



Fostering Quality Education Through Learning Models: Evidence from Problem-Based and Cooperative Learning with Interpersonal Intelligence on Students' Learning Outcomes

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Abstract: This study examines differences in student learning outcomes based on learning models (Problem-Based Learning and Cooperative Learning) and students' levels of interpersonal intelligence. This study employed a quasi-experimental design using a 2×3 factorial framework. This research was conducted in the 2nd semester of the elementary school teacher education study program, the Basic Concepts of Basic Science/Social Studies course at Setiabudi Rangkasbitung University in Banten Province. A total of 100 students participated in the study, with each group including fifty students. The sampling method used, cluster random sampling. The interpersonal intelligence instrument uses a questionnaire with a Likert scale of 1-5 and the learning outcomes of the instrument are multiple choice pre- and post-test questions. This study yielded three main findings. There was a significant difference in learning outcomes between students taught using different learning models (PBL vs Cooperative), as indicated by an F-value of 10.739 and a significance level of $p < 0.001$. There were also significant differences in learning outcomes among students with high, medium, and low levels of interpersonal intelligence, as shown by an F-value of 23.419 and a significance level of $p < 0.001$. In addition, there was a significant interaction effect between the learning model and students' levels of interpersonal intelligence on learning outcomes, as evidenced by an F-value of 8.357 and a significance level of $p < 0.006$. This study implies that the choice of learning model plays a crucial role in improving learning outcomes, as problem-based learning and cooperative learning contribute in different ways.

Keywords: Cooperative learning; Interpersonal intelligence; Learning models; Learning outcomes; Problem-based learning

Introduction

Improving student learning outcomes remains a central priority in contemporary educational reform, particularly as education systems attempt to respond to rapidly evolving social, technological, and economic demands. Traditional teacher-centered pedagogical approaches are increasingly criticized for limiting students' active engagement and higher-order cognitive development. Consequently, educational research has progressively shifted toward student-centered learning paradigms that emphasize active knowledge construction, collaboration, and problem solving.

Within this context, instructional models such as Problem-Based Learning (PBL) and Cooperative Learning have attracted substantial scholarly attention due to their alignment with constructivist learning principles. Both approaches position learners as active participants in the learning process and encourage social interaction as a mechanism for knowledge construction. Nevertheless, despite the growing body of research supporting their pedagogical effectiveness, comparative investigations examining how these learning models interact with learner characteristics remain limited, particularly in relation to interpersonal intelligence (Abas et al., 2019).

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Problem-Based Learning (PBL) has been widely acknowledged for its capacity to promote deep learning and higher-order cognitive skills. By engaging students in authentic and complex problems, PBL encourages inquiry, critical thinking, and collaborative knowledge construction. Empirical studies have demonstrated that PBL contributes to improved conceptual understanding, analytical reasoning, and problem-solving competence across various disciplines (Abdurahman et al., 2023; Lubis et al., 2022; Safitri et al., 2023). Moreover, meta-analytic evidence indicates that PBL supports long-term knowledge retention and facilitates the transfer of learning to real-world contexts when compared to traditional lecture-based approaches (Yana & Oviana, 2024). However, the successful implementation of PBL often depends on learners' readiness to engage in collaborative inquiry, suggesting that individual learner characteristics may significantly influence its effectiveness.

Similarly, Cooperative Learning has been extensively investigated as an instructional strategy designed to enhance both cognitive and social learning outcomes. Structured cooperative models such as Jigsaw and Student Teams Achievement Divisions (STAD) emphasize positive interdependence, individual accountability, and promotive interaction among students. These pedagogical principles are considered fundamental for fostering collaborative engagement and enhancing students' motivation and academic achievement (Gillies, 2016; Kyndt et al., 2013). Research has consistently shown that cooperative learning environments encourage peer support and shared responsibility, which in turn contribute to improved academic performance and social cohesion (Johnson & Johnson, 2018). Nevertheless, the effectiveness of cooperative learning structures may vary depending on students' social and interpersonal competencies, which shape their ability to engage productively in collaborative tasks.

Although both Problem-Based Learning and Cooperative Learning emphasize collaborative engagement, the two models differ fundamentally in their pedagogical orientation and instructional design. PBL adopts an inquiry-driven approach in which students explore complex problems and construct knowledge through investigative processes. In contrast, Cooperative Learning relies on structured group interactions and clearly defined roles to facilitate collective learning outcomes. Comparative research suggests that PBL may be more effective in fostering critical thinking and conceptual integration, while Cooperative Learning may be particularly beneficial for enhancing academic achievement and social interaction (Mulyanto et al., 2018; Servant-Miklos, 2019). However,

these findings remain inconclusive because many studies fail to consider learner-related variables that may influence the effectiveness of each instructional model.

One learner characteristic that may play a crucial role in collaborative learning contexts is interpersonal intelligence. Interpersonal intelligence refers to the capacity to understand and respond effectively to others' emotions, intentions, and social cues. In educational settings, this ability is closely associated with communication skills, empathy, and collaborative competence (Khatoon et al., 2020). Students with higher levels of interpersonal intelligence tend to demonstrate stronger abilities in managing group dynamics, negotiating meaning, and facilitating productive peer interaction. Empirical evidence indicates that interpersonal intelligence significantly predicts academic success in collaborative and discussion-based learning environments (Arihi et al., 2025; Fadahunsi et al., 2025; Gkintoni et al., 2024; Malaran & Pañares, 2025; Nazilah & Mayarni, 2023). Furthermore, students who possess strong interpersonal skills are often more capable of sustaining constructive dialogue and resolving conflicts during group activities (MacCann et al., 2020; Rahayu et al., 2024).

Despite growing recognition of interpersonal intelligence as an influential learner variable, existing research often treats it merely as an independent predictor of academic achievement rather than as a moderating variable that interacts with instructional models. Many empirical studies report the effectiveness of PBL or Cooperative Learning independently without examining how differences in students' interpersonal intelligence may influence the impact of these pedagogical approaches. For example, research has demonstrated significant main effects of PBL on science learning outcomes and Cooperative Learning on academic achievement across several subject areas (Gillies, 2016; Mandalika et al., 2024; Yana & Oviana, 2024).

This research gap is apparent in prior studies. Despite prior research indicating the effects of Problem-Based Learning and Cooperative Learning on enhancing educational achievements (Gillies, 2016; Yana & Oviana, 2024), empirical data continues to be disjointed and inconsistent. Most studies evaluate each learning model individually, rather than performing direct comparative evaluations in controlled environments. Recent evidence indicates that interpersonal intelligence is a crucial factor influencing student engagement and accomplishment (Arihi et al., 2025; Nazilah & Mayarni, 2023). Nonetheless, research concerning the interplay between interpersonal intelligence and diverse learning styles in connection to educational achievements is scarce.

Constructivist learning theory underscores the need of social interaction in knowledge formation, whereas multiple intelligences theory highlights the importance of individual learner variations. Nevertheless, empirical research infrequently integrates these two theoretical frameworks by examining the interplay between learning models and interpersonal intelligence. Moreover, the majority of prior studies relied on quasi-experimental approaches that concentrate on a singular independent variable. A limited number of research have employed factorial experimental designs to examine the main effects and interaction effects between learning models and learner variables. Research on Problem-Based Learning (PBL) and Cooperative Learning has predominantly taken place in the domains of science and mathematics education. Comparative assessments of these methodologies within the wider framework of social studies education are few..

Given these limitations, further investigation is needed to examine how instructional models interact with learner characteristics to influence academic outcomes. In particular, research employing factorial designs is necessary to determine whether Problem-Based Learning and Cooperative Learning produce different effects on student learning outcomes depending on levels of interpersonal intelligence. Such investigations are essential for developing more adaptive and evidence-based instructional strategies that accommodate individual differences in collaborative learning environments.

Therefore, this study examines differences in student learning outcomes based on learning models (Problem-Based Learning and Cooperative Learning) and students' levels of interpersonal intelligence. By analyzing both the main effects of instructional models and the interaction effects between learning models and interpersonal intelligence, this research aims to provide a more comprehensive understanding of how pedagogical strategies and learner characteristics jointly shape academic performance. This framework rectifies the noted deficiencies and provides a foundation for exploring additional research enquiries: What are the differences in student learning outcomes when using educational paradigms such as Problem-Based Learning (PBL) and cooperative learning? How do differences in student intelligence level (high, medium, and low) affect learning outcomes? How do learning methods (PBL and cooperative learning) and interpersonal intelligence interact with student learning outcomes?

Method

This study employed a quasi-experimental design using a 2×3 factorial framework to examine the effects

of learning models (Problem-Based Learning versus Cooperative Learning) and students' levels of interpersonal intelligence (high, medium and low) on student learning outcomes. A factorial design was selected because it enables the simultaneous examination of main effects and interaction effects between instructional models and learner characteristics, which is particularly appropriate when investigating learner-model fit in classroom settings (Creswell & Creswell, 2018). The quasi-experimental approach was adopted due to the practical constraints of educational environments where random assignment at the individual level is not feasible. Instead, intact classes were randomly assigned to either the PBL or Cooperative Learning treatment condition to maintain ecological validity while preserving experimental control.

The instructional treatments were implemented over eight weeks within the same curricular unit to ensure content equivalence. The Problem-Based Learning condition followed structured phases including problem orientation, identification of learning issues, collaborative inquiry, development of solutions, and reflective evaluation, consistent with established PBL frameworks that emphasize inquiry-driven knowledge construction and self-directed learning (Abdurahman et al., 2023). The Cooperative Learning condition adopted the Student Teams Achievement Divisions (STAD) model, incorporating teacher presentation, team study, individual quizzes, and group recognition procedures to foster positive interdependence and individual accountability (Gillies, 2016). Both treatments were delivered by teachers who received prior training to ensure fidelity of implementation.

This research was conducted in the 2nd semester of the elementary school teacher education study program, the Basic Concepts of Basic Science/Social Studies course at Setiabudi Rangkasbitung University in Banten Province. A total of 100 students participated in the study, with each group including fifty students. The 100 students were distributed proportionally randomly into groups based on the sampling method used, cluster random sampling. All students were proficient speakers of Indonesian. The initial experimental group was assigned the PBL learning model, whereas the subsequent group was assigned the cooperative learning model. Prior to the intervention, students completed a pretest to assess baseline academic equivalence across groups.

Students' interpersonal intelligence was measured using a validated self-report scale adapted from multiple intelligences frameworks, focusing on dimensions such as empathy, social sensitivity, communication skills, and

collaborative disposition. The instrument consisted of 15 Likert-type items rated on a five-point scale. Content validity was established through expert review, and construct validity was examined via confirmatory factor analysis. The reliability coefficient (Cronbach’s alpha) exceeded .85, indicating strong internal consistency. Interpersonal intelligence scores were categorized into high, medium, and low groups, a method frequently applied in factorial educational research to operationalize moderator variables. This approach Use three-level groupings (High, Middle, Low) of interaction effects within experimental designs.

Student learning outcomes were assessed through two complementary measures: cognitive achievement and collaborative competence. Cognitive achievement was evaluated using a curriculum-aligned achievement test comprising multiple-choice and open-ended problem-solving items designed to measure conceptual understanding and higher-order thinking skills. Collaborative competence was measured through a structured observation rubric assessing participation quality, responsiveness to peers, and conflict management skills, as these behaviors are central to both PBL and Cooperative Learning environments (Gillies, 2016).

Data collection occurred in four stages. During the initial phase, students completed the interpersonal intelligence scale and a pretest to establish baseline performance. The second phase involved implementation of the instructional treatments over eight consecutive weeks, during which fidelity checklists were employed to monitor adherence to model procedures. In the third phase, students completed a posttest measuring cognitive achievement, and collaborative competence was assessed through structured observation during group activities. A retention test was administered four weeks later to evaluate the durability of learning gains, responding to prior research that emphasizes the importance of long-term outcome assessment beyond immediate post-intervention effects.

Data analysis was conducted using two-way Analysis of Variance (ANOVA) to test for main effects of learning model and interpersonal intelligence level, as well as the interaction effect between these variables. Two-way ANOVA, or two-factor ANOVA, examines the concurrent effects of two nominal variables, referred to as factors A and B. These parameters can assume various values referred to as levels. Every pairing of a factor level of A with a factor level of B constitutes a treatment (Assaad et al., 2015).

Result and Discussion

This study examined the disparities in student learning outcomes between Problem-Based Learning and Cooperative Learning models, as well as variations in students' interpersonal intelligence levels categorised as high, medium, and low. This study yielded three research findings: (1) disparities in learning outcomes between students subjected to varying learning models (PBL versus Cooperative), (2) variations in learning outcomes among students categorised by high, medium, and low levels of interpersonal intelligence, and (3) the influence of the interaction between learning models and students' levels of interpersonal intelligence on learning outcomes, as evidenced by the average pre-test and post-test scores. Evaluations were performed prior to and after to the intervention to assess student learning results. The results indicated substantial disparities in educational achievements across the two student cohorts. A notable disparity in students' interpersonal intelligence was detected between the two groups. Notably, there were considerable disparities among students with high, medium, and low levels of interpersonal intelligence. This was apparent from the disparities in the average outcomes reported by the different groups. Consequently, Tables 1 and 2 present a summary of student learning results before to and after the execution of the learning models, encompassing the degrees of student interpersonal intelligence across the different groups.

Table 1. Descriptive statistics of the control group learning outcomes

Statistics	Interpersonal Intelligence	Pre-test	N	Post-test	N
Means	High	78.50	18	80.11	18
	Medium	66.37	19	67.67	18
	Low	61.46	13	65.46	14
Std. Deviation	High	5.844	18	9.418	18
	Medium	7.182	19	6.523	19
	Low	10.219	13	10.219	14

Table 1 presents the descriptive statistics of students’ learning outcomes in the control group categorized by levels of interpersonal intelligence (high, medium, and low), measured through pre-test and post-

test scores. The analysis aims to provide an overview of students’ initial academic conditions and the changes in their learning outcomes after the instructional process in the control class.

Students with high interpersonal intelligence demonstrated the highest level of academic performance among the three groups. The mean score on the pre-test was 78.50 (N = 18), indicating relatively strong prior knowledge before the instructional intervention. Following the learning process, the post-test mean increased slightly to 80.11 (N = 18). This improvement suggests that students in this category maintained relatively high academic achievement after instruction. However, the standard deviation increased from 5.844 in the pre-test to 9.418 in the post-test, indicating that the variation of scores among students became wider after the learning process, suggesting differing levels of improvement within this group.

For students with medium interpersonal intelligence, the pre-test mean score was 66.37 (N = 19), reflecting moderate baseline knowledge. After the instructional process, the post-test mean increased to 67.67 (N = 18), indicating a modest improvement in learning outcomes. The standard deviation decreased from 7.182 in the pre-test to 6.523 in the post-test, suggesting that students' scores became slightly more homogeneous after instruction. This pattern indicates that although the improvement in average performance was relatively small, the distribution of student achievement became more consistent.

Students categorized with low interpersonal intelligence exhibited the lowest mean scores at the

initial stage. The pre-test mean was 61.46 (N = 13), indicating relatively lower prior understanding of the learning material compared with the other groups. After the learning process, the post-test mean increased to 65.46 (N = 14), suggesting a noticeable improvement in students' learning outcomes. Nevertheless, the standard deviation remained relatively high at 10.219 in both the pre-test and post-test, indicating substantial variability in academic performance among students in this category.

Overall, the descriptive statistics indicate that students with higher levels of interpersonal intelligence tend to achieve higher average learning outcomes in both pre-test and post-test measurements. Although improvements in mean scores are observed across all categories, the magnitude of change differs between groups. The largest increase in mean score appears in the low interpersonal intelligence group, while the highest overall achievement remains within the high interpersonal intelligence group. These descriptive findings suggest a potential relationship between interpersonal intelligence and academic performance in the control group. However, further inferential statistical analysis is required to determine whether the observed differences are statistically significant and whether interpersonal intelligence significantly influences students' learning outcomes.

Table 2. Descriptive statistics of the experimental group learning outcomes

Statistics	Interpersonal Intelligence	Pre-test	N	Post-test	N
Means	High	74.13	16	84.31	16
	Medium	71.68	19	77.79	19
	Low	64.80	15	66.47	15
Std. Deviation	High	7.420	16	10.170	16
	Medium	7.896	19	11.665	19
	Low	11.797	15	14.352	15

The data indicate an overall improvement in learning outcomes after the implementation of the experimental learning model. Students with high interpersonal intelligence achieved a pre-test mean score of 74.13 (SD = 7.420; n = 16), which increased significantly to 84.31 (SD = 10.170; n = 16) in the post-test. This represents a substantial gain of 10.18 points, suggesting that the experimental treatment was highly effective for students with strong interpersonal competencies. The increase in standard deviation from 7.420 to 10.170 indicates greater variability in post-test performance, meaning that while most students improved, the extent of improvement differed among individuals.

Students with medium interpersonal intelligence also showed meaningful progress. Their pre-test mean score was 71.68 (SD = 7.896; n = 19), increasing to 77.79

(SD = 11.665; n = 19) in the post-test. The improvement of 6.11 points demonstrates that the experimental learning model positively influenced this group as well. However, the larger post-test standard deviation (11.665) compared to the pre-test (7.896) suggests that learning gains were not evenly distributed, with some students benefiting more than others.

For students with low interpersonal intelligence, the pre-test mean score was 64.80 (SD = 11.797; n = 15), rising slightly to 66.47 (SD = 14.352; n = 15) in the post-test. The increase of 1.67 points indicates a modest improvement, but the gain is considerably smaller than that observed in the high and medium groups. The relatively large and increasing standard deviation (from 11.797 to 14.352) reflects substantial heterogeneity within this group, suggesting that the intervention had inconsistent effects on students with lower interpersonal intelligence.

When comparing across levels, students with higher interpersonal intelligence consistently achieved better academic performance both before and after the intervention. More importantly, the magnitude of improvement appears to be proportional to the level of interpersonal intelligence: the higher the interpersonal intelligence, the greater the gain in learning outcomes. This pattern suggests a potential interaction between the

learning model and students' interpersonal intelligence levels.

Overall, the descriptive statistics indicate that the experimental learning model effectively enhanced student learning outcomes, particularly among students with high and medium interpersonal intelligence. The findings also imply that interpersonal intelligence may function as a moderating variable influencing the effectiveness of instructional interventions.

Table 3. Test of ANOVA 2 ways

Dependent Variable				Learning Outcomes	
Corrected Model	6663.463a	5	1332.693	12.033	0.000
Intercept	518688.113	1	518688.113	4683.132	0.000
Learning Models	1189.459	1	1189.459	10.739	0.001
Interpersonal Intelligence	5187.563	2	2593.781	23.419	0.000
Learning Models * Interpersonal Intelligence	300.595	2	150.298	8.357	0.006
Error	10411.127	94	110.757		
Total	553045.000	100			
Corrected Total	17074.590	99			

a. R Squared = .0772 (Adjusted R Squared = .0665)

The overall model (Corrected Model) is statistically significant, with $F(5, 94) = 12.033$ and $p = .000$. This indicates that the combination of learning models, interpersonal intelligence, and their interaction significantly explains variation in students' learning outcomes. The model's R Squared value is .0772 (Adjusted R Squared = .0665), meaning that approximately 77.2%-7.6% of the variance in learning outcomes can be explained collectively by the independent variables included in the model. Although the effect size is modest, the model remains statistically meaningful in explaining differences in academic performance.

The main effect of learning models is statistically significant, $F(1, 94) = 10.739$, $p = .001$. This finding indicates that there is a significant difference in learning outcomes between students taught using Problem-Based Learning (PBL) and those taught using cooperative learning. In other words, the type of instructional model employed has a measurable impact on students' academic achievement.

The main effect of interpersonal intelligence is also highly significant, $F(2, 94) = 23.419$, $p = .000$. This result demonstrates that students' levels of interpersonal intelligence (high, medium, and low) significantly influence learning outcomes. The relatively large F value suggests that interpersonal intelligence contributes more strongly to variance in learning outcomes compared to the learning model variable alone. Thus, students' interpersonal competence appears to be an important predictor of academic success.

Importantly, the interaction effect between learning models and interpersonal intelligence is statistically significant, $F(2, 94) = 8.357$, $p = .006$. This indicates that the effectiveness of the learning model depends on students' interpersonal intelligence levels. In practical terms, the difference in learning outcomes between PBL and cooperative learning is not consistent across all students; rather, it varies depending on whether students possess high, medium, or low interpersonal intelligence. This interaction effect strengthens the argument that instructional strategies and learner characteristics jointly influence academic achievement. The error term (Mean Square = 110.757) represents unexplained variance in the model. Given the significant interaction effect, it can be inferred that the impact of learning models cannot be interpreted independently of interpersonal intelligence levels.

Overall, the two-way ANOVA results confirm three important findings: first, learning models significantly affect learning outcomes; second, interpersonal intelligence significantly influences academic performance; and third, there is a significant interaction between the two variables. These findings suggest that optimizing student learning outcomes requires not only selecting effective instructional models but also considering students' interpersonal intelligence profiles as a moderating factor in instructional design.

Table 4. Using Tukey Test

(I) Interpersonal Intelligence	(J) Interpersonal Intelligence	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
High	Medium	10.14*	2.484	0.000	4.22	16.06
	Low	17.95*	2.686	0.000	11.55	24.34
Medium	High	-10.14*	2.484	0.000	-16.06	-4.22
	Low	7.80*	2.621	0.010	1.56	14.05
Low	High	-17.95*	2.686	0.000	-24.34	-11.55
	Medium	-7.80*	2.621	0.010	-14.05	-1.56

Based on observed means.

The error term is Mean Square (Error) = 70.232.

*. The mean difference is significant at the .05 level.

The Multiple Comparisons table using the Tukey HSD post hoc test presents pairwise comparisons among students with high, medium, and low levels of interpersonal intelligence on learning outcomes. This analysis was conducted following the significant main effect of interpersonal intelligence identified in the two-way ANOVA, with the error term Mean Square (Error) = 70.232. The comparison between students with high and medium interpersonal intelligence shows a mean difference of 10.14, which is statistically significant ($p = .000$). The 95% confidence interval ranges from 4.22 to 16.06 and does not include zero, confirming that students with high interpersonal intelligence perform significantly better than those with medium levels. This indicates a substantial academic advantage associated with higher interpersonal competence.

The difference between high and low interpersonal intelligence is even larger, with a mean difference of 17.95 ($p = .000$). The 95% confidence interval (11.55 to 24.34) further confirms the robustness of this difference. This finding demonstrates that students with high interpersonal intelligence significantly outperform those with low interpersonal intelligence in terms of learning outcomes. The magnitude of this gap suggests that interpersonal intelligence plays a strong role in shaping academic achievement.

Similarly, the comparison between medium and low interpersonal intelligence reveals a statistically significant mean difference of 7.80 ($p = .010$), with a 95% confidence interval ranging from 1.56 to 14.05. Although the difference is smaller than that observed between the high and low groups, it remains statistically meaningful. This indicates that students with medium interpersonal intelligence still achieve significantly better learning outcomes than those with low levels. The negative mean differences shown in the reverse comparisons (e.g., medium vs. high, low vs. high, low vs. medium) simply reflect the direction of comparison and confirm the same pattern of significance.

Overall, the Tukey HSD results demonstrate a clear hierarchical pattern: students with high interpersonal intelligence achieve the highest learning outcomes,

followed by those with medium levels, and finally those with low levels. All pairwise differences are statistically significant at the .05 level. These findings reinforce the conclusion that interpersonal intelligence is a critical differentiating factor in students' academic performance and substantiate the earlier ANOVA results indicating a strong main effect of interpersonal intelligence on learning outcomes.

Discussion

This study yielded three research findings: disparities in learning outcomes between students subjected to varying learning models (PBL versus Cooperative), variations in learning outcomes among students categorised by high, medium, and low levels of interpersonal intelligence, and the influence of the interaction between learning models and students' levels of interpersonal intelligence on learning outcomes.

The primary finding of this study is the disparity in learning outcomes between students utilising different educational models (PBL versus Cooperative). These results align with prior research (Ardianti & Marlina, 2020; Çelik & Bati, 2025; Fauzan et al., 2024; Hakim et al., 2025; Jannah et al., 2025; Koriřáková et al., 2023; Musthofa et al., 2019; Rivera-Pérez et al., 2021; Saputra et al., 2024; Sulastri et al., 2024; Wang, 2021; Wijayanto et al., 2025), which has consistently demonstrated that both Problem-Based Learning (PBL) and Cooperative Learning significantly enhance student learning outcomes in comparison to traditional methods. Problem-Based Learning (PBL) enhances critical thinking abilities, problem-solving skills, and autonomous learning, whilst Cooperative Learning effectively boosts cognitive learning outcomes, engagement, and social cooperative skills. Nevertheless, the majority of studies exclusively juxtapose each model with traditional learning, and only a limited number have explicitly contrasted PBL with cooperative learning inside a singular experimental framework. Moreover, prior studies have typically failed to incorporate individual student traits, especially interpersonal

intelligence, in evaluating the efficacy of learning models.

The second research conclusion indicates disparities in learning outcomes among students classified as having high, medium, and low levels of interpersonal intelligence. The findings substantiate prior studies (Abas et al., 2019; Garner et al., 2025; Istapra et al., 2021; Listiana et al., 2025; Nazilah & Mayarni, 2023; Okwuduba et al., 2021; Pratiwi & Arbeni, 2025; Rahayu et al., 2024; Sutiyatno & Subiyanto, 2021) indicating that interpersonal intelligence affects student learning outcomes. Analysis of pre-test, post-test, and follow-up data identified four student groups demonstrating interpersonal intelligence, signifying significant learning outcomes: high vs. medium, high vs. low, medium vs. high, and low vs. high. These research findings align with prior studies demonstrating the impact of interpersonal intelligence on student learning outcomes. The bulk of investigations employed correlational or basic regression methodologies. Research employing an interactional strategy, such as factorial design or moderated regression, that investigates the concurrent and moderating influences of interpersonal intelligence on the efficacy of learning models remains comparatively few. Consequently, the results of this study are innovative as they employ a distinct methodology compared to prior studies.

The third research finding is the interaction between learning models and students' interpersonal intelligence concerning learning outcomes, a recent discovery. The research findings indicate an important interaction between learning models and students' interpersonal intelligence regarding learning outcomes. Extensive research on educational outcomes has concentrated on the efficacy of diverse pedagogical models, such as Project-Based Learning, Problem-Based Learning, and Collaborative Learning. Numerous research indicate that student-centered learning approaches can markedly enhance the quality of learning results in comparison to conventional models. Nevertheless, the majority of this research has concentrated exclusively on the direct influence of learning models on student learning results, neglecting variability in students' cognitive characteristics.

Conversely, pupils' interpersonal intelligence is acknowledged as a vital factor in educational outcomes. Prior research indicates that youngsters exhibiting enhanced learning outcomes possess higher skills in concept organization and argument development. This research has predominantly examined the effect of students' interpersonal intelligence independently, rather than in relation to the use of a particular learning paradigm. This research gap stems from the absence of optimum empirical investigations investigating the

concurrent interaction of learning models and students' interpersonal intelligence levels on learning outcomes, employing experimental designs that enable statistical analysis of these interactions.

This study is distinctive as it examines the interaction effects of learning models (PBL vs. Cooperative Learning) and students' interpersonal intelligence on learning outcomes, rather than merely evaluating the influence of each variable in isolation. This study offers a novel addition by illustrating that the efficacy of a learning model is not universal but contingent upon students' cognitive characteristics. This study presents a methodological breakthrough through the application of a factorial experimental design (e.g., 2x3), enabling a thorough examination of the distinct impacts of learning models on students with diverse interpersonal intelligences. This methodology provides more substantial empirical data than earlier descriptive or correlational investigations.

Conclusion

This study corroborates three principal findings: Disparities in learning outcomes among students subjected to distinct learning models (Problem-Based Learning versus Cooperative Learning), variations in learning outcomes among students categorised by high, medium, and low levels of interpersonal intelligence, and the influence of the interplay between learning models and students' interpersonal intelligence levels on learning outcomes. This study's findings significantly endorse constructivist theory, which posits that learning is more effective when students actively construct knowledge through interaction, problem-solving, and critical reflection. This study has several limitations that should be acknowledged. First, the research was conducted within a limited geographic scope, focusing on a specific educational context. As a result, the findings may not be fully generalizable to broader educational settings with different socio-cultural or institutional characteristics. Second, the analysis in this study primarily concentrates on the role of interpersonal intelligence as a moderating variable, while other potentially influential factors such as learning motivation, prior academic achievement, and socio-emotional skills were not examined. Future studies are therefore encouraged to incorporate a wider range of learner variables and broader research contexts to provide a more comprehensive understanding of the effectiveness of collaborative learning models. This study implies that the choice of learning model plays a crucial role in improving learning outcomes, as problem-based learning and cooperative learning contribute in different ways. The findings also indicate

that interpersonal intelligence should be considered in instructional planning, since students with varying levels of interpersonal intelligence may respond differently to each learning model.

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Author Contributions

IS: conceptualisation, original draft preparation, methodology; AW: conceptualisation, methodology, review and editing; LM: curation, original draft preparation, methodology, formal analysis, validation.

Conflicts of Interest

The authors declare no conflict of interest.

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