

The Relationships among Project-Based Learning, Critical Thinking, and Students' English Writing Proficiency: A Mixed-Methods Study

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ARTICLE INFO

Keywords:

critical thinking;
project based learning;
writing skills

Article history:

Received 2026-02-25

Revised 2026-06-13

Accepted 2026-09-30

ABSTRACT

Writing proficiency requires both linguistic competence and higher-order reasoning, yet many Indonesian EFL students experience difficulties in developing ideas, organizing arguments, and expressing them coherently. This study examined the relationships among Project-Based Learning (PjBL), critical thinking, and English writing proficiency among Grade X students in Serang Regency, Indonesia. An explanatory sequential mixed-methods design was employed, with a quantitative correlational phase followed by qualitative inquiry. The quantitative phase involved 330 students selected from a population of 1,887 using the Slovin formula. Data were analyzed using Pearson correlation and multiple linear regression, while interview data were thematically analyzed using NVivo. PjBL was positively associated with writing proficiency ($r = .756, p < .01$), as was critical thinking ($r = .760, p < .01$). Both variables significantly predicted writing proficiency, with PjBL ($t = 6.60, p < .001$) and critical thinking ($t = 7.58, p < .001$); the model explained 76.8% of the variance ($R^2 = .768, F = 161.13, p < .001$). Qualitative findings showed that PjBL provided an authentic and collaborative context for generating and refining ideas, while critical thinking supported analysis, evidence evaluation, and logical argumentation. Time, resource, teamwork, and evidence-related challenges constrained these processes. Overall, PjBL and critical thinking were complementary factors associated with writing proficiency. The findings suggest that writing instruction should integrate authentic project-based inquiry with explicit critical-thinking tasks to help students generate, evaluate, and organize evidence-based arguments, supported by structured scaffolding and collaborative guidance.

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1. INTRODUCTION

Writing competence is widely recognised as an essential component of English language learning because it enables students to communicate ideas, express meanings, and participate in academic communication through written texts (Alwasilah, 2024; Herawati, 2024; Zakaria et al., 2021). However, writing remains one of the most challenging language skills for Indonesian senior high school students

learning English as a foreign language because it requires both linguistic competence and higher-order cognitive processes (Nurlatifah & Yusuf, 2022). Students are expected not only to use grammar and vocabulary appropriately but also to generate ideas, organise information logically, and communicate meaning effectively (Mabasa & Protacio, 2025). In practice, many Indonesian EFL learners continue to experience difficulties related to limited vocabulary, grammatical problems, low exposure to English, and insufficient opportunities for meaningful writing practice (Guna et al., 2025; Hapsari et al., 2022). Students may also struggle to organise ideas coherently and express opinions confidently because of concerns about language errors and limited experience in extended writing activities (Lumbantobing & Napitupulu, 2025). These challenges indicate the need for understanding the factors associated with students' performance in English writing.

Despite the recognised importance of writing competence, English writing instruction in Islamic senior high schools in Serang Regency continues to present considerable challenges for students. Preliminary classroom findings indicate that many students experience difficulties in generating ideas, developing arguments, organising paragraphs coherently, using appropriate grammar and vocabulary, and expressing opinions clearly in English writing tasks. Interviews with English teachers further revealed that students often depend heavily on teacher guidance, show low confidence in expressing ideas independently, and rarely engage in drafting or revising their written work. Classroom observations also suggested that writing instruction remains largely teacher-centered, with greater emphasis on grammatical correction and final products than on collaborative learning, inquiry, drafting, revision, and reflective feedback processes. Where prior writing scores are available, students' performance further indicates continuing weaknesses in textual organisation, coherence, grammatical accuracy, and argument development. These contextual conditions highlight the need for examining student-centered instructional characteristics and cognitive factors that may be associated with English writing proficiency.

Because effective writing requires both linguistic competence and higher-order reasoning, English writing competence should be understood through clear theoretical foundations (Dildora, 2025). In this study, writing competence refers to students' ability to communicate ideas clearly, logically, and accurately through written texts by integrating content development, organisation, vocabulary, grammar, mechanics, and coherence (Jacobs et al., 1981). From a writing process perspective, writing is viewed as a recursive activity involving planning, drafting, revising, and editing to improve textual quality and meaning construction (Harmer, 2004). Critical thinking theory further explains that effective writing requires students to evaluate ideas, organise arguments, and communicate reasoning logically (Paul & Elder, 2008). In addition, social constructivist perspectives (Vygotsky, 1978) emphasise interaction, collaboration, and feedback in supporting learning, while genre-based pedagogy helps students understand the communicative purpose, structure, and language features of specific text types. Together, these theoretical perspectives provide an important foundation for understanding how students develop meaningful and well-organised writing in EFL classrooms.

In relation to the present correlational design, student-centered approaches such as Project-Based Learning (PjBL) have increasingly been promoted to support active participation and meaningful learning in EFL classrooms (Irawan & Ahmad, 2025; Neupane, 2025; Salsadilla et al., 2025). From a theoretical perspective, Project-Based Learning conceptualises learning as an active, inquiry-based, and collaborative process in which students construct knowledge through authentic tasks, problem-solving, interaction, and the creation of meaningful products (Larmer & Mergendoller, 2015). Consistent with social constructivist principles (Vygotsky, 1978), PjBL emphasises collaboration, interaction, reflection, and feedback as important mechanisms that support learning and knowledge construction. In English writing instruction, PjBL provides learning characteristics that may be associated with students' writing competence through authentic writing activities that involve information gathering, idea exploration, collaborative discussion, drafting, revising, and presenting written work to meaningful audiences (Negara et al., 2023; Ratu et al., 2025). Throughout these learning processes, students are encouraged to evaluate and refine ideas through peer and teacher feedback, reflect on textual organisation and clarity,

and revise written texts to address coherence, grammatical accuracy, and communicative effectiveness (Batubara et al., 2023; Sa'adah & Wahyuni, 2024). Therefore, the characteristics of PjBL may be relevant to understanding students' English writing competence and classroom learning processes.

Besides pedagogical characteristics associated with Project-Based Learning, effective writing is also closely associated with students' critical thinking ability because writing requires learners to analyse, evaluate, and communicate ideas meaningfully (Ekalia et al., 2025; Suteja & Setiawan, 2022; Wati, 2024). In English writing activities, critical thinking supports students in evaluating ideas, developing arguments, selecting relevant evidence, considering alternative viewpoints or counterarguments, and organising information logically to achieve communicative purposes (Raj et al., 2022). These cognitive processes encourage students to reflect on the clarity, relevance, and consistency of ideas while being associated with coherence and reasoning in written texts (Gultom & Sinaga, 2023; Zhao & Li, 2026). Therefore, effective writing should be understood not only as grammatical accuracy but also as students' ability to construct logical arguments, justify ideas, and communicate meaning in a coherent and evidence-based manner (Facione, 2011; Hyland, 2019). Consequently, critical thinking may provide an important cognitive factor associated with English writing competence among EFL learners.

Although previous studies have reported relationships among Project-Based Learning, critical thinking, and writing instruction in language learning (Ferecbeyli, 2024; Hamidah & Pinkan, 2023; Pandya & Saiyad, 2025; Taherkhani & Gholizadeh, 2023), these variables have rarely been integrated within a single framework, particularly in Islamic senior high school EFL contexts. Previous research has also focused mainly on statistical outcomes (Ajam et al., 2026; Ochoa et al., 2025; Wati, 2024), while giving comparatively less attention to classroom learning processes and students' perceptions that may help explain the relationships among these variables in practice. Therefore, this study seeks to address these conceptual, contextual, and methodological gaps by examining the relationships among Project-Based Learning, critical thinking, and English writing proficiency within Islamic senior high schools in Serang Regency, using an explanatory sequential mixed-methods framework to examine their relationships with objectively assessed EFL writing proficiency and explain the quantitative findings through students' writing experiences. The novelty lies in integrating PjBL, critical thinking, and objectively assessed EFL writing within a single explanatory sequential mixed-methods framework, particularly in the underrepresented context of Islamic senior high schools in Serang Regency.

This research gap is particularly evident in the context of senior high school education in Serang Regency, where empirical investigations combining PjBL, critical thinking, and English writing proficiency remain scarce. Although prior studies acknowledge that PjBL is associated with critical thinking and writing skills, few have adopted a comprehensive framework that simultaneously examines (1) the relationship between PjBL and writing proficiency, (2) the relationship between PjBL and critical thinking, and (3) the role of critical thinking as a factor associated with writing proficiency within the PjBL–writing relationship. More importantly, limited research has integrated these pedagogical and cognitive dimensions with objectively assessed EFL writing proficiency and subsequently used qualitative evidence to explain the quantitative relationships. The present study addresses this gap through an explanatory sequential mixed-methods design, in which quantitative findings on correlations and predictive relationships are followed by qualitative examination of how PjBL and critical thinking relate to students' English writing development. The absence of such integrative analysis limits theoretical clarity and practical guidance for educators.

Furthermore, research focusing on the relationship between PjBL and writing skills across varying educational contexts and grade levels is insufficient. By examining these relationships, this study aims to provide valuable insights into how PjBL and critical thinking are associated with students' writing skills. Rather than claiming that PjBL or critical thinking causes improvements in writing, this study investigates their relationships with objectively assessed English writing proficiency and uses qualitative findings to provide contextual explanations of students' writing development. To achieve this, the study formulates the following research questions: 1) Is there a significant correlation between

project-based learning (PjBL) and English writing proficiency among high school students in Serang Regency? 2) Is there a significant correlation between critical thinking and English writing proficiency among high school students in Serang Regency? 3) Do project-based learning (PjBL) and critical thinking significantly predict students' English writing proficiency among high school students in Serang Regency? 4) How do project-based learning (PjBL) and critical thinking relate to students' English writing development?

2. METHODS

2.1 Research Design

This study adopted an explanatory sequential mixed-methods design, in which the quantitative phase preceded the qualitative phase and informed the subsequent qualitative inquiry. The quantitative strand employed a correlational research design to investigate the relationships among Project-Based Learning (PjBL), critical thinking, and students' English writing skills. The qualitative phase followed the quantitative phase to provide a deeper understanding of the statistical results. Integration occurred through a connecting approach, whereby the qualitative phase was informed by the quantitative findings and subsequently used to explain and elaborate on the quantitative results. This design was considered appropriate because the study aimed to examine the relationships among PjBL, critical thinking, and English writing skills and subsequently gain an in-depth understanding of the processes underlying those relationships (Kansteiner & König, 2020; Schoonenboom, 2019).

2.2 Participants

The population comprised 1,887 Grade X students enrolled in designated public high schools in Serang Regency, Indonesia. The selection of these schools was based on contextual and practical factors, including the availability of Grade X students, the presence of English teachers, accessibility for data collecting, and the necessity to include students from diverse educational backgrounds. Grade X students were deemed suitable participants due to their prior extensive English instruction and anticipated familiarity with both English writing assignments and project-based learning activities. The sample size was calculated with the Slovin formula with a 5% margin of error, yielding 330 student participants. The sample size enabled the researchers to do Pearson correlation and multiple regression analyses with adequate statistical power to investigate the individual and collective correlations among the variables.

The participants for the qualitative study consisted of 30 tenth-grade students selected from the quantitative sample. They were chosen using a specific sampling technique based on established selection criteria. The selected participants represented relevant characteristics or variations found in the quantitative results, thereby providing diverse perspectives on the relationships identified during the quantitative phase..

2.3 Procedures

Data collection occurred subsequent to the validation of the questionnaire and the confirmation of its dependability. The validated instrument was administered to 330 chosen tenth-grade pupils. Prior to completing the questionnaire, participants were apprised of the study's objective and directed to respond truthfully based on their genuine learning experiences. This quantitative study employed a correlational approach, hence no instructional treatments or experimental interventions were implemented. Student responses were gathered, verified for completeness, and numerically coded on a five-point Likert scale.

During the second phase, the selected students participated in semi-structured interviews. The interviews were conducted using an interview guide addressing students' experiences with PjBL,

critical thinking, and English writing activities. Each interview lasted approximately 30 minutes and was audio-recorded/other procedure with participants' consent. The interviews were subsequently transcribed for qualitative analysis.

2.4 Data Analysis

The quantitative data were analyzed using SPSS version 26. Descriptive statistics and preliminary assumption tests, including normality and linearity, were conducted before addressing research questions one to three. Pearson product-moment correlation was used to examine the relationships among PjBL, critical thinking, and English writing skills, followed by multiple linear regression analysis to examine their predictive relationships. The qualitative data were analyzed using NVivo software. The interview transcripts were coded to identify meaningful units of information related to PjBL, critical thinking, and writing development. Related codes were grouped into categories, which were subsequently reviewed and consolidated into themes representing recurring patterns in the qualitative data. The quantitative and qualitative findings were integrated through the connecting approach. Quantitative findings informed the qualitative inquiry, while the qualitative themes were used to explain and elaborate on the quantitative findings (Aspers & Corte, 2019).

2.5 Trustworthiness

The trustworthiness of the qualitative findings was addressed through trustworthiness strategies. The coding and theme development processes were systematically documented to maintain consistency in data interpretation. The emerging themes were reviewed to ensure that they were grounded in participants' responses and aligned with the research objectives. In addition, specific procedure, e.g., member checking/peer debriefing/triangulation was conducted to strengthen the credibility of the findings.

3. FINDINGS AND DISCUSSION

3.1. Findings

3.1.1. Quantitative finding

Quantitative data were collected from 330 tenth-grade students in Serang Regency and analyzed using SPSS version 26. Descriptive statistics and the Kolmogorov–Smirnov test were conducted to examine the characteristics and distribution of the three study variables. The results are presented in Table 1.

Table 1. Descriptive Statistics and Normality Test

Variable	N	Min	Max	M	SD	K-S p
Writing skills	330	23	94	55.23	9.71	.509*
PjBL	330	28	86	54.73	10.06	.427*
Critical thinking	330	28	81	55.70	9.66	.455*

*= normally distributed

As shown in Table 1, students' mean writing proficiency score was 55.23 (SD = 9.71), while the mean scores for PjBL and critical thinking were 54.73 (SD = 10.06) and 55.70 (SD = 9.66), respectively. The Kolmogorov–Smirnov significance values were .509 for writing skills, .427 for PjBL, and .455 for critical thinking. All values exceeded .05, indicating that the three variables met the normality assumption. Accordingly, Pearson's product-moment correlation was used to examine the relationships specified in the two research questions.

Project-Based Learning in Relation to English Writing Proficiency

The Pearson correlation results are presented in Table 2. PjBL was positively correlated with English writing proficiency, $r = .76$, $p < .01$. The statistically significant correlation indicates that higher PjBL scores were associated with higher English writing proficiency among the students..

Table 2. Pearson Correlations among Variables

Variable	1	2	3
1. Writing skills	1		
2. PjBL	.76*	1	
3. Critical thinking	.76*	—	1

* = $p < .01$

Critical Thinking in Relation to English Writing Proficiency

As reported in Table 2, critical thinking was positively correlated with English writing proficiency, $r = .76$, $p < .01$. This statistically significant correlation indicates that students with higher critical thinking scores tended to demonstrate higher English writing proficiency. The unrounded coefficients were .756 for PjBL and .760 for critical thinking, indicating that the two relationships were very similar in magnitude.

PjBL and Critical Thinking as Predictors of Writing Proficiency

Following the significant correlations identified in RQ1 and RQ2, a multiple linear regression analysis was conducted to examine whether PjBL and critical thinking significantly predicted students' English writing proficiency when considered individually and jointly. The partial significance tests are presented in Table 3. Both predictors made statistically significant contributions to the regression model. PjBL was a significant predictor of English writing proficiency, $t = 6.60$, $p < .001$, while critical thinking was also a significant predictor, $t = 7.58$, $p < .001$. The higher t value for critical thinking indicates a somewhat stronger statistical contribution than PjBL within the model.

Table 3. Partial Significance t-Test of Predictors

Predictor	t	p	Interpretation
PjBL	6.60	<.001	Significant
Critical thinking	7.58	<.001	Significant

The overall regression model is reported in Table 4. The model was statistically significant, $F = 161.13$, $p < .001$, with a standard error of 6.04. The reported R^2 was .768, indicating that PjBL and critical thinking jointly explained 76.8% of the variance in students' English writing proficiency. The adjusted R^2 was .685, indicating that the model accounted for 68.5% of the variance after adjustment. The remaining 23.2% of the unadjusted variance was not explained by the predictors included in the model.

Table 4. Regression Model Summary

Model	R	R^2	Adjusted R^2	F	p	Std. Error
PjBL and critical thinking → writing skills	.756	.768	.685	161.13	<.001	6.04

Overall, the results indicate that both PjBL and critical thinking significantly predicted students' English writing proficiency. Critical thinking showed the stronger individual statistical contribution based on its higher t value, while the two predictors jointly explained a substantial proportion of the variance in writing proficiency.

3.1.2. Qualitative finding

How PjBL and Critical Thinking Relate to English Writing Development

The qualitative findings explain how Project-Based Learning (PjBL) and critical thinking contributed to students' English writing development. The analysis generated three interrelated themes: PjBL as an authentic and collaborative context, critical thinking as a cognitive mechanism, and the synergy between the two. A fourth theme concerning instructional conditions and challenges emerged as a contextual factor influencing these processes. The themes, illustrative participant excerpts, and their contributions to writing development are presented in Table 5.

Table 5. Qualitative Themes, Participant Excerpts, and Contributions to English Writing Development

Theme	Key finding	Illustrative participant excerpt	Contribution to writing development
PjBL as an authentic and collaborative context	PjBL connected English learning with real-world applications and collaborative inquiry.	S2: "solve real-world problems and work collaboratively." S7: "the integration of classroom lessons with real-world applications."	Created opportunities for students to generate, discuss, and refine ideas before writing.
Critical thinking as a cognitive mechanism	Critical thinking supported analysis, evidence evaluation, and logical argumentation.	S1: "distinguishing between opinion and fact." S2: "constructing logical arguments."	Supported reasoned argumentation, evidence use, coherence, and logical organization.
Synergy between PjBL and critical thinking	PjBL created opportunities for collaborative problem-solving and the application of critical thinking.	S5: "the application of critical thinking skills can be applied in the classroom." S6: "collaborative problem-solving with classmates."	Connected authentic inquiry with higher-order thinking, supporting the transformation of ideas into written texts.
Instructional conditions and challenges	Project implementation and critical writing were constrained by time, resources, teamwork, and the complexity of evidence-based reasoning.	S4: "time management, resource limitations, and conflict within teams." S3: "teaching scaffolded writing techniques can help address these challenges."	Highlights the importance of time, resources, collaboration, and instructional scaffolding.

PjBL as an Authentic and Collaborative Context

PjBL contributed to writing development by providing an authentic and collaborative context in which students could discuss, investigate, and solve problems before producing written texts. The findings indicate that real-world applications and collaborative activities enabled students to develop and refine ideas prior to writing. Thus, PjBL supported writing development through the learning processes surrounding writing rather than through writing practice alone.

Critical Thinking as a Cognitive Mechanism

Critical thinking contributed to the quality and organization of students' writing by supporting analysis, evidence evaluation, argument development, and logical organization. The qualitative findings indicate that these processes helped students develop more coherent and reasoned texts. However, difficulties in distinguishing fact from opinion, constructing logical arguments, and conducting thorough analysis also indicate the need for explicit instructional support.

The Synergy between PjBL and Critical Thinking

PjBL and critical thinking appeared to operate through complementary mechanisms. PjBL provided the authentic and collaborative context for inquiry, while critical thinking enabled students to analyze, evaluate, and organize ideas generated through that inquiry. The NVivo analysis further identified interconnected patterns involving analysis, collaboration, revision, feedback, and argument development. This convergence suggests that the contribution of the two constructs extends beyond their separate effects, as authentic project work creates opportunities for higher-order thinking to be applied to the development of written texts.

Instructional Conditions and Challenges

The contribution of PjBL and critical thinking was also shaped by practical and instructional conditions. Students identified time constraints, resource limitations, team conflict, and difficulties in locating and analyzing evidence as barriers to effective project work and critical writing. These findings highlight the importance of adequate time, resources, collaborative support, and scaffolded instruction in facilitating writing development.

Overall, PjBL provided the authentic and collaborative context for generating and refining ideas, whereas critical thinking provided the cognitive processes for evaluating and logically organizing those ideas into written arguments. Their integration therefore provided complementary conditions for students' English writing development.

3.1.3. Integrated Findings on PjBL, Critical Thinking, and English Writing

The quantitative and qualitative findings were integrated to provide a more comprehensive explanation of how PjBL and critical thinking contributed to students' English writing development. The quantitative results established the strength and significance of the relationships and predictive effects, while the qualitative findings explained the processes and contextual conditions underlying these patterns. The integration is presented in Table 6.

Table 6. Joint Display of Quantitative and Qualitative Findings on English Writing Development

Quantitative finding	Qualitative finding	Integration/Meta-inference
PjBL was positively associated with writing proficiency, $r = .756$, $p < .01$.	PjBL provided an authentic and collaborative context for students to generate, discuss, and refine ideas before writing. S2: "solve real-world problems and work collaboratively." S7: "the integration of classroom lessons with real-world applications."	The significant association is qualitatively explained by PjBL's authentic and collaborative processes, which supported idea generation and refinement before writing.
Critical thinking was positively associated with writing proficiency, $r = .760$, $p < .01$.	Critical thinking supported analysis, evidence evaluation, and logical argumentation. S1: "distinguishing between opinion and fact." S2: "constructing logical arguments."	The strong association is consistent with students' use of analytical and evaluative processes to develop evidence-based, coherent, and logically organized texts.
Both PjBL and critical thinking significantly predicted writing proficiency: PjBL, $t = 6.60$, $p < .001$; critical thinking, $t = 7.58$, $p < .001$.	PjBL created opportunities for collaborative problem-solving, while critical thinking enabled students to analyze and organize ideas. S5: "the application of critical thinking skills can be applied in the classroom." S6: "collaborative problem-solving with classmates."	The quantitative findings and qualitative themes converge: PjBL functions primarily as an authentic and collaborative context, whereas critical thinking functions as a cognitive mechanism for transforming inquiry into written arguments.
PjBL and critical thinking jointly	NVivo analysis identified interconnected patterns involving analysis,	The substantial explained variance is supported by convergent qualitative

explained 76.8% of the variance in writing proficiency, $R^2 = .768$, $p < .001$.	collaboration, revision, feedback, and argument development.	evidence showing that collaboration, inquiry, analysis, revision, and argument development operate as interconnected processes in writing development.
Critical thinking showed a somewhat stronger individual contribution than PjBL based on the regression t values.	Students reported difficulties with distinguishing fact from opinion, constructing logical arguments, and conducting thorough analysis.	Critical thinking may represent the stronger individual statistical contributor, but its application depends on instructional opportunities and scaffolding provided through project-based activities.
The regression model was significant, $F = 161.13$, $p < .001$; adjusted $R^2 = .685$.	Students identified time constraints, resource limitations, team conflict, and difficulties in evidence-based reasoning as barriers. S4: "time management, resource limitations, and conflict within teams." S3: "teaching scaffolded writing techniques can help address these challenges."	The quantitative model demonstrates substantial predictive power, while the qualitative findings identify contextual conditions that may facilitate or constrain the realization of these effects.

The joint display demonstrates convergence between the two strands. PjBL was associated with writing proficiency through authentic and collaborative learning processes, whereas critical thinking was associated with the analytical and evaluative processes involved in developing written arguments. Their joint predictive relationship with writing proficiency further indicates that these associations are complementary rather than isolated. However, the qualitative findings also qualify the quantitative results by showing that time, resources, teamwork, and instructional scaffolding may shape how these processes are experienced and related to writing development.

3.2. Discussion

Four research findings were identified as a result of the study: PjBL was positively correlated with English writing proficiency among high school students in Serang Regency, critical thinking was positively correlated with English writing proficiency, PjBL and critical thinking both significantly predicted English writing proficiency, and PjBL provided an authentic and collaborative context, while critical thinking enabled students to analyze, evaluate, and organize ideas. Four research concerns are addressed in this investigation.

The initial research question is: Is there a significant correlation between project-based learning (PjBL) and English writing proficiency among high school students in Serang Regency? The research results indicate that PjBL was positively correlated with English writing proficiency. The results of this study are in accordance with previous research that has demonstrated the significant association of the PjBL model with creative writing abilities and its relationship with the writing process to assist students in enhancing their writing abilities (Alemneh & Gebrie, 2024; Khulel, 2022; Septiviana & Abdurrahman, 2024; Winarni, 2023). This study differs from previous research in that the diversity of research topics offers a fresh perspective on educational methodology. It offers evidence-based insights that can be used to inform future teaching practices and curriculum design, with the goal of understanding the relationship between PjBL and English writing proficiency.

Moreover, the second research query is as follows: Is there a significant correlation between critical thinking and English writing proficiency among high school students in Serang Regency? The study's findings in schools A and B suggest that students' critical thinking was positively correlated with their English writing abilities. The findings of this study indicate that students' critical thinking skills were positively correlated with their writing ability, which is consistent with the findings of (Amhar et al., 2022; Rahmat, 2020; Rahmat et al., 2020; Winarti et al., 2021). This investigation differs from those that have preceded it. The uniqueness of this study is its examination of the intricate relationship between

students' writing proficiency and critical thinking skills. Although the significance of critical thinking in academic performance is emphasised in a significant amount of the existing literature, this study specifically examines the relationship between this skill and writing ability. This study emphasises a significant educational insight: critical thinking is positively correlated with writing skills, as it is associated with the ability of students to structure their arguments, analyse sources, and develop coherent narratives. Additionally, this investigation employs innovative methodologies, including combined qualitative and quantitative assessments, to investigate the relationship between critical thinking and various aspects of writing, including clarity, coherence, creativity, and engagement. This novel viewpoint motivates educators to incorporate critical thinking exercises into their curriculum, with the ultimate objective of cultivating not only more proficient writers but also more analytical and deliberate thinkers.

The third study question pertains to whether project-based learning (PjBL) and critical thinking significantly predict students' English writing proficiency among high school students in Serang Regency. The findings indicated that PjBL and critical thinking both significantly predicted English writing proficiency. This study's originality resides in the integration of PjBL and critical thinking to evaluate their predictive relationships with students' English writing proficiency through mixed methodologies. Critical thinking skills are vital for facilitating students' learning, particularly in the 21st century. Project-based learning grounded in PjBL design thinking has been associated with critical thinking abilities (Wulandari et al., 2023). This study significantly contributes to the theoretical comprehension of the relationship among PjBL, critical thinking, and students' English writing abilities. This study advances learning theory and establishes a robust basis for future research by reinforcing the significant correlation between PjBL and critical thinking in students' English writing abilities.

The fourth study question explores how project-based learning (PjBL) and critical thinking relate to students' English writing development. The findings indicate that PjBL provided an authentic and collaborative context, while critical thinking enabled students to analyze, evaluate, and organize ideas. In this context, PjBL and critical thinking can be understood as complementary aspects of students' English writing development: PjBL provides opportunities for students to engage in authentic and collaborative writing contexts, while critical thinking supports students in analyzing, evaluating, and organizing ideas. This study's novelty resides in employing three variables to establish their link. This study used a mixed-method approach that combines quantitative and qualitative data, yielding more intricate conclusions. Additionally, the researchers performed their study in two distinct schools in Serang Regency as participants.

4. CONCLUSION

The research indicates that Project-Based Learning (PjBL) and critical thinking are positively associated with students' English writing proficiency and, when considered together, significantly predict writing proficiency. The qualitative findings further explain this relationship by showing that PjBL provides an authentic and collaborative context for writing, while critical thinking supports students in analyzing, evaluating, and organizing ideas throughout their writing development. Taken together, these findings suggest that PjBL and critical thinking are complementary factors associated with students' English writing proficiency. This study is significant as it provides essential information for students, instructors, and readers to understand the relationship between Project-Based Learning (PjBL), critical thinking, and writing abilities within the framework of English language learning. Scholars recommend that readers, especially educators, focus on the use of Project-Based Learning (PjBL) and critical thinking, as these elements are strongly correlated with students' proficiency in English writing. However, the findings should be interpreted cautiously because the correlational design does not permit causal inference, and clearer reporting of group characteristics and measurement procedures is needed to strengthen methodological transparency.

Future studies should investigate the relationships among PjBL, critical thinking, and English writing proficiency using longitudinal or experimental designs if causal relationships are to be

examined. Research may also incorporate additional variables, including writing motivation, self-efficacy, and digital literacy, to better explain the relationship between PjBL and writing performance. Furthermore, studies conducted in diverse educational contexts and involving technology-supported PjBL approaches are needed to strengthen the generalizability and practical implications of the existing evidence.

Conflicts of Interest: No potential conflict of interest was reported by the author.

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