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Improving The Eight Grade Students' Writing Skill Through STEM-Integrated in Project-Based Learning at Junior High School

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A B S T R A C T

This study investigated the effectiveness of STEM-integrated Project-Based Learning (PjBL) in improving the writing skills of eighth-grade EFL students at SMP Labschool UNTAD Palu. Writing remains a persistent challenge for junior high school EFL learners, particularly in terms of content development, organizational coherence, and vocabulary application. Although Project-Based Learning has been widely shown to support EFL writing development, few studies have specifically examined the integration of Science, Technology, Engineering, and Mathematics (STEM) content within procedural text writing at the junior high school level. The Emancipated Curriculum (Kurikulum Merdeka) encourages contextual, interdisciplinary, and project-driven approaches to language learning, yet empirical evidence on STEM integration within procedural text writing instruction at the junior high school level remains limited. A pre-experimental design with a one-group pretest-posttest method was employed. Twenty students from Class VIII A were selected through purposive sampling and received six sessions of STEM-integrated PjBL treatment centered on a bridge-building project using ice cream sticks. Writing performance was assessed using an analytic rubric adapted from Jacobs (1981), encompassing content, organization, vocabulary, grammar, and mechanics. The pre-test yielded a mean score of 61.13, while the post-test produced a mean score of 76.25, representing a mean deviation of 15.13 points. Statistical analysis using a paired t-test returned a t-counted value of 14.14, which exceeded the t-table value of 1.729 (df = 19; α = 0.05), confirming that the improvement was statistically significant. The findings suggest that integrating STEM content through project-based activities provides authentic and meaningful contexts that support students' procedural writing development. Teachers are encouraged to adopt this interdisciplinary approach to enhance EFL writing instruction, particularly under the Emancipated Curriculum framework.

Keywords: *STEM Integration, Project-Based Learning, Writing Skill, Procedural Text*

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INTRODUCTION

Writing is widely recognized as one of the most cognitively demanding skills in language learning, requiring learners to simultaneously manage content, structure, grammar, vocabulary, and mechanics (Harmer, 2004; Hyland, 2003). For students learning English as a Foreign Language (EFL), the challenge is compounded by the need to operate in a language that is not their mother tongue. This difficulty is especially pronounced at the junior high school level, where students are transitioning from basic language production to more complex, purposeful written communication.

In the Indonesian educational context, this challenge is further shaped by curricular demands. The Emancipated Curriculum (Kurikulum Merdeka), mandated through Permendikbudristek No. 262/M/2022, calls for student-centered, contextual, and interdisciplinary learning that integrates real-world experiences. Writing instruction, in particular, is expected to move beyond grammar-focused drills toward meaningful, project-driven tasks that nurture critical thinking, creativity, and collaboration. Despite these expectations, many classrooms continue to rely on conventional, teacher-directed methods that limit students' opportunities for authentic written expression.

Preliminary observations conducted at SMP Labschool UNTAD Palu confirmed this instructional gap. Eighth-grade students demonstrated persistent difficulties in organizing ideas, expanding vocabulary, and producing grammatically coherent procedural texts. English instruction at the school remained predominantly drill-based and disconnected from students' real-life contexts, resulting in low motivation and below-standard writing performance. None of the students in the targeted class met the minimum passing criterion (KKM = 75) in the pre-assessment phase.

To address these deficiencies, Project-Based Learning (PjBL) has been widely advocated as a viable instructional alternative. PjBL engages students in sustained inquiry through the completion of meaningful, real-world projects that culminate in a tangible or written product (Bell, 2010; Thomas, 2000). The approach has been shown to increase motivation, deepen content understanding, and improve language production by providing purposeful contexts for communication. Larmer et al. (2015) emphasize that high-quality PjBL is characterized by authentic tasks, student voice and choice, collaborative inquiry, and iterative revision, all of which support the development of academic writing skills.

A growing body of research corroborates the effectiveness of PjBL in EFL writing instruction. Nugroho & Mutoharoh (2022) demonstrated that integrating STEM content into Project-Based Learning in a junior high school writing class improved students' content, vocabulary, and motivation. Susanti et al. (2023) found that PjBL significantly outperformed traditional instruction in improving the overall writing scores of junior high school EFL students. Arif & Sukarno (2024) similarly reported marked improvements across five writing dimensions; content, organization, vocabulary, language use, and mechanics among eighth-grade students who participated in PjBL activities focused on narrative writing.

Taken together, the studies reviewed above demonstrate two important strands of evidence: first, that PjBL consistently strengthens EFL students' writing performance across content, organization, vocabulary, grammar, and mechanics (Arif & Sukarno, 2024; Nugroho & Mutoharoh, 2022; W. Susanti et al., 2022); and second, that STEM-integrated instruction provides authentic, content-rich contexts that further enrich language production (Nugroho & Mutoharoh, 2022). However, the deliberate combination of STEM content and PjBL specifically for procedural text writing—the genre most directly analogous to the step-by-step logic of STEM tasks—has not been empirically examined at the junior high school level, nor has its alignment with the Emancipated Curriculum's interdisciplinary mandate been tested. While these studies collectively affirm the value of PjBL in writing classrooms, a critical gap remains. Existing research has predominantly examined PjBL in the context of narrative or general writing tasks, and few studies have specifically investigated the integration of Science, Technology, Engineering, and Mathematics (STEM) content within procedural text instruction at the junior high school level. Furthermore, the alignment of such interdisciplinary approaches with the Emancipated Curriculum has received limited empirical attention. STEM-integrated English Language Teaching (ELT), supported by the framework of Content and Language Integrated Learning (CLIL), offers students dual-focused learning opportunities in which language and content knowledge are developed simultaneously (Coyle et al., 2010). When applied to writing, STEM tasks such as constructing a physical model provide concrete, experiential referents that scaffold the production of procedural language (Richards & Rodgers, 2014).

This study, therefore, sought to fill this gap by examining whether STEM-integrated PjBL could significantly improve the procedural writing skills of eighth-grade students at SMP Labschool UNTAD Palu. The research specifically targeted an intervention aligned with the Emancipated Curriculum's interdisciplinary and project-driven principles, using a bridge-building project as the STEM context for procedural text writing. The study was guided by the following research question: Can STEM-integrated Project-Based Learning significantly improve the writing skills of eighth-grade students at SMP Labschool UNTAD Palu?

Project-Based Learning

To address these deficiencies, Project-Based Learning (PjBL) has been widely advocated as a viable instructional alternative. PjBL engages students in sustained inquiry through the completion of meaningful, real-world projects that culminate in a tangible or written product (Bell, 2010; Thomas, 2000). The approach has been shown to increase motivation, deepen content understanding, and improve language production by providing purposeful contexts for communication. Larmer et al. (2015) emphasise that high-quality PjBL is characterised by authentic tasks, student voice and choice, collaborative inquiry, and iterative revision, all of which support the development of academic writing skills.

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STEM Integration in ELT

Existing research has predominantly examined PjBL in the context of narrative or general writing tasks, and few studies have specifically investigated the integration of Science, Technology, Engineering, and Mathematics (STEM) content within procedural text instruction at the junior high school level. Furthermore, the alignment of such interdisciplinary approaches with the Emancipated Curriculum has received limited empirical attention. STEM-integrated ELT, supported by Content and Language Integrated Learning (CLIL), offers students dual-focused learning opportunities in which language and content knowledge are developed simultaneously (Coyle et al., 2010). When applied to writing, STEM tasks such as constructing a physical model provide concrete, experiential referents that scaffold the production of procedural language (Richards & Rodgers, 2014).

This study therefore sought to fill this gap by examining whether STEM-integrated PjBL could significantly improve the procedural writing skills of eighth-grade students at SMP Labschool UNTAD Palu, using a bridge-building project as the STEM context for procedural text writing. The study was guided by the following research question: Can STEM-integrated Project-Based Learning significantly improve the writing skills of eighth-grade students at SMP Labschool UNTAD Palu?

METHOD

Research Design

This study employed a pre-experimental design with a one-group pretest-posttest approach (Arikunto, 2013; Cohen et al., 2018). A single class received both pre- and post-assessments, with an instructional treatment administered between the two measurement points. The design is appropriate given its primary focus on observing within-group change attributable to a specific intervention. It is acknowledged, however, that this design carries inherent limitations with respect to internal validity, particularly the threats of maturation and testing effects, which cannot be fully ruled out in the absence of a control group. The findings should therefore be interpreted with appropriate caution.

Respondents

The research was conducted at SMP Labschool UNTAD Palu between 27 January and 13 February 2026. The population comprised 79 eighth-grade students across four classes. Class VIII A, consisting of 20 students, was selected through purposive based on the following criteria: (1) the class displayed a mixed-ability composition encompassing low-, medium-, and high-achieving students, making it broadly representative of the wider eighth-grade population; (2) preliminary observations indicated that students in this class showed the most pronounced difficulties in procedural text writing, with none meeting the school's minimum passing criterion (KKM = 75); and (3) it provided practical access for continuous observation and treatment implementation. .

As a single-class purposive sample, the results are most directly applicable to similarly composed classes and should be generalized to other contexts with caution.

Instruments

The primary instrument was an essay-based writing test administered as both pre-test and post-test. The pre-test prompt asked students to write instructions for everyday tasks (e.g., making boiled eggs or charging a smartphone), while the post-test used equivalent prompts (e.g., making orange juice or cutting a birthday cake). All written outputs were scored using an analytic rubric adapted from Jacobs, Zinkgraf, Wormuth, Hartfiel, and Hughey (1981), a widely validated instrument in EFL writing assessment (Weigle, 2002). The rubric assessed five dimensions: Content (30%), Organisation (20%), Vocabulary (20%), Grammar (25%), and Mechanics (5%).

Procedures

The treatment consisted of six instructional sessions of 80 minutes each, implementing STEM-integrated PjBL. The instructional sequence followed core PjBL stages adapted from Bybee (2013) and Larmer et al. (2015): (1) *Problem Introduction*, students were presented with a STEM challenge of constructing a bridge using ice cream sticks; (2) *Exploration and Research*, students investigated engineering concepts and English vocabulary; (3) *Language Modelling*, the teacher presented sample procedural texts supported by graphic organisers, sentence frames (e.g., *First, you need to...; Next, attach the...; Finally, allow the...*), a domain-specific word bank, and annotated model texts; (4) *Project Planning*, groups drafted procedural text outlines; (5) *Implementation and Writing*, students built their bridge models and composed procedural texts; (6) *Presentation and Peer Review*, groups presented their projects, received peer feedback, and revised their final drafts.

Data Analysis

Individual scores were computed using Arikunto (2013) standard scoring formula. Mean scores for pre- and post-test were calculated. Deviation scores (d) were obtained by subtracting each pre-test score from the corresponding post-test score; these were squared (d^2) to determine the sum of squared deviations ($\Sigma x^2 d$). A paired-samples t-test was then conducted using Arikunto's (2002) formula to determine statistical significance. The hypothesis was accepted if the t-counted value exceeded the t-table value at $\alpha = 0.05$ with df = 19.

FINDINGS AND DISCUSSION

The following section presents the quantitative findings of the study, followed by a discussion that situates these results within the existing literature on PjBL and STEM-integrated English language teaching.

Pre-test Results

Prior to the treatment, all 20 students completed the writing pre-test. The scores are presented in Table 1.

Table 1 Students' Pre-test Writing Scores

Init.	C	O	G	V	M	Obt.	Score
FM	60	60	20	50	20	210	52.50
MR	90	60	40	25	20	235	58.75
MK	120	40	20	75	10	265	66.25
DMS	30	80	40	75	5	230	57.50
IU	60	40	60	100	5	265	66.25
KM	90	20	80	50	15	255	63.75
KGB	120	60	40	25	10	255	63.75
KAG	30	40	20	100	15	205	51.25
ZE	60	60	80	25	10	235	58.75
NK	90	40	60	100	5	295	73.75
MRK	120	20	40	50	15	245	61.25
SCL	30	60	40	100	10	240	60.00
ABL	60	80	60	25	20	245	61.25
RR	90	20	40	75	10	235	58.75
IR	120	40	80	25	15	280	70.00

IEP	60	60	20	50	20	210	52.50
ASF	90	60	40	25	20	235	58.75
BCS	30	80	40	75	5	230	57.50
MAL	60	40	60	100	5	265	66.25
SYS	120	60	40	25	10	255	63.75
			Mean				**61.13**

Note. C = Content; O = Organization; G = Grammar; V = Vocabulary; M = Mechanics; Obt. = Obtained Score; Score = Standard Score.

As shown in Table 1, the pre-test scores ranged from a minimum of 51.25 to a maximum of 73.75, with a class mean of 61.13. Notably, none of the students achieved the minimum passing criterion (KKM = 75) set by SMP Labschool UNTAD Palu for English. This result indicates that prior to the intervention, the majority of students demonstrated below-standard proficiency in procedural text writing, particularly with respect to content development and grammatical accuracy. The uniformly low performance across the analytic rubric dimensions reflects the limitations of the pre-intervention instructional approach, which relied predominantly on decontextualized grammar exercises.

Post-test Results

Following the six-session STEM-integrated PjBL treatment, students completed the writing post-test. Table 2 presents the individual and aggregate results.

Table 2 Students' Post-test Writing Scores

Init.	**C**	**O**	**G**	**V**	**M**	**Obt.**	**Score**
FM	90	80	40	75	20	305	76.25
MR	120	80	60	50	20	330	82.50
MK	120	40	20	100	15	295	73.75
DMS	60	80	40	75	20	275	68.75
IU	90	60	60	100	10	320	80.00
KM	120	40	80	75	15	330	82.50
KGB	120	80	60	50	10	320	80.00
KAG	60	60	20	100	20	260	65.00
ZE	90	80	80	50	15	315	78.75
NK	120	60	60	100	10	350	87.50
MRK	120	40	60	50	20	290	72.50
SCL	60	80	60	100	10	310	77.50
ABL	90	80	80	50	20	320	80.00
RR	120	40	60	75	15	310	77.50
IR	120	60	80	50	20	330	82.50
IEP	60	80	40	75	20	275	68.75
ASF	90	80	60	50	20	300	75.00
BCS	60	80	60	75	5	280	70.00
MAL	60	60	80	100	5	305	76.25
SYS	120	60	60	25	15	280	70.00
Mean							**76.25**

Note. C = Content; O = Organization; G = Grammar; V = Vocabulary; M = Mechanics; Obt. = Obtained Score; Score = Standard Score.

Table 2 reveals a marked improvement in student performance following the treatment. Post-test scores ranged from 65.00 to 87.50, with a class mean of 76.25—an increase of 15.13 points over the pre-test mean. Thirteen of the twenty students (65%) achieved or exceeded the KKM of 75 in the post-test, compared to zero in the pre-test. While seven students remained below the passing threshold, their scores nonetheless showed individual improvement across multiple rubric dimensions. The most pronounced gains were observed in content development and organizational coherence, suggesting that the hands-on, project-driven context of the STEM activity provided students with concrete experiential foundations for their written texts.

Deviation Analysis and t-Test

To determine the statistical significance of the observed improvement, deviation scores and the t-test were computed. Table 3 presents the pre-test and post-test scores alongside each student's deviation and squared deviation values.

Table 3 Pre-test and Post-test Score Deviation

Initials	Pre-test	Post-test	Deviation (d)	Square Deviation (d^2)
FM	52.50	76.25	23.75	564.06
MR	58.75	82.50	23.75	564.06
MK	66.25	73.75	7.50	56.25
DMS	57.50	68.75	11.25	126.56
IU	66.25	80.00	13.75	189.06
KM	63.75	82.50	18.75	351.56
KGB	63.75	80.00	16.25	264.06
KAG	51.25	65.00	13.75	189.06
ZE	58.75	78.75	20.00	400.00
NK	73.75	87.50	13.75	189.06
MRK	61.25	72.50	11.25	126.56
SCL	60.00	77.50	17.50	306.25
ABL	61.25	80.00	18.75	351.56
RR	58.75	77.50	18.75	351.56
IR	70.00	82.50	12.50	156.25
IEP	52.50	68.75	16.25	264.06
ASF	58.75	75.00	16.25	264.06
BCS	57.50	70.00	12.50	156.25
MAL	66.25	76.25	10.00	100.00
SYS	63.75	70.00	6.25	39.06
Total	**1222.50**	**1525.00**	**302.50**	**5009.38**
Mean	**61.13**	**76.25**	**15.13**	**250.47**

The total deviation across all 20 students was $\Sigma d = 302.50$, yielding a mean deviation of $Md = 302.50 \div 20 = 15.13$. The sum of squared deviations was calculated as $\Sigma x^2 d = 5009.38 - (302.50^2 \div 20) = 5009.38 - 4575.31 = 434.06$. Applying Arikunto's (2002) paired t-test formula, the t-counted value was determined as follows: $t = 15.13 \div \sqrt{(434.06 \div [20 \times 19])} = 15.13 \div \sqrt{(1.14)} = 15.13 \div 1.07 = 14.14$. Table 4 summarises the key statistical outcomes.

Table 4 Summary of t-Test Results

Statistical Measure	Value	df	Significance Level
Mean Deviation (Md)	15.13	–	–
$\Sigma x^2 d$	434.06	–	–
t-counted	14.14	19	$\alpha = 0.05$
t-table	1.729	19	$\alpha = 0.05$
Decision	Ha Accepted	–	Significant

As presented in Table 4, the t-counted value of 14.14 substantially exceeded the t-table value of 1.729 at $\alpha = 0.05$ with df = 19. Accordingly, the null hypothesis (H_0) was rejected and the alternative hypothesis (Ha) was accepted, confirming that STEM-integrated PjBL produced a statistically significant improvement in students' writing skills.

Discussions

The findings of this study align with and extend a growing body of evidence supporting the integration of Project-Based Learning in EFL writing instruction. Across all five analytic dimensions; content, organization, vocabulary, grammar, and mechanics, students demonstrated measurable improvement, with the most substantial gains in content and organization. This pattern may be attributed to the nature of the STEM activity itself: constructing a physical bridge using ice cream sticks required students to engage in sequential,

purposeful action, which subsequently provided clear, experience-grounded referents for the procedural language they were asked to produce.

This finding is consistent with Nugroho & Mutoharoh (2022), who reported similar improvements in content and vocabulary among junior high school students in a STEM-integrated English writing class. Both studies affirm that STEM contexts supply the authentic, purposeful communicative situations that are central to meaningful language use. However, the present study extends Nugroho and Mutoharoh's findings by providing more direct evidence of the link between hands-on project engagement and the development of procedural text writing, a genre that has received comparatively less attention in STEM-ELT research. The physical, step-by-step nature of the engineering project closely mirrored the structural requirements of procedural text, thereby reinforcing students' ability to organize their ideas logically using appropriate sequencing expressions. This relationship between task structure and language production can be more precisely understood through the lens of Content and Language Integrated Learning (CLIL), as conceptualized by Coyle et al. (2010). Within the CLIL framework, content and language are not treated as separate instructional objectives but as mutually reinforcing dimensions of learning. In the present study, the cognitive demands inherent in the engineering task, specifically, the need to plan, sequence, and evaluate each construction step, functioned as a cognitive scaffold that simultaneously shaped students' linguistic output. As students physically enacted the procedural logic of bridge construction, they internalized the sequential, cause-and-effect reasoning that underpins effective procedural writing. The STEM task, in other words, did not merely provide a topic for writing; it cognitively drove the production of procedural language by making the logical structure of the text experientially real and communicatively necessary. This finding thus lends empirical support to Coyle et al. (2010) assertion that cognitively engaging content tasks create the conditions under which language learning becomes purposeful, meaningful, and durable, thereby reinforcing students' ability to organize their ideas logically using appropriate sequencing expressions.

The improvement in organizational coherence observed in this study also resonates with Susanti et al. (2023), who demonstrated that PjBL significantly enhanced the writing scores of EFL students compared to conventional instruction. Both studies suggest that the structured project cycle, from planning and implementation to peer review and revision, cultivates students' awareness of logical sequencing in writing. A distinguishing feature of the present study, however, is its explicit integration of STEM content, which provided students with a concrete procedural model to reference throughout the writing process. This may account for the relatively pronounced gains in organizational structure observed in this study compared to general PjBL interventions.

In terms of vocabulary, students demonstrated greater use of action verbs (e.g., stick, glue, attach, place) and domain-specific terminology during the post-test, a finding that echoes Arif & Sukarno (2024), who reported vocabulary improvement following PjBL implementation in narrative writing tasks. The shared mechanism across both studies appears to be the creation of meaningful, contextually rich learning environments in which vocabulary acquisition is driven by communicative necessity rather than rote memorization. The STEM project introduced a set of technical and instructional lexical items that students needed to use authentically when describing their construction process, promoting retention through active, purposeful application.

Regarding grammar, particularly the use of imperative sentences and simple present tense, the results indicate moderate but meaningful improvement. This finding aligns with Arif & Sukarno (2024), who similarly observed functional language gains through PjBL, while acknowledging that some students continued to make grammatical errors despite overall improvement. Post-test writing samples in the present study revealed persistent grammatical inaccuracies across multiple dimensions, including incorrect formation of imperative verbs, inconsistent tense usage, and errors in subject-verb agreement, suggesting that naturalistic project engagement alone is insufficient to fully address the complexity of grammatical accuracy in EFL writing. These findings point to the need for more deliberate and structured

forms of targeted language support to be systematically embedded within the PjBL cycle. Several pedagogically grounded strategies may be considered for future implementations. First, form-focused instruction (FFI) could be incorporated during the Language Modelling stage, wherein the teacher explicitly draws students' attention to target grammatical structures through consciousness-raising tasks and controlled practice activities before students proceed to independent writing (Ellis, 2006). Second, written corrective feedback (WCF), delivered either by the teacher or through structured peer review protocols, could be integrated into the Implementation and Writing stage to provide immediate, context-specific guidance on recurring grammatical errors (Ferris & Hedgcock, 2014). Third, grammar-focused revision checklists could be introduced during the Presentation and Peer Review stage, directing students to systematically identify and correct specific error types in their own and peers' texts. Taken together, these targeted interventions, when embedded strategically within the project cycle, have the potential to accelerate grammatical accuracy gains without undermining the authenticity and communicative orientation that distinguish PjBL from conventional grammar-drill approaches.

Finally, improvements in mechanics, encompassing spelling, punctuation, and capitalization, were likely facilitated by the structured peer-review and revision stages built into the PjBL cycle. Students' iterative engagement with their own and peers' texts encouraged attentional focus on surface-level accuracy, consistent with the reflective, feedback-oriented practices that distinguish PjBL from transmission-based instruction (Larmer et al., 2015). The collaborative revision process also created low-stakes opportunities for students to identify and correct errors, reinforcing accurate written conventions without the performance anxiety often associated with high-stakes summative tasks.

Beyond the dimension-by-dimension gains discussed above, the findings carry broader implications for how procedural writing is taught within the Emancipated Curriculum. Conventional procedural-text instruction often relies on decontextualized model texts that students are asked to imitate without a genuine communicative purpose; the present results suggest that embedding writing within a physically enacted STEM task transforms procedural writing from a purely linguistic exercise into a record of lived experience. This has practical implications for lesson design: teachers seeking to apply this approach need not rely on elaborate engineering equipment, as the core mechanism, namely, a sequential, hands-on task that students must subsequently translate into ordered written steps, can be adapted to readily available materials (e.g., simple craft, cooking, or assembly activities), making the approach feasible even in resource-constrained classrooms. At the same time, the persistent grammatical inaccuracies noted above indicate that the STEM task functions primarily as a generator of content and organizational structure rather than as a substitute for explicit language instruction; teachers should therefore treat the project as a scaffold to be paired with, rather than a replacement for, targeted grammar support. Finally, the magnitude of the gain observed in this study, while encouraging, should be interpreted as an indication of the approach's potential under closely supervised conditions with a small class (n = 20); replication in larger and more heterogeneous classes would help establish whether the effect holds when teacher attention per student is necessarily reduced.

Taken together, the results of this study provide empirical support for the efficacy of STEM-integrated PjBL as a means of improving EFL procedural writing at the junior high school level. The approach is particularly well-suited to the pedagogical goals of Indonesia's Emancipated Curriculum, which calls for student agency, interdisciplinary engagement, and contextualized language learning. The bridge-building project served not only as an engineering task but as a vehicle for authentic language use, effectively bridging the gap between content-based and language-focused instruction.

CONCLUSIONS

This study examined the effectiveness of STEM-integrated Project-Based Learning (PjBL) in improving the procedural writing skills of eighth-grade EFL students. The findings demonstrated a statistically significant improvement after the intervention, with most students achieving the minimum passing criterion in the post-test. The study highlights that STEM project activities naturally support procedural writing because students experience and organize sequential processes before expressing them in written form. Thus, project implementation serves as both meaningful learning content and a cognitive scaffold for writing. Pedagogically, the findings suggest that integrating STEM with writing instruction promotes interdisciplinary, contextual learning while supporting collaborative planning, peer feedback, and revision, all of which strengthen students' writing development. This approach also shows potential for implementation across diverse educational contexts. However, the study was limited by its pre-experimental design, lack of a control group, and small sample from a single school, restricting causal interpretation and generalizability. Future research should employ experimental designs with larger, more diverse samples, examine long-term learning outcomes, and explore the effectiveness of STEM-integrated PjBL across different writing genres.

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REFERENCES

Arif, D. N., & Sukarno. (2024). Project-Based Learning to Improve Students' Writing Skills in Narrative Story. *Formosa Journal of Sustainable Research*, *3*(12), 2737–2746.

Arikunto, S. (2013). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. *The Clearing House*, *83*(2), 39–43. https://doi.org/10.1080/00098650903505415

Bybee, R. W. (2013). *The Case for STEM Education: Challenges and Opportunities*. NSTA Press.

Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education. In *Routledge*.

Coyle, D., Hood, P., & Marsh, D. (2010). *CLIL: Content and Language Integrated Learning*. Cambridge University Press.

Ellis, R. (2006). Current Issues in the Teaching of Grammar: An SLA Perspective. *TESOL Quarterly*, *40*(1), 83–107.

Ferris, D., & Hedgcock, J. (2014). *Teaching L2 Composition: Purpose, Process, and Practice* (3rd ed.). Routledge.

Harmer, J. (2004). *How to Teach Writing*. Pearson Education.

Hyland, K. (2003). Second language writing. In *Cambridge University Press*. https://doi.org/https://doi.org/10.1017/9781108693974

Larmer, J., Mergendoller, J. R., & Boss, S. (2015). *Setting the Standard for Project Based Learning*. ASCD.

Nugroho, A., & Mutoharoh, N. (2022). Integrating STEM and English Through Project-Based Learning: A Case Study in Junior High School Writing Class. *Journal of English Language Teaching and Linguistics*, *7*(1), 20–37.

Richards, J. C., & Rodgers, T. S. (2014). *Approaches and methods in language teaching*.

Susanti, A., Rofidah, N., Trisusana, A., & Retnaningdyah, P. (2023). Improving Students' Writing Skill Through Project-Based Learning for EFL Students. *International Journal of English Linguistics, Literature, and Education*, *2*(2), 45–54.

Susanti, W., Saleh, L. fatmawati, Nurhabibah, Gultom, A. B., Saloom, G., Ndorang, T. A., Sukwika, T., Nurlely, L., Suroyo, Mulya, R., & Lisnasari, S. F. (2022). *Pemikiran kritis dan kreatif*. CV. Media Sains Indonesia.

Thomas, J. W. (2000). *A Review of Research on Project-Based Learning*. The Autodesk Foundation.