

Instructional Design for SDG 4: Developing Collaboration Skills Through an ADDIE-Based Peer Project Learning Model

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ABSTRACT

Objective: To develop the Peer Project Collaborative Learning (PPCL) model and examine its feasibility, practicality, and effectiveness in improving junior secondary students' critical thinking and collaboration skills in Catholic Religious Education at St. Paulus Catholic Junior High School, Palangka Raya. **Method:** Employing a Research and Development (R&D) approach using the ADDIE framework (Analyze, Design, Development, Implementation, and Evaluation). **Results:** The findings indicate that the PPCL model achieved a very high level of validity based on expert judgment (98.8%) and demonstrated high practicality through positive responses from teachers and students (91%). The pretest results showed no significant difference between the experimental and control groups ($p = 0.534$), confirming comparable initial abilities. Following implementation, students who learned through the PPCL model achieved significantly higher collaboration performance than those receiving conventional Project-Based Learning ($M = 41.26$ vs. 38.26 ; $t(66) = -6.241$, $p < 0.001$), with a higher normalized gain (0.60 vs. 0.44). **Novelty:** The findings extend constructivist and collaborative learning theories by demonstrating that structured reciprocal peer interaction embedded within collaborative project activities effectively reduces free-riding, promotes active participation, and enhances twenty-first-century competencies. The PPCL model also offers practical guidance for teachers seeking to design student-centered learning environments that strengthen both cognitive and collaborative competencies in religious education and other secondary school contexts for SDG 4.

INTRODUCTION

The rapid transformation of education in the Society 5.0 era has positioned twenty first century competencies as a global benchmark for preparing students to face increasingly complex social and technological challenges. Contemporary educational systems emphasize the development of the 4Cs critical thinking, creativity, communication, and collaboration as essential competencies for lifelong learning and workforce readiness for SDG 4 (Trilling & Fadel, 2009; Thornhill-Miller et al., 2023). These competencies are also reflected in the updated definition of Educational Technology proposed by the Association for Educational Communications and Technology (AECT, 2023), which emphasizes designing, implementing, managing, and evaluating learning experiences that empower learners through appropriate technological and pedagogical resources. Within this framework, collaboration occupies a unique position because it functions both as a learning outcome and as a process through which higher-order thinking and social competence are developed. Consequently, Education 4.0 increasingly recognizes collaboration as an indispensable graduate attribute for adaptive and competitive citizens (González-Pérez & Ramírez-Montoya, 2022).

This educational transformation is equally relevant to Catholic Religious Education (CRE), particularly in learning activities designed to cultivate students' moral reasoning, responsibility, and participation in society. The Grade IX topic "Respecting

the Dignity of the Human Person and Nature" requires students not only to understand Catholic doctrine but also to engage collaboratively in discussing contemporary social issues and developing shared solutions. Collaboration in Catholic education is therefore more than a generic twenty-first-century competency; it reflects the theological principle of synodality, which emphasizes communion, participation, and shared mission within the Church. Through collaborative learning experiences, students are expected to develop mutual responsibility, active listening, and collective decision-making that embody Christian values in authentic educational contexts (Habur, 2026).

Despite these expectations, preliminary observations conducted at SMP Katolik St. Paulus Palangka Raya revealed that collaboration skills among Grade IX students remained relatively low. Initial questionnaire data involving 35 students indicated that only 46.5% demonstrated effective teamwork, 50.3% recognized the importance of communication for achieving common goals, 55.2% showed positive interdependence during group activities, and only 44.7% were able to coordinate collective actions effectively. Classroom observations further showed that group assignments were frequently dominated by only a few students, whereas other members depended on their peers with minimal contribution. This phenomenon corresponds to free-riding, a common problem in collaborative learning environments lacking structured guidance, accountability, and individual contribution assessment (Benning, 2024). Teachers also reported limited monitoring during group work, reducing opportunities for meaningful interaction and equitable participation.

These classroom conditions indicate a discrepancy between the intended goals of twenty first century learning and actual instructional practice. Although collaborative activities have occasionally been implemented through discussion and project assignments, learning remains predominantly teacher centered, with limited opportunities for reciprocal peer interaction and structured teamwork. Previous studies similarly report that project-based learning promotes authentic learning experiences but may become ineffective when students lack sufficient instructional structure and collaborative regulation (Helle et al., 2006). Likewise, collaborative learning encourages social interaction but frequently results in unequal participation when clear roles and accountability mechanisms are absent, while peer learning effectively facilitates reciprocal knowledge sharing only when embedded within meaningful learning tasks (Boud, 2001; Topping, 2005). These limitations suggest that no single instructional approach adequately addresses the complex challenges of fostering collaboration in secondary religious education.

The research gap is also evident in previous literature. First, studies commonly investigate peer learning, project-based learning, and collaborative learning independently or combine only two of these approaches, whereas an integrated instructional model combining all three remains limited (Marreh & Velankar, 2024; Schürmann et al., 2024). Second, empirical studies concerning collaborative instructional models in Catholic Religious Education at the junior secondary level remain scarce despite the importance of collaboration within Catholic educational philosophy. Third, most existing studies primarily examine cognitive achievement or student participation without developing instructional models specifically designed to improve collaboration through structured peer interaction and systematic contribution assessment. Consequently, there remains limited evidence regarding how collaboration can be intentionally designed, facilitated, and evaluated within religious education classrooms.

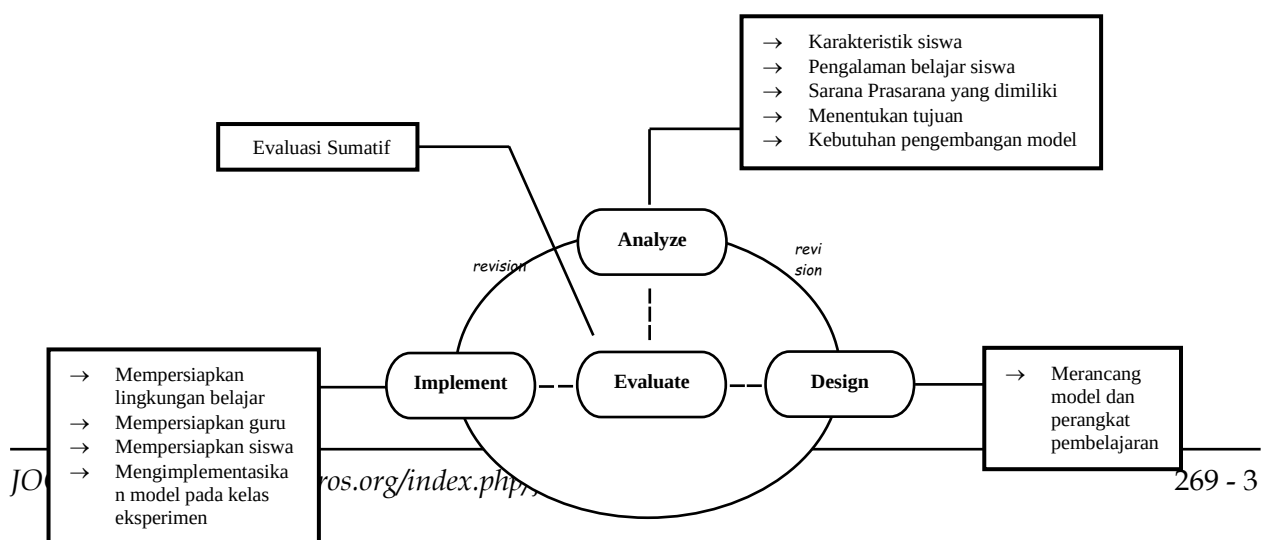
To address these gaps, this study develops the Peer Project Collaborative Learning (PPCL) model by integrating the complementary strengths of peer learning, project-based learning, and collaborative learning into a single instructional framework. Within PPCL, collaborative learning provides the social structure for teamwork, project-based learning offers authentic and meaningful tasks, and peer learning facilitates reciprocal teaching and knowledge construction among students. This integration is expected to reduce free riding, strengthen individual accountability, and promote active participation throughout project completion. Unlike conventional project-based learning, PPCL explicitly incorporates reciprocal peer teaching within collaborative projects, thereby creating a structured learning environment that simultaneously develops collaboration and active engagement.

Accordingly, this study aims to develop and evaluate the Peer Project Collaborative Learning (PPCL) model for improving collaboration skills among Grade IX students in Catholic Religious Education. Specifically, the study addresses two research questions: (1) Is the PPCL model valid and practical for improving students' collaboration skills? (2) To what extent is the PPCL model effective in improving the collaboration skills of Grade IX students in Catholic Religious Education? By proposing an integrated instructional model specifically designed for religious education, this study contributes to the growing literature on twenty-first-century learning while providing practical guidance for teachers seeking to foster meaningful collaboration in secondary school classrooms.

RESEARCH METHOD

Research design

This study used a Research and Development (R&D) design to develop, validate, and evaluate the PPCL model and its supporting learning package. The development framework was the ADDIE model such as Analyze, Design, Development, Implementation, and Evaluation (Branch, 2009) and it's chosen because it provides a systematic, iterative procedure that links needs analysis, design, and evaluation.



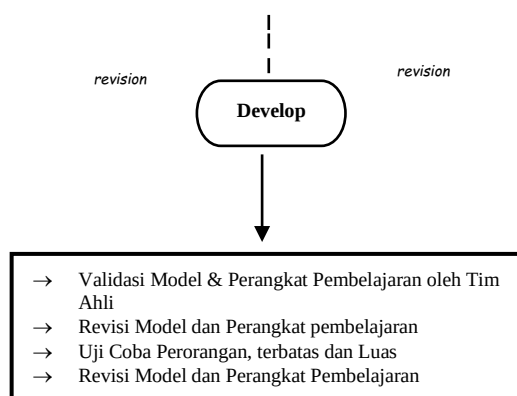


Figure 1. ADDIE design

To test effectiveness, a quasi-experimental pretest–posttest control group design was embedded in the Implementation and Evaluation stages, comparing an experimental class taught with PPCL against a control class taught with project-based learning (PjBL).

Tabel 1. Pretest post test control group design

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

The effectiveness of the PPCL model was examined using a quasi experimental pretest posttest control group design. Both the experimental and control classes were administered a pretest before the intervention and a posttest after the intervention. The experimental class was taught using the Peer Project Collaborative Learning (PPCL) model, while the control class received conventional Project-Based Learning (PjBL) instruction. Differences in students' collaboration skills before and after the intervention were analyzed to determine the effectiveness of the developed model.

Research sites

This study was conducted at SMP Katolik St. Paulus Palangka Raya, Central Kalimantan, Indonesia. The school was purposively selected because it has consistently implemented Catholic Religious Education (CRE) based on the national curriculum while encouraging student-centered learning activities. However, preliminary observations indicated that collaborative learning had not been systematically developed, particularly in the Grade IX topic "Respecting the Dignity of the Human Person and Nature." Classroom activities frequently relied on conventional group work, in which only a few students actively participated while others contributed minimally, resulting in unequal participation during collaborative tasks.

Participants

The study was conducted with 68 Grade IX students at SMP Katolik St. Paulus Palangka Raya, Central Kalimantan, distributed into an experimental class ($n = 34$) and a control class ($n = 34$). The learning material was the PAK theme "Respecting the Dignity of the Human Person and Nature" in the Merdeka Curriculum. Both classes received the same material, facilities, and duration (six meetings); the only difference was the instructional model. Three trained observers recorded the implementation fidelity of each lesson phase.

The PPCL models

PPCL is structured as a three layer concentric harmonisation. Peer learning forms the core (reciprocal teaching within the Zone of Proximal Development), project-based learning forms the middle layer (an authentic project task), and collaborative learning forms the outer layer (shared goals and social coordination). This nesting is what the model terms cross phase functional differentiation: each constituent approach is active throughout, but a different one becomes the leading driver at each phase. Figure 1 presents the architecture, and Figure 2 presents the five-phase syntax with its theoretical grounding.

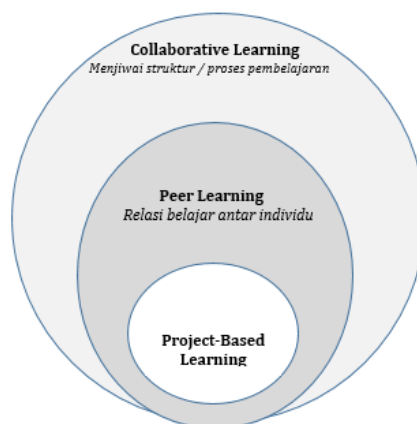


Figure 1. The three-layer concentric architecture of the PPCL model



Figure 2. The five-phase syntax of the PPCL model

Figure 2 illustrates the five phase syntax of the Peer Project Collaborative Learning (PPCL) model, which integrates the principles of peer learning, collaborative learning, and project-based learning into a coherent instructional sequence. The model consists of five interconnected phases: (1) Orientation and Group Formation, where the teacher introduces learning objectives, forms heterogeneous groups, and explains students' roles; (2) Collaborative Project Planning, during which students identify problems, discuss project objectives, distribute responsibilities, and develop project plans; (3) Peer Teaching and Collaborative Project Development, the core phase of the model, where students engage in reciprocal peer teaching while collaboratively completing project tasks; (4) Project Presentation and Reflection, in which each group presents its project outcomes, receives peer feedback, and reflects on both the learning process and collaboration experiences; and (5) Evaluation and Appreciation, where teachers assess students' collaboration skills and project performance using structured assessment instruments while recognizing individual and group achievements. These five phases

are designed to promote active participation, positive interdependence, individual accountability, and reciprocal learning, thereby fostering students' collaboration skills throughout the instructional process.

Research instruments and data analysis

Three categories of data were collected to evaluate the validity, practicality, and effectiveness of the developed Peer Project Collaborative Learning (PPCL) model. Model validity was assessed through expert validation involving instructional design experts and Catholic Religious Education content experts, while practicality was evaluated using response questionnaires completed by teachers, classroom observers, and students after the implementation of the model. Both validity and practicality data were analyzed using descriptive percentage techniques and interpreted according to predetermined feasibility criteria.

Students' collaboration skills were measured using a peer-assessment instrument developed based on four collaboration indicators: cooperation, communication toward shared goals, positive interdependence, and social coordination. The instrument initially consisted of 15 items and was piloted with 30 Grade IX students. Item validity was examined using the Pearson Product-Moment correlation, with an r -table value of 0.361, resulting in 12 valid items and three invalid items. Reliability testing using Cronbach's Alpha produced a coefficient of 0.842, indicating a high level of internal consistency. The collected data were analyzed using both descriptive and inferential statistics. Validity and practicality data were analyzed descriptively using percentage scores, whereas the effectiveness of the PPCL model was examined using an independent-samples t -test in IBM SPSS Statistics version 22. Prior to hypothesis testing, the assumptions of parametric analysis were verified through the Shapiro-Wilk normality test and Levene's homogeneity test. After both assumptions were satisfied, the independent-samples t -test was performed to determine whether there was a significant difference in collaboration skills between students taught using the Peer Project Collaborative Learning (PPCL) model and those taught using the conventional Project-Based Learning (PjBL) model. In addition, the normalized gain (N-gain) score was calculated to measure the magnitude of improvement in students' collaboration skills following the learning intervention. This combination of descriptive and inferential analyses provided comprehensive evidence regarding the validity, practicality, and effectiveness of the developed instructional model.

RESULTS AND DISCUSSION

Validity and practicality of the model

Expert validation of the PPCL model produced an overall score of 98.8% (instructional-design expert I = 97.6%; expert II = 100%), placing the model in the "very valid" category and confirming both content and construct validity. The supporting learning package was likewise validated: the teaching module reached 98.4%, the teaching material 98.7%, and the lesson package overall scored in the "very good" range. Practicality, judged by four raters across presentation, Usability, benefit, and innovation, reached 91%, and implementation fidelity across the lesson phases averaged 82–85.6% ("very good"). Table 2 summarizes the validity and practicality results.

Table 2. Validity and practicality of the PPCL model and learning package

Aspect evaluated	Score (%)	Category
PPCL model (design experts I & II)	98.8	Very valid
Teaching module	98.4	Very good
Teaching material	98.7	Very good
Practicality (4 raters)	91.0	Very practical
Implementation fidelity (observers)	85.6	Very good

Baseline equivalence (pretest)

Before the intervention, the prerequisite tests were satisfied: the collaboration pretest data were normally distributed (Shapiro–Wilk: control = 0.157; experimental = 0.353; both > 0.05) and homogeneous (Levene = 1.500, $p = 0.225$). The independent-samples t -test on the pretest showed no significant difference between the control class ($M = 30.53$, $SD = 2.777$) and the experimental class ($M = 30.97$, $SD = 3.040$), $t(66) = -0.625$, $p = 0.534$ (> 0.05). The two groups therefore began from an equivalent baseline (Cohen's $d = 0.15$, negligible), a desirable condition for attributing posttest differences to the treatment. Table 3 reports the pretest statistics.

Table 3. Collaboration pretest group statistics and independent-samples t -test

Group	N	Mean	SD	$t(66)$	Sig.
Control (PjBL)	34	30.53	2.777	0.625	0.534
Experimental (PPCL)	34	30.97	3.040		

Effectiveness for improving collaboration (posttest)

After six meetings, the posttest showed a clear divergence between the groups. The experimental class reached a mean collaboration score of 41.26 ($SD = 2.108$), markedly higher than the control class mean of 38.26 ($SD = 1.847$). Levene's test confirmed equal variances ($F = 1.054$, $p = 0.308$), and the independent-samples t -test returned $t(66) = 6.241$, $p = 0.000$ (< 0.05), with a mean difference of 3.00 (95% CI -3.96 to -2.04). Because the confidence interval excludes zero, the difference is statistically robust. The null hypothesis is rejected: the PPCL model is effective for improving students' collaboration skills. Table 4 and Figure 3 present these results.

Table 4. Collaboration posttest – group statistics and independent-samples t -test

Group	N	Mean	SD	$t(66)$	Sig.
Control (PjBL)	34	38.26	1.847	6.241	0.000
Experimental (PPCL)	34	41.26	2.108		

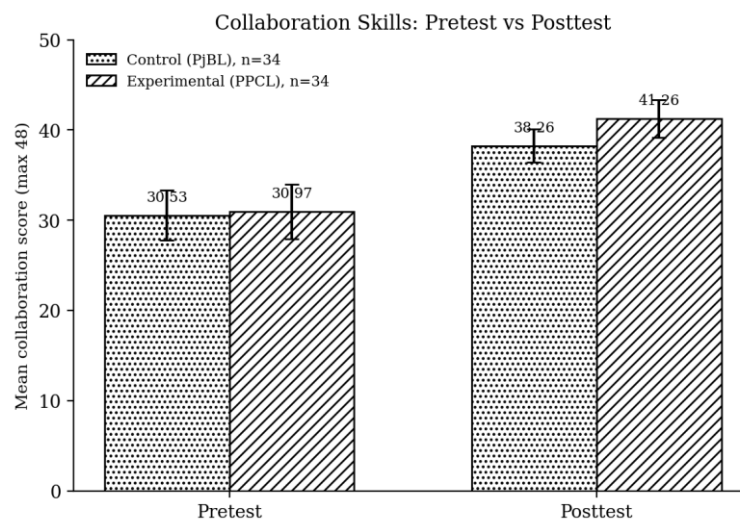


Figure 4. Mean collaboration scores at pretest and posttest by group (error bars = SD)

Beyond statistical significance, the practical magnitude of the effect was large. The posttest Cohen's d was 1.51, indicating that the two distributions barely overlap. The normalized gain confirmed the same pattern: the experimental class achieved $g = 0.60$ (medium-to-high) against $g = 0.44$ (medium) for the control class, and the raw gain was 10.29 points for PPCL versus 7.73 for PjBL. In other words, although project-based learning alone improved collaboration, adding the peer-learning core through the PPCL syntax produced a substantially larger improvement. Table 4 summarizes the effect-size and gain indices.

Table 4. Effect size and normalized gain for collaboration

Index	Experimental	Control	Interpretation
Normalized gain (g)	0.60	0.44	Medium-high vs medium

The normalized gain (g) was calculated to measure the magnitude of improvement in students' collaboration skills from pretest to posttest. According to Hake's (1998) classification, a gain score of 0.60 in the experimental class indicates a medium-to-high improvement, whereas a gain score of 0.44 in the control class indicates a medium improvement. These results demonstrate that the Peer Project Collaborative Learning (PPCL) model produced greater learning gains than the conventional Project-Based Learning (PjBL) approach, indicating that integrating reciprocal peer learning within collaborative project activities more effectively enhances students' collaboration skills.

Discussion

Why the peer core drives collaboration

The central finding that the Peer Project Collaborative Learning (PPCL) model significantly outperformed conventional Project-Based Learning indicates that the improvement in students' collaboration skills resulted from the instructional architecture of the model rather than merely from project activities themselves. Empirical evidence showed that the experimental class achieved a significantly higher posttest mean score ($M = 41.26$) than the control class ($M = 38.26$). The independent-samples t -test further confirmed this difference with $t(66) = -6.241$, $p < 0.001$, indicating that the improvement was statistically significant. In addition, the experimental class

obtained a normalized gain (g) of 0.60, compared with 0.44 in the control class, while the Cohen's d value of 1.51 indicated a very large practical effect. These findings demonstrate that PPCL generated substantially greater improvements in collaboration than conventional Project-Based Learning alone.

The superior performance of PPCL can be explained by its instructional design. In conventional project-based learning, the teacher often remains the primary source of guidance, and interaction among students occurs mainly for task completion. Consequently, collaboration frequently becomes superficial because students simply divide responsibilities instead of constructing knowledge together. In contrast, PPCL embeds reciprocal peer teaching into every learning phase, requiring students to explain concepts, question peers' ideas, negotiate understanding, provide feedback, and revise project outcomes collaboratively. Through repeated interaction, students actively practice cooperation, communication, positive interdependence, and social coordination throughout the entire learning process rather than only during project completion.

This mechanism aligns with Vygotsky's Social Constructivist Theory, which argues that learning develops most effectively through social interaction within the Zone of Proximal Development (ZPD) (Vygotsky, 1978; Verenikina, 2003). Students with stronger conceptual understanding scaffold their peers, while explaining concepts also reinforces the tutors' own cognitive processing. Consequently, reciprocal peer learning simultaneously promotes conceptual understanding and interpersonal competence. Because every PPCL syntax phase—from identifying problems to project reflection—requires collaborative interaction, collaboration skills are continuously reinforced throughout instruction.

These findings are consistent with previous studies. Laal and Ghodsi (2012) demonstrated that collaborative learning improves teamwork and social interaction, while Kokotsaki et al. (2016) concluded that Project-Based Learning supports collaboration when implemented through authentic learning experiences. Likewise, Chang and Wongwatkit (2024) and Zhang and Hwang (2023) found that combining project-based learning with peer assessment significantly enhances communication, cooperation, and collaborative problem solving. The present study extends these findings by integrating peer teaching, collaborative learning, and project-based learning into one instructional syntax, thereby explaining the substantially higher collaboration gains achieved by PPCL.

Collaboration and free riding

One of the most significant contributions of PPCL is its ability to reduce the free-riding phenomenon identified during the preliminary study. Classroom observations revealed that collaborative assignments were frequently completed by only a few highly active students, while other members contributed minimally. Such unequal participation weakens collaborative learning because responsibility is concentrated among a limited number of students. Free-riding generally occurs when individual contributions are neither visible nor formally assessed, allowing passive students to receive equal credit without participating meaningfully.

The implementation of PPCL directly addressed this issue by embedding individual accountability within collaborative learning activities. Every student was required to explain ideas, respond to peers' questions, provide constructive feedback, and actively participate during the Sharing Knowledge stage. Individual contributions were further documented through a structured peer-assessment instrument based on four

collaboration indicators. This instructional design encouraged every learner to become actively engaged because contribution quality directly influenced peer evaluation.

The effectiveness of this mechanism is reflected in the quantitative findings. Students taught using PPCL achieved a higher collaboration score ($M = 41.26$) than students taught using Project-Based Learning ($M = 38.26$), accompanied by a medium-to-high normalized gain ($g = 0.60$) compared with 0.44 in the control class. Furthermore, the statistically significant difference ($p < 0.001$) and the large effect size (Cohen's $d = 1.51$) indicate that reciprocal peer learning substantially increased equitable participation among students. Rather than merely dividing project tasks, students became responsible for supporting one another's learning throughout the instructional process.

These findings support Benning (2024), who argued that free-riding emerges when individual contributions remain invisible. Similarly, Falchikov and Goldfinch (2000) demonstrated that peer assessment promotes responsibility by encouraging students to evaluate both their own and their peers' participation objectively. Harney et al. (2017) likewise emphasized that effective teamwork depends on structured coordination rather than simply assigning students to groups. PPCL operationalizes these principles by integrating reciprocal teaching, authentic projects, and systematic peer assessment into one coherent instructional framework.

Collaboration as a synodal practice in Catholic Religious education

Beyond improving measurable collaboration skills, PPCL carries particular significance within Catholic Religious Education (CRE) because collaboration reflects the principle of synodality, emphasizing communion, participation, and shared mission among members of the Church (Habur, 2026). Within this perspective, collaboration is not merely an educational competency but also an expression of Christian values, including solidarity, mutual respect, empathy, shared responsibility, and collective service. Consequently, collaborative learning becomes both a pedagogical strategy and a form of faith formation.

The feasibility of implementing PPCL in Catholic Religious Education is strongly supported by the development results. Expert validation produced an overall validity score of 98.8%, categorizing the model as very valid, while teacher, observer, and student evaluations yielded a practicality score of 91%. Moreover, classroom implementation fidelity ranged between 82% and 85.6%, indicating that each instructional phase was consistently implemented throughout the intervention. These findings demonstrate that the PPCL syntax is theoretically sound, practically applicable, and capable of supporting collaborative learning in authentic classroom settings.

Each stage of PPCL encourages students to listen actively, negotiate meaning respectfully, solve problems collectively, and assume responsibility for shared learning outcomes. Thus, collaboration becomes a lived educational experience consistent with the Catholic understanding of communal life. This distinguishes PPCL from many collaborative learning models that primarily pursue cognitive achievement without explicitly incorporating moral and spiritual dimensions into classroom interaction.

The findings also bridge the gap between twenty-first-century competencies and Catholic educational philosophy. Whereas contemporary education emphasizes collaboration as an employability skill, Catholic education seeks to cultivate learners capable of serving others through cooperation and shared responsibility. PPCL successfully integrates these two objectives by demonstrating that collaboration can be

systematically designed, intentionally developed, and empirically measured within Catholic Religious Education.

Implications, limitations, and future research

The findings have important implications for educational practice. Teachers who already implement Project-Based Learning may significantly strengthen students' collaboration skills by restructuring collaborative activities around reciprocal peer learning and individual peer assessment. The substantial improvement demonstrated by the experimental class, reflected in the higher posttest mean (41.26), normalized gain (0.60), and large effect size ($d = 1.51$), indicates that embedding reciprocal peer interaction into project activities provides considerably greater collaboration gains than Project-Based Learning alone. Rather than treating collaboration simply as an outcome of group work, PPCL positions collaboration as a structured learning process supported through instructional syntax and continuous peer interaction.

Theoretically, this study extends constructivist learning theory by demonstrating that integrating peer learning, collaborative learning, and project-based learning within a unified instructional framework produces stronger collaboration outcomes than implementing each approach separately. The study also contributes to the literature on twenty-first-century competencies by proposing an instructional model in which collaboration functions simultaneously as a learning process, a measurable competency, and a character-building practice grounded in Catholic educational values.

Nevertheless, several limitations should be acknowledged. The study involved only 68 Grade IX students from a single Catholic junior secondary school, limiting the generalizability of the findings to broader educational contexts. Furthermore, the intervention lasted only six instructional meetings, making it difficult to evaluate the long-term retention of collaboration skills. Collaboration was primarily measured using peer assessment, although future studies could enrich the analysis by incorporating classroom observations, discourse analysis, learning analytics, or behavioral measures to capture collaborative interaction more comprehensively.

Future research should therefore evaluate PPCL across multiple schools, educational levels, and subject areas using larger samples and longer implementation periods. Longitudinal investigations could examine the sustainability of collaboration development over an entire semester or academic year. Future studies may also explore the integration of digital collaborative platforms and AI-assisted peer feedback to strengthen reciprocal learning and collaboration in increasingly technology-enhanced educational environments. Such investigations would further establish PPCL as a robust instructional model for developing collaboration skills required in twenty-first-century education while remaining aligned with the distinctive values of Catholic Religious Education.

Overall, the findings demonstrate that the PPCL model contributes to the achievement of Sustainable Development Goal 4 (SDG 4), which promotes inclusive, equitable, and quality education while fostering lifelong learning opportunities for all. By integrating reciprocal peer learning, collaborative project work, and continuous peer assessment, PPCL creates an active and student-centered learning environment that strengthens collaboration, critical communication, and shared responsibility. The successful implementation of the model in Catholic Religious Education further indicates that innovative pedagogical approaches can simultaneously enhance twenty-first-century competencies and support inclusive, high-quality learning experiences.

These findings suggest that PPCL provides a practical instructional framework for advancing educational quality through meaningful, collaborative, and learner-centered teaching practices.

CONCLUSION

Fundamental Finding: This study demonstrates that the Peer Project Collaborative Learning (PPCL) model is a valid, practical, and effective instructional model for improving collaboration skills in Catholic Religious Education. By integrating reciprocal peer learning, collaborative learning, and project-based learning into a coherent instructional framework, PPCL creates meaningful learning experiences that encourage active participation, shared responsibility, communication, and cooperative problem solving. The findings further demonstrate that collaboration can be systematically developed within faith-based education without diminishing its religious mission, thereby positioning Catholic Religious Education as a learning environment that simultaneously nurtures academic competencies and Christian values. **Implication:** The findings contribute theoretically by extending constructivist learning through the integration of peer learning, collaborative learning, and project-based learning into a unified pedagogical model for developing collaboration skills. Practically, PPCL offers Catholic Religious Education teachers a structured and empirically validated instructional approach for fostering collaboration as both a key twenty-first-century competency and an expression of the Catholic principle of synodality, emphasizing communion, participation, and shared responsibility. The study also supports the implementation of Sustainable Development Goal 4 (SDG 4) by demonstrating that innovative, student-centered, and collaborative learning can strengthen educational quality, promote active participation, and develop lifelong competencies essential for inclusive and equitable education. **Limitation:** This study was conducted with Grade IX students in a single Catholic junior secondary school, which may limit the generalizability of the findings to other educational contexts. In addition, the intervention was implemented over a relatively short period and focused primarily on collaboration skills measured through peer assessment. Therefore, the findings should be interpreted within the scope of the research setting and instructional duration. **Future Research:** Future studies are encouraged to evaluate the implementation of PPCL across different schools, educational levels, and subject areas using larger and more diverse samples. Longer intervention periods are also needed to examine the sustainability of collaboration skills over time. Furthermore, future research may integrate digital collaborative platforms, learning analytics, or AI-assisted peer feedback to explore how technology can further strengthen reciprocal learning and collaboration while supporting the advancement of quality education in diverse learning environments.

AUTHOR CONTRIBUTIONS

Paulina Maria Ekasari Wahyuningrum contributed to the conceptualization of the study, literature review, research design, methodology development, instrument development and validation, model development, data collection, field investigation, implementation of the instructional model, formal analysis, data interpretation, visualization, preparation of the original manuscript draft, project administration, and final approval of the manuscript. **Siti Masitoh** contributed to the literature review, data source identification, manuscript review and editing, validation, and academic

supervision. **Andi Kristanto** contributed to the literature review, data source identification, manuscript review and editing, validation, and academic supervision. All authors have read, reviewed, and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The author declares that there are no financial, professional, or personal conflicts of interest that could have influenced the research process, interpretation of the findings, or the preparation of this manuscript.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The author acknowledges the use of AI-assisted writing tools, including ChatGPT (OpenAI), during the preparation of this manuscript. These tools were used solely to assist with language refinement, grammar correction, manuscript organization, and improvement of academic writing clarity. All research design, data collection, data analysis, interpretation of findings, and final conclusions were conducted independently by the author. All AI-assisted outputs were critically reviewed, verified, and revised to ensure the accuracy, originality, and academic integrity of the manuscript. The author takes full responsibility for the content and conclusions presented in this article.

REFERENCES

- Abdelmohsen, M. M. (2020). The development and validation of a module on enhancing students' critical thinking, collaboration and writing skills. *SAR Journal*, 3(4), 166–177. <https://doi.org/10.18421/SAR34-04>
- Almulla, M. A. (2023). Constructivism learning theory: A paradigm for students' critical thinking, creativity, and problem solving to affect academic performance in higher education. *Cogent Education*, 10(1). <https://doi.org/10.1080/2331186X.2023.2172929>
- Arends, R. (2012). *Learning to teach*. New York: McGraw-Hill Companies.
- Ausubel, D. P. (1963). *The psychology of meaningful verbal learning*. Grune & Stratton.
- 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>
- Benning, T. M. (2024). Reducing free-riding in group projects in line with students' preferences: Does it matter if there is more at stake? *Active Learning in Higher Education*, 25(2), 242–257. <https://doi.org/10.1177/14697874221118864>
- Boud, D. (2001). Introduction: Making the move to peer learning. In D. Boud, R. Cohen, & J. Sampson (Eds.), *Peer learning in higher education* (pp. 1–20). London: Kogan Page.
- Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer.
- Chang, S. C., & Wongwatkit, C. (2024). Effects of a peer assessment-based scrum project learning system on computer programming's learning motivation, collaboration, communication, critical thinking, and cognitive load. *Education and Information Technologies*, 29(6), 7105–7128. <https://doi.org/10.1007/s10639-023-12084-x>
- Chin, C., & Kayalvizhi, G. (2005). What do pupils think of open science investigations? *Educational Research*, 47(1), 107–126. <https://doi.org/10.1080/0013188042000337596>
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson.

- Falchikov, N., & Goldfinch, J. (2000). Student peer assessment in higher education: A meta-analysis comparing peer and teacher marks. *Review of Educational Research*, 70(3), 287–322. <https://doi.org/10.3102/00346543070003287>
- Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, 7(1). <https://doi.org/10.21061/jte.v7i1.a.2>
- González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: A systematic review. *Sustainability*, 14(3), 1493. <https://doi.org/10.3390/su14031493>
- Griffin, P., & Care, E. (Eds.). (2015). *Assessment and teaching of 21st century skills: Methods and approach*. Dordrecht: Springer. <https://doi.org/10.1007/978-94-017-9395-7>
- Habur, A. M. (2026). Is synodality the future of Catholic education? *Frontiers in Education*, 11, 1756162. <https://doi.org/10.3389/feduc.2026.1756162>
- Harianto, G. P., Rusijono, Masitoh, S., & Setyawan, W. H. (2020). Collaborative-cooperative learning model to improve theology students' characters: Is it effective? *Cakrawala Pendidikan*, 39(2). <http://dx.doi.org/10.2139/ssrn.3767719>
- Harney, O. M., Hogan, M. J., & Quinn, S. (2017). Investigating the effects of peer-to-peer prompts on collaborative argumentation, consensus and perceived efficacy in collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, 12(3), 307–336. <https://doi.org/10.1007/s11412-017-9263-9>
- Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education. *Higher Education*, 51, 287–314. <https://doi.org/10.1007/s10734-004-6386-5>
- Joyce, B., Weil, M., & Showers, B. (2009). *Models of teaching (4th ed.)*. Boston: Allyn and Bacon.
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. *Procedia – Social and Behavioral Sciences*, 31, 486–490. <https://doi.org/10.1016/j.sbspro.2011.12.091>
- Lai, E. R. (2011). *Collaboration: A literature review*. Pearson Research Report.
- Marreh, S., & Velankar, Y. P. (2024). Recent trends in collaborative learning: A systematic review and analysis. *International Journal of Evaluation and Research in Education*, 13(4), 2473–2481. <https://doi.org/10.11591/ijere.v13i4.28501>
- Nieveen, N. (1999). Prototyping to research product quality. In *Design approaches and tools in education and training*. Kluwer Academic Publishers.
- Schürmann, V., Marquardt, N., & Bodemer, D. (2024). Conceptualization and measurement of peer collaboration in higher education: A systematic review. *Small Group Research*, 55(4). <https://doi.org/10.1177/10464964231200191>
- Sichterman, B., Noroozi, O., Boetje, J., van Ginkel, S., Khosravi, H., & Versendaal, J. (2025). Supporting peer learning with artificial intelligence: A systematic literature review. *Innovations in Education and Teaching International*, 62(5), 1648–1664. <https://doi.org/10.1080/14703297.2025.2530118>
- Snyder, J. J., & Wiles, J. R. (2015). Peer-led team learning in introductory biology: Effects on peer leader critical thinking skills. *PLoS ONE*, 10(1), e0115084. <https://doi.org/10.1371/journal.pone.0115084>
- Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J.-M., Morisseau, T., & Lubart, T. (2023). Creativity, critical thinking, communication, and collaboration. *Journal of Intelligence*, 11(3), 54. <https://doi.org/10.3390/jintelligence11030054>

- Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, 25(6), 631–645. <https://doi.org/10.1080/01443410500345172>
- Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco: Jossey-Bass.
- Verenikina, I. (2003). *Understanding scaffolding and the ZPD in educational research*. AARE–NZARE Conference, Auckland.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wentzel, K. R., & Watkins, D. E. (2002). Peer relationships and collaborative learning as contexts for academic enablers. *School Psychology Review*, 31(3), 366–377. <https://doi.org/10.1080/02796015.2002.12086161>
- Xu, E., Wang, W., & Wang, Q. (2023). The effectiveness of collaborative problem solving in promoting students' critical thinking: A meta-analysis. *Humanities and Social Sciences Communications*, 10, 16. <https://doi.org/10.1057/s41599-023-01508-1>
- Yulianti, E., Husna, I. M., Fitriyah, I. J., Nugraheni, D., & Hamimi, E. (2025). Mobile-aided PjBL for improving junior high school students' critical thinking and learning motivation. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: e-Saintika*, 9(3), 887–908. <https://doi.org/10.36312/h8831197>
- Zhang, D., & Hwang, G. J. (2023). Effects of interaction between peer assessment and problem-solving tendencies on students' learning achievements and collaboration in mobile technology-supported project-based learning. *Journal of Educational Computing Research*, 61(1), 3–35. <https://doi.org/10.1177/07356331221094250>

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