudes throughout the workshop. Challenges were also identified, which include varied language proficiency that resulted in uneven participation, apart from time constraints that limited the depth of writing activities. Meanwhile, creativity was observed as students applied STEM concepts and thematic vocabulary in their short stories, with peer collaboration as a significant supportive aspect. All the instructors also confirmed the feasibility of the module, noting that it was practical, well-supported by instructional materials, and with potential for wider implementation.

A thematic analysis of the students' open-ended feedback regarding the module was also carried out. Data highlighted seven main themes students perceived as the most valuable aspects in the STEM-ESL module for their language development and understanding of STEM concepts.

Table 4. *Themes from Students' Open-Ended Feedback on the Most Valuable Aspects in the STEM-ESL Module.*

Theme / Description	**Representative quotations**	**N (responses) %**
Collaborative learning/ teamwork	*"The part where my friends and I discussed and gave ideas to one another."*	31
Creative writing/ story writing	*"Learning how to produce a short story and learning about STEM concepts and using them for writing."*	29

Conceptual understanding (STEM concepts)	*"The STEM experiment demonstrations are interesting and help me learn new words."*	23
STEM experiments/ Hands-on learning	*"Doing the science experiments; the experiments were fun."*	18
Vocabulary development/Use of STEM words	*"Writing the short story in English using STEM concepts and vocabulary."*	15
Enjoyment/ Engagement	*"The interesting teaching methods that make me focused."*	11
Confidence/ Participation	*"Become confident to share my ideas in English."*	7
Instructional support	*"The explanation given was useful and made it fun."*	5

Note. Some responses mentioned more than one theme; hence the percentages do not total 100.

Firstly, most students frequently mentioned collaborative learning and teamwork (31%) as the most valuable aspect of the STEM-ESL module, which emphasises their importance and students' confidence in using STEM vocabulary during sentence construction and short-story writing. Students reported that collaboration produced ideas and support for language development, enabling them to learn STEM vocabulary and use it in generating writing ideas, which is the key objective of this module and CLIL-inspired pedagogy. Secondly, language development through short stories (29%), using STEM vocabulary and concepts, was also regarded as an engaging activity that enhances their vocabulary retention and narrative skills. Many students appreciated this structure, stating that they enjoyed "learning to write a short story using STEM words" (S28) and "writing a short story in English using STEM concepts" (S45). Thirdly, conceptual understanding through STEM experiments (23%) was also mentioned as a valuable aspect by the students. Next, students valued the STEM experiments and hands-on learning (18%). Their interest and deepened grasp of STEM concepts and thematic vocabulary were highlighted in some students' feedback, which stated that "*the STEM experiment demonstrations are interesting and help me learn the words*" and "*doing the science experiments*" as reflected by S22 and S70, respectively. STEM vocabulary development and its uses were also reported as the valuable aspect of the module, with 15% of students mentioning so. Students also stated that the module helped them increase their confidence and participation (7%). "*I am more confident to share my ideas with my friends in English*" (S34) reflects this. They also found the integrated STEM and ESL activities enjoyable, engaging, and stimulating experiences (11%), as reported by S67 and S29, who respectively wrote, "All *activities… are interesting and give ideas on writing short stories"* and "*The science experiments are fun.*" The instructors' supportive role (5%) was also mentioned as a valuable part of the integrated module. Students remarked on "*supportive facilitators*" (S51) and "*explanation from the instructor helped me a lot*" (S73) as crucial for clarifying STEM concepts and supporting language use necessary for sustaining their engagement and comprehension.

DISCUSSION OF KEY FINDINGS

Vocabulary Development (RQ1)

The most prominent finding of this study was the significant gain following the STEM-ESL integration module in students' vocabulary development. The improved pictorial-based self-rating checklist mean scores from 1.94 to 2.75 with a statistically significant t (df) = 35.12 (79), p = <0.001, revealed clear vocabulary gains from a total of 68 targeted STEM words. The large size effect based on Cohen's d = 3.86 underscores the pedagogical strength of the module. The shift from "I don't know this word" (0) and "heard but not sure" (1) to "know the word" (2) and "can use in a sentence" (3) suggests that the integrated module combining STEM

experiments and language tasks provided meaningful contexts for students to improve recognition and strengthen productive vocabulary knowledge. These results are consistent with CLIL-orientated research by Coyle et al. (2010), which reports on the effectiveness of combining language tasks within subject learning to scaffold vocabulary acquisition. The findings also directly address the critical needs highlighted by Pazilah et al. (2025), who reported that STEM students often lacked the specialised vocabulary necessary for academic success.

Instructor Observations (RQ2)

The instructors' ratings and qualitative feedback aligned well with the vocabulary gains, reinforcing the integrated module as an effective intervention. High scores yielded for attentiveness, motivation, and vocabulary use showed the module's effectiveness in engaging learners in both STEM experiments and language tasks. The instructors reported that students were able to answer questions using the thematic vocabulary correctly and actively use STEM-related words in tasks that included meaning-matching practices, sentence construction, and short-story writing. These demonstrated the transfer of learning from the experimental tasks and language-focused activities to language applications. However, the instructors also noted uneven participation among students due to different proficiency levels. The instructors also identified limited time as a significant drawback in implementing this integrated module. This problem is similar to the challenge reported by Mehisto (2012) for the CLIL implementation, particularly in pacing and unequal learners' participation that lowered full engagement in language learning. Above all, the language instructors unanimously suggested the strong feasibility and replicability of the integrated module for wider classroom use with minor adjustments in the timing and pacing of the activities.

Students' Feedback on the Most Valuable Gains from the STEM-ESL Integrated Module (RQ3)

Seven key elements identified in the students' feedback aligned closely with the successful pedagogical strategies identified in the literature review. The most valued aspects were learning and teamwork, which is parallel to the findings by Fitri et al. (2022), who reported that digital storytelling tasks fostered peer collaboration and motivation. In this study, students reported that they gained confidence through group language-based activities, discussion, and short story writing. Creative short-story writing was also identified as an enjoyable and effective way to practise vocabulary, while learning STEM concepts through hands-on experiments was reported to be effective in remembering and applying the vocabulary. Students also valued vocabulary development through the application of the STEM concepts and thematic vocabulary embedded in the module to the short-story task. These resonate well with Jan and Aziz (2022), who highlighted the importance of incorporating short stories to improve vocabulary and creative expression, as well as Lim and Noor (2019), who demonstrated that storytelling enhanced writing skills by embedding vocabulary learning into a meaningful context. Other themes such as enjoyment, confidence, and instructional support together revealed an affectively positive learning environment, where students related fun and variety with increased focus and motivation.

Limitations and Recommendations for Future Research

As this module was carried out as part of the CSR initiative, it involved a limited timeframe, which directly posed several limitations. Firstly, although the use of a pictogram-based self-report STEM-related vocabulary checklist is practical, it could be supplemented with objective measures such as pre-and post-tests of vocabulary usage in writing to address the concern for academic writing skills. Secondly, the lack of a control group suggests the necessity for a quasi-experimental design for more enriched findings and causal claims. Thirdly, possible practical challenges resulting from students' varying proficiency levels should also be addressed by making necessary pedagogical adjustment to strengthen the module's feasibility. Therefore, future studies should look into long-term retention of vocabulary gains and explore the module's efficacy using students from different demographic contexts. A more thorough investigation into language instructors' perspectives on the STEM-ESL integrated module would also be invaluable.

CONCLUSION

This study, which focuses on selected STEM concepts and thematic vocabulary in English, contributes to the body of literature in STEM and ESL integration through a CSR-driven module that provides scaffolding for vocabulary enhancement, STEM literacy, and narrative writing skills among lower secondary students in Malaysia. Despite being limited by the lack of a control group, this work provides a replicable framework for a cross-disciplinary teaching approach to fulfil the ever-changing needs in the nation's educational context. Future research should use longitudinal tracking, controlled designs, and cross-school replication to further validate the integration module.

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