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The Effectiveness of the Peer Project Collaborative Learning Model on Students' Critical Thinking Skills: A Quasi-Experimental Study

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A B S T R A C T

This study examines whether the Peer Project Collaborative Learning (PPCL) model is more effective than Project-Based Learning (PjBL) in improving the critical thinking skills of junior high school students. PPCL integrates peer, project, and collaborative learning into a five-phase syntax. A quasi-experiment with a pretest–posttest control group design was conducted on 68 ninth-grade students at a Catholic junior high school in Palangka Raya, divided into an experimental group taught with PPCL and a control group taught with PjBL. Critical thinking was measured with a validated eight-item essay test and analysed using an independent-samples t-test. Groups were statistically equivalent at pretest, but the experimental group obtained a significantly higher posttest mean (26.59 vs. 24.56; $t = 5.086$; $p < 0.001$; $d = 1.23$). The findings indicate that embedding peer interaction within project work meaningfully strengthens critical thinking.

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INTRODUCTION

Critical thinking has become one of the core competencies of twenty-first century education, enabling learners to interpret, analyse, evaluate, and draw reasoned conclusions as a basis for decision-making Scriven & Paul, 1992; Facione, 2013).International frameworks position it alongside communication, collaboration, and creativity as an indispensable capability for life and work (Trilling & Fadel, 2009; Thornhill-Miller et al., 2023). Despite this consensus, large-scale assessments continue to report that many students struggle with higher-order reasoning (OECD, 2019) and the gap is especially visible in subjects that have traditionally emphasised content transmission over reasoning.

Catholic Religious Education (CRE) is one such subject. In the ninth-grade theme on respecting human dignity and creation, learners are expected not only to grasp doctrinal content but also to reason critically about ethical and ecological questions. Preliminary observation at a Catholic junior high school in Palangka Raya, however, revealed consistently low achievement across critical thinking indicators: fewer than half of the students surveyed could pose questions about what they did not understand, evaluate reasoning and its procedures, or reflect on their own thinking within a group. Instruction remained largely teacher-centred, leaving little room for the disciplined intellectual engagement that critical thinking requires (Otukile-Mongwaketse, 2018)

Project-Based Learning (PjBL) is frequently proposed as a remedy, and meta-analytic evidence confirms its positive effect on achievement and twenty-first century skills (Kokotsaki et al., 2016; Rehman & Mahmood, 2024). Yet PjBL alone does not guarantee high-quality reasoning: when group work is poorly structured, contribution becomes uneven and a few members carry the workload while others free-ride (Oxford, 1997 Benning, 2024). Peer learning addresses this weakness directly, because explaining, questioning, and giving feedback to peers deepens understanding and stimulates evaluative thinking (Topping, 2005; Boud, 2001); Snyder & Wiles, 2015). Collaborative learning, in turn, provides the social architecture in which negotiation of meaning and shared knowledge construction can occur (Laal & Laal, 2012).

Building on these complementary strengths, this study evaluates the Peer Project Collaborative Learning (PPCL) model, which integrates peer, project, and collaborative learning into a single five-phase syntax. While the development and feasibility of PPCL have been established elsewhere, its comparative effectiveness against a strong active-learning counterfactual has not been tested. The contribution of this paper is therefore twofold: it provides quasi-experimental evidence on a niche and under-researched population in ninth-grade Catholic Religious Education students in Central Kalimantan and it isolates the added value of embedding structured peer interaction within project work for the specific outcome of critical thinking. Accordingly, the study asks whether students taught with the PPCL model achieve significantly higher critical thinking scores than students taught with conventional Project-Based Learning.

THEORETICAL REVIEW

Critical Thinking

Critical thinking is understood as a disciplined intellectual process of conceptualising, applying, analysing, synthesising, and evaluating information drawn from observation, experience, reflection, and reasoning (Scriven & Paul, 1992; Ennis, 2015). Facione (2020) frames it as the combination of cognitive skills; interpretation, analysis, evaluation, inference, and explanation; with reflective dispositions. In school settings these skills do not emerge spontaneously; they require deliberate instructional designs that confront learners with problems and require them to justify their conclusions (Bean, 2021; Moon, 2007).

Peer, Project, and Collaborative Learning as Foundations of PPCL

The PPCL model rests on three interlocking learning theories. From Vygotsky's social constructivism it draws the idea that higher mental functions develop through interaction within the zone of proximal development, where peers and more capable others provide scaffolding (Vygotsky, 1980; Verenikina, 2003; Fani & Ghaemi, 2011). From Ausubel's theory of meaningful learning it adopts the principle that new knowledge must be anchored to existing cognitive structures (Ausubel, 1977). From Piaget it takes the assumption that ninth-grade learners, at the formal operational stage, are capable of hypothetical and evaluative reasoning (Piaget & Inhelder, 1969a).

Empirically, collaborative and peer-supported designs have repeatedly been shown to enhance critical thinking. Gokhale (1995) demonstrated that collaborative learning produces stronger critical thinking than individual study, and a recent meta-analysis confirmed that collaborative problem solving significantly promotes critical thinking (Xu et al., 2023). Peer assessment and peer feedback embedded in project work similarly improve reasoning and collaboration (Zhang & Hwang, 2023; Chang & Wongwatkit, 2024; Zeng & Ravindran, 2024). PjBL itself yields meaningful gains in higher-order thinking when well structured (Loyens et al., 2023; Yulianti et al., 2025). These convergent findings support the expectation that a model uniting all three approaches will outperform PjBL alone.

H1: Students taught with the PPCL model achieve significantly higher critical thinking scores than students taught with Project-Based Learning.

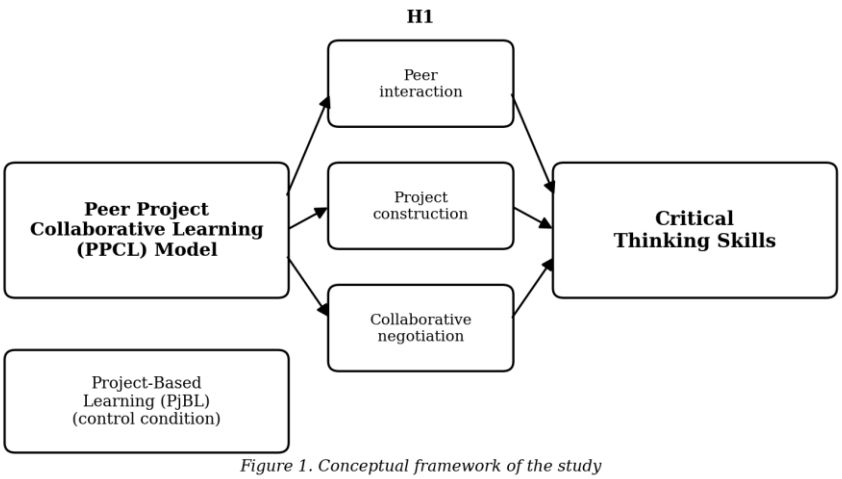

Figure 1. Conceptual framework of the study

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METHODOLOGY

This study employed a quasi-experimental approach with a pretest–posttest control group design (Creswell, 2012). The independent variable was the learning model (PPCL versus PjBL) and the dependent variable was students' critical thinking. The population comprised ninth-grade students at a Catholic junior high school in Palangka Raya, Central Kalimantan. The sample consisted of 68 students assigned to two intact classes: an experimental group (n = 34) taught with the PPCL model and a control group (n = 34) taught with Project-Based Learning. Both groups studied the same theme respecting human dignity and creation with identical materials, facilities, and instructional time across six meetings; the only difference was the learning model.

Table 1. Pretest Posttest Control Group Design

Group test	Pre Test	Treatment	Post test
Experiment	O1	X	O2
Control	O3	-	O4

Critical thinking was measured with an essay test constructed from interpretation, analysis, evaluation, and inference indicators. Of fifteen items trialled, eight were retained after item analysis, all exceeding the critical value ($r > 0.361$), with an internal consistency of Cronbach's $\alpha = 0.834$, indicating a valid and reliable instrument. Data were analysed in SPSS 22. Prior to hypothesis testing, the Shapiro–Wilk test was used to verify normality and Levene's test to verify homogeneity of variance. The hypothesis was tested with an independent-samples t-test comparing the posttest means of the two groups; the criterion for a significant difference was a two-tailed significance value below 0.05. Cohen's d was computed to estimate the magnitude of the effect.

RESULTS

The analysis proceeded in three steps. First, the pretest data were screened against the parametric assumptions of normality and homogeneity of variance. Second, an independent-samples t-test on the pretest scores verified that the experimental and control groups were equivalent before treatment, so that any later difference could be ascribed to the learning model. Third, an independent-samples t-test on the posttest scores tested the hypothesis, and Cohen's d was computed to gauge the practical magnitude of the difference. Each step is reported in turn below, with the descriptive output summarised in tables and a figure rather than reproduced in full.

Assumption Testing: Normality and Homogeneity

Before testing the hypothesis, the pretest data were screened for normality and homogeneity. The Shapiro–Wilk test indicated that both groups were normally distributed, with significance values above 0.05 for the control group (0.157) and the experimental group (0.353). Levene's test confirmed homogeneity of variance, $F(1, 66) = 2.935$, $p = 0.091$ (> 0.05). Both prerequisites were therefore

satisfied, justifying the use of a parametric independent-samples t-test. Table 1 summarises the assumption testing results.

Table 2. Results of the normality and homogeneity prerequisite tests

Test	Statistic / Group	Value	Decision
Normality (Shapiro–Wilk)	Control	Sig. = 0.157	Normal
Normality (Shapiro–Wilk)	Experiment	Sig. = 0.353	Normal
Homogeneity (Levene)	F(1, 66)	F = 2.935; Sig. = 0.091	Homogeneous

Baseline Equivalence of Groups (Pretest)

The pretest established that the two groups were comparable before treatment. The control group obtained a mean of 18.82 (SD = 2.249) and the experimental group a mean of 19.03 (SD = 2.812). The independent-samples t-test showed no significant difference between them, $t(66) = -0.333$, $p = 0.740$ (> 0.05). The near-identical starting points confirm that any subsequent divergence can be attributed to the learning model rather than to prior ability.

Table 3. Independent-samples t-test of pretest critical thinking scores

Group	N	Mean	SD	Sig. (2-tailed)
Control (PjBL)	34	18.82	2.249	0.740
Experiment (PPCL)	34	19.03	2.812	

Hypothesis Test (Posttest)

After six meetings, the posttest revealed a clear advantage for the PPCL group. The experimental group reached a mean of 26.59 (SD = 1.438), compared with 24.56 (SD = 1.829) for the control group. The independent-samples t-test confirmed that this difference was statistically significant, $t(66) = 5.086$, $p < 0.001$, with a mean difference of 2.029 (95% CI (1.23). The effect size was large, Cohen's $d = 1.23$, indicating that the difference is not only statistically significant but also practically substantial. H1 is therefore supported. Table 3 reports the posttest comparison, and Figure 3 displays the pattern of means.

Table 4. Independent-samples t-test of posttest critical thinking scores

Group	N	Mean	SD	t (df = 66)	Sig.
Control (PjBL)	34	24.56	1.829	5.086	0.000
Experiment (PPCL)	34	26.59	1.438		

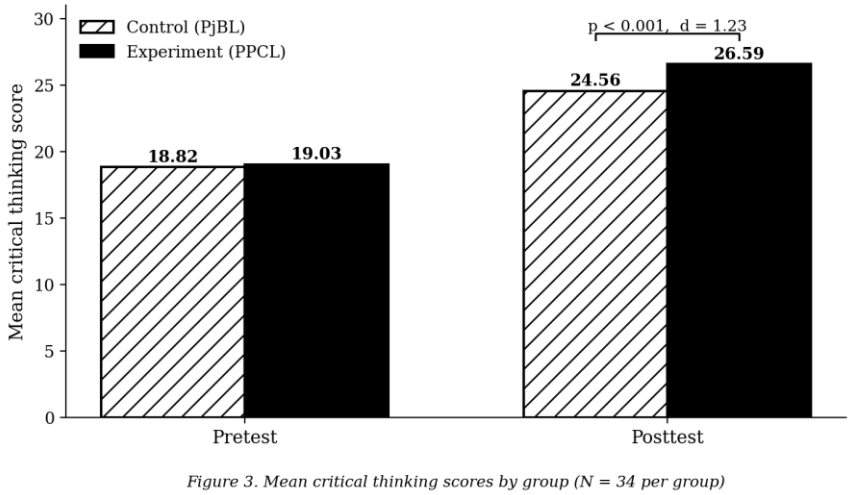

Figure 3. Mean critical thinking scores by group (N = 34 per group)

Figure 2. Mean critical thinking scores by group at pretest and posttest (N = 34 per group)

Pattern of Gains across the Two Groups

The posttest comparison tells only part of the story; the way scores moved over time is just as telling. The two groups started out almost identical, separated by a mere 0.21 points at pretest. By the posttest, that gap had grown to 2.03 points in favor of the experimental group. In relative terms, the control group improved by roughly 30.5 percent, but the PPCL group climbed by about 39.7 percent. In other words, the experimental group did not simply end up ahead and it gained more ground in the same six meetings, under the same conditions. Since the materials, facilities, and instructional time were identical for both groups, this faster growth points back to the learning model itself.

The spread of scores adds another layer to the picture. At posttest, the experimental group varied less than the control group (SD = 1.438 versus 1.829), which means the gains under PPCL were not driven by a handful of top students but were shared fairly evenly across the class. This fits the logic of the model. Because PPCL asks every student to take part and to explain their reasoning to peers at each phase, it spreads the thinking load more evenly than ordinary project work, where a few capable students can carry the group. A higher average paired with a tighter spread suggests that the model lifted the reasoning of the whole class, rather than simply widening the distance between the strongest and the weakest.

DISCUSSION

The results show that students taught with the PPCL model developed stronger critical thinking than those taught with conventional Project-Based Learning. Since the two groups started from statistically equivalent baselines and differed only in the learning model, the posttest gap can reasonably be traced to the treatment itself. The large effect size reinforces this reading: the advantage of PPCL is educationally meaningful, not just a statistical quirk thrown up by a sensitive test.

Why does PPCL work better? The answer seems to lie in how it shapes the social conditions for reasoning. The students in the control group worked on a case study (Kokotsaki et al., 2016;Loyens et al., 2023). The students in the control group worked together in a number of different ways to define the case, develop a work plan, and present and critique the work of each other. One of the more identifiable aspects of PPCL is that there is a deliberate step of peer participation in every phase of the process. In the peer-learning framework (Topping, 2005) (Snyder & Wiles, 2015), the need to attack, defend, and modify one's view is an essential factor in driving deeper logic. When students are made to provide justification of their views to a peer, the expectation drives students to a higher level of interpretation to the peer, and critique the work more than they would do if working in isolation.

These findings sit comfortably alongside earlier research. Gokhale (1995) found that collaborative learning sharpens critical thinking compared with studying alone, and a later meta-analysis by (Zhang & Hwang, 2023) confirmed that collaborative problem solving significantly promotes it. The particular benefit of pairing peer assessment or peer feedback with project work has been shown by Xu et al. (2023) and Chang & Wongwatkit, (2024), who reported gains in critical thinking, collaboration, and communication. The present study carries this evidence into a setting that has rarely been examined Catholic Religious Education at the junior high school level and shows that the same mechanism holds even in a content-rich, value-laden subject.

Theoretically, the outcome supports a social-constructivist view of critical thinking. The PPCL phases move students repeatedly through the zone of proximal development, where peers scaffold one another toward reasoning none of them could yet manage alone (Vygotsky,1980; Verenikina, 2003). Grounding the project in what students already understand reflects Ausubel's principle of meaningful learning (Ausubel, 1977) while the formal-operational capacity of ninth-graders equips them to meet the hypothetical and evaluative demands of the task (Piaget & Inhelder, 1969). PPCL, in this sense, is these theories translated into a workable classroom sequence.

The subject setting deserves a closer look. Catholic Religious Education is often delivered as exposition, with students cast as recipients of doctrinal content rather than as thinkers in their own right. Yet the theme used here is respecting human dignity and creation calls for precisely the kind of ethical and ecological judgement that critical thinking involves, and that judgement rarely surfaces under teacher-centered instruction. By asking students to map problems, justify their plans, and critique one another's arguments, PPCL turns a value-laden topic into a space for disciplined reasoning. The benefits seen here, then, are not limited to science or mathematics, where active-learning studies usually live; they reach into the humanities and religious education as well, widening the model's relevance.

CONCLUSIONS AND RECOMMENDATIONS

This quasi-experiment demonstrates that the Peer Project Collaborative Learning model is significantly more effective than conventional Project-Based Learning in improving the critical thinking skills of ninth-grade Catholic Religious

Education students. With equivalent baselines, the PPCL group achieved a higher posttest mean (26.59 vs. 24.56), a significant difference ($t = 5.086$, $p < 0.001$) accompanied by a large effect size ($d = 1.23$). The integration of peer, project, and collaborative learning therefore offers a practical and theoretically grounded route to strengthening higher-order thinking. Teachers and curriculum developers are encouraged to adopt PPCL as an alternative model, particularly for contextual and reflective subjects, and to ensure that peer interaction is structured into every phase rather than left to chance.

FURTHER STUDY

This study was limited to a single school, one subject, and one theme, with intact classes rather than full randomisation, so generalisation should be cautious. It also focused on a single outcome. Future research could test PPCL across different schools, subjects, and grade levels, employ randomised designs, examine longer-term retention of critical thinking, and explore its effects on related skills such as collaboration, communication, and creativity.

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