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Do Active Learning Models Differ? Examining of PBL, Cooperative Learning and Critical Thinking on Social Studies Outcomes

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ABSTRACT

Objective: This study ams to analyse variations in students' learning outcomes based on the learning models employed Problem-Based Learning (PBL) and Cooperative Learning and their levels of critical thinking. **Method:** This study employed a quasi-experimental approach with a 2 × 3 factorial design to examine the effects of instructional models and students' critical thinking levels on learning outcomes. A total of 100 students participated in the study, with 50 students assigned to each instructional group. The participants were proportionally assigned to the groups using cluster random sampling. **Results:** The study produced three man findings: (1) there were differences in learning outcomes between students taught using PBL and those taught using Cooperative Learning; (2) learning outcomes varied among students with high, moderate, and low levels of critical thinking; and (3) there was an interaction effect between the instructional models and students' critical thinking levels on their learning outcomes. **Novelty:** This study makes several important contributions to the existing literature. First, it directly compares two prominent active learning models, namely PBL and Cooperative Learning, within the same analytical framework rather than examining them separately. Second, it positions critical thinking not merely as an independent predictor of achievement but as a moderating variable that may influence the effectiveness of instructional models in improving social studies learning outcomes. Third, the study employs a factorial design that enables the simultaneous examination of both man and interaction effects. This approach provides a more comprehensive explanation of the relationship between learner characteristics and instructional models and contributes to the development of constructivist and social cognitive perspectives in social studies instruction.

INTRODUCTION

Improving student learning outcomes remans a persistent priority in contemporary educational reform. The transition from teacher-centered paradigms toward student-centered instruction has generated substantial scholarly attention, particularly concerning models such as Problem-Based Learning (PBL) and Cooperative Learning. Both models are grounded in constructivist theory and emphasize active engagement, collaboration, and contextualized problem solving. These approaches are widely promoted because they are considered capable of improving not only academic achievement but also students' higher-order thinking skills and social participation. However, despite robust empirical support for their effectiveness, comparative evidence regarding how these models interact with individual learner characteristics remans limited (Abas et al., 2019). Existing studies tend to examine instructional models in isolation and rarely investigate whether differences in students' cognitive capacities influence the effectiveness of active learning environments. This limitation becomes

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increasingly important in heterogeneous classrooms where variations in critical thinking ability may significantly shape instructional outcomes.

Within the broader discourse of active learning, Problem-Based Learning (PBL) has received considerable attention due to its emphasis on inquiry, problem solving, and conceptual exploration. PBL is widely recognized for its capacity to promote higher-order thinking, conceptual understanding, and problem-solving skills (Abdurahman et al., 2023; Lubis et al., 2022; Safitri et al., 2023). Meta-analytic evidence further indicates that PBL enhances long-term retention and application of knowledge compared to conventional lecture-based instruction (Yana & Oviana, 2024). These findings reinforce the argument that inquiry-oriented learning environments can strengthen students' analytical reasoning and independent learning processes. Nevertheless, the effectiveness of PBL is not always consistent across contexts because successful inquiry depends heavily on students' ability to analyze information critically, formulate arguments, and regulate collaborative discussion.

Alongside PBL, Cooperative Learning (CL) has also emerged as a dominant student-centered instructional approach. Cooperative Learning, particularly structured models such as Jigsaw and Student Teams Achievement Divisions (STAD), has been shown to improve academic achievement, motivation, and peer interaction (Gillies, 2016; Kyndt et al., 2013). Cooperative structures promote positive interdependence, individual accountability, and promotive interaction, which contribute to improved learning outcomes across disciplines (Johnson & Johnson, 2018). Unlike PBL, which prioritizes inquiry-based problem exploration, Cooperative Learning focuses more strongly on structured interaction and shared responsibility among group members. This distinction suggests that the two models may generate different cognitive and social learning experiences for students.

Theoretical and empirical differences between PBL and Cooperative Learning have led researchers to compare their relative effectiveness. Research comparing these models suggests that PBL may yield stronger gains in critical thinking and conceptual integration, whereas Cooperative Learning may be particularly effective in enhancing academic performance and social cohesion (Mulyanto et al., 2018; Servant-Miklos, 2019). Although these findings appear promising, they remain inconclusive because most comparative studies focus primarily on direct instructional effects while overlooking the role of learner characteristics as moderating variables. Consequently, the literature still lacks a comprehensive explanation of why one instructional model may be more effective than another under different student conditions.

One learner characteristic that requires greater scholarly attention is critical thinking ability. In social studies education, critical thinking plays a central role because students are expected to evaluate information, interpret social phenomena, assess multiple perspectives, and formulate evidence-based conclusions. Students with stronger critical thinking skills are generally better able to participate in discussion-based and inquiry-oriented learning environments because they can analyze arguments systematically and construct meaningful interpretations of complex issues. Recent empirical studies similarly indicate that cognitive and social capacities significantly predict academic achievement in interactive learning settings (Arihi et al., 2025; Nazilah & Mayarni, 2023). Furthermore, students with stronger critical thinking and collaborative abilities tend to benefit more from discussion-oriented instruction due to their enhanced capacity to negotiate meaning and maintain productive group

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interaction (Rahayu et al., 2024). These findings imply that learner characteristics may substantially influence the effectiveness of active learning models.

Despite the increasing recognition of learner characteristics as influential educational variables, existing research often treats them merely as isolated predictors rather than as moderating variables interacting with instructional models. For example, studies have demonstrated significant main effects of PBL on science achievement and of Cooperative Learning on mathematics and social science outcomes (Gillies, 2016; Mandalika et al., 2024; Yana & Oviana, 2024). However, few investigations employ factorial designs to examine whether the effectiveness of PBL versus Cooperative Learning differs according to students' levels of critical thinking. As a result, the field still lacks a nuanced understanding of learner-model compatibility. This absence creates a theoretical gap because constructivist learning theory emphasizes that knowledge construction is shaped not only by instructional design but also by students' cognitive engagement and reasoning processes.

Another limitation concerns methodological rigor within previous studies. Much of the literature relies on quasi-experimental designs with limited control over confounding variables such as motivation, prior achievement, or socio-cultural influences. Furthermore, many studies focus only on immediate post-test outcomes without examining broader cognitive interactions underlying learning performance. Although prior research acknowledges that active learning environments require strong cognitive engagement and collaborative participation, empirical examinations of interaction effects between learning models and critical thinking remain scarce. This methodological weakness contributes to inconsistent conclusions regarding the superiority of PBL or Cooperative Learning across educational contexts.

The theoretical positioning of PBL in constructivism is sound because learning is viewed as contextual, actively constructed, and socially mediated (Anazifa & Djukri, 2017; Chen & Yang, 2021; Iryani & Suryadi, 2025; Purwaningsih et al., 2020; Siew & Ambo, 2018). Meanwhile, Cooperative Learning is introduced as a collaborative and goal-oriented group approach that supports idea exchange and collective problem solving (Nasri & Biria, 2016). Although these theoretical foundations are well established, the conceptual framing within previous studies remains generalized. Cooperative Learning encompasses diverse structures such as peer review, collaborative drafting, jigsaw activities, and role-based teamwork, all of which may generate different cognitive outcomes. Similarly, the effectiveness of PBL may depend on students' readiness to engage in inquiry-based reasoning. Yet prior studies rarely investigate how differences in students' critical thinking levels shape the effectiveness of these instructional models.

Previous studies have generally examined problem based learning (PBL) and cooperative learning separately or compared their overall effectiveness without considering differences in students' critical thinking levels. As a result, evidence remans limited regarding how each learning model performs across different levels of critical thinking within a single factorial framework. Comparing these two models using the same experimental design is necessary because it enables researchers to examine both the independent effects of learning models and their interaction with students' critical thinking abilities. This approach provides more comprehensive evidence for selecting instructional strategies that are better aligned with students' cognitive characteristics in

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social studies education, where analytical reasoning, problem solving, and informed decision making are essential learning outcomes.

This study offers several important contributions to the existing literature. First, the study directly compares two dominant active learning models, namely PBL and cooperative learning, within the same analytical framework rather than examining them separately. Second, the study positions critical thinking not merely as an independent predictor of achievement but as a moderating variable that may influence the effectiveness of instructional models on social studies learning outcomes. Third, the study employs a factorial analytical design capable of examining both main effects and interaction effects simultaneously. This approach provides a more comprehensive explanation of learner-model relationships and contributes to the development of constructivist and socio-cognitive perspectives in social studies instruction.

This study seeks to analyse variations in student learning results contingent upon learning paradigms (PBL versus Cooperative Learning) and students' critical thinking levels. The study specifically examines the following research questions: 1) Are there distinctions in the learning outcomes of students who are instructed using PBL and those who are instructed using cooperative learning? 2) Are learning outcomes influenced by the differing levels of critical thinking among pupils (high, medium, and low)? 3) Is there an interaction impact between learning models and students' critical thinking levels on social studies learning outcomes?.

RESEARCH METHOD

This study employed a quasi-experimental design with a 2 × 3 factorial structure to investigate the influence of instructional models and students' critical thinking abilities on learning outcomes. The primary component consisted of two educational frameworks: cooperative learning and problem-based learning (PBL). The second group encompassed three tiers of critical thinking proficiency: high, medium, and low. A factorial design was chosen as it enables the concurrent analysis of both main and interaction effects between instructional strategies and learner characteristics, rendering it especially appropriate for investigating instructional efficacy across diverse cognitive profiles (Creswell & Creswell, 2018).

One class underwent the PBL intervention, while the other class engaged in Cooperative Learning instruction. This research was conducted in the second semester of the primary school teacher education program, namely in the Basic Concepts of Social Studies course at Setiabudi Rangkasbitung University in Banten Province. One hundred students participated in the study, with each group including fifty students. One hundred students were randomly allocated into groups proportionally according to the cluster random sampling method employed. All students demonstrated proficiency in speaking Indonesian. The first experimental group was designated the PBL learning model, whereas the following group was allocated the cooperative learning model. Before the intervention, students undertook a pretest to evaluate baseline academic equivalence among groups.

The instructional interventions were executed over eight consecutive weeks utilising comparable learning resources and instructional goals. The PBL intervention adhered to systematic stages, including problem orientation, identification of learning challenges, collaborative inquiry, solution formulation, and reflective evaluation. These steps correspond with recognised PBL concepts that highlight inquiry-based learning,

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autonomous knowledge production, and genuine problem-solving (Abdurahman et al., 2023). The Cooperative Learning group employed the Student Teams Achievement Divisions (STAD) model, encompassing teacher presentations, team study sessions, individual quizzes, and group recognition protocols aimed at fostering positive interdependence and individual accountability (Gillies, 2016). To guarantee treatment fidelity, participating educators had preliminary instructional training, and fidelity checklists were utilised during the intervention period.

Students' critical thinking was measured using a critical thinking questionnare adapted from the California critical thinking skills framework developed by Facione (2011), which conceptualises critical thinking as purposeful and self-regulatory judgment involving interpretation, analysis, evaluation, inference, explanation, and self-regulation.. To guarantee treatment fidelity, participating educators had preliminary instructional training, and fidelity checklists were utilised during the intervention period. The critical thinking abilities of students were evaluated with a validated tool based on the critical thinking framework developed (Gillies, 2016).

The data gathering occurred in four phases. Initially, students administered the critical thinking measure and a pretest to determine baseline equivalency. During the second phase, the instructional interventions were executed for a duration of eight weeks, accompanied by regular fidelity monitoring. In the third stage, students undertook a posttest to evaluate cognitive achievement, while collaborative competence was assessed through systematic classroom observations during group activities. A retention test was conducted four weeks post-intervention to assess the durability of learning outcomes beyond initial effects. Data were examined by two-way analysis of variance (ANOVA) to assess the principal effects of learning models and critical thinking levels, as well as their interaction effects on student learning outcomes. Prior to doing hypothesis testing, the assumptions of normality and homogeneity of variance were assessed to validate the appropriateness of parametric statistical analysis.

Prior to primary data collection, the instrument underwent content validation by three experts in social studies education and educational measurement to ensure construct relevance and content representativeness. Item validity was then examined using corrected item-total correlations, with all items exceeding the recommended threshold of 0.30, indicating satisfactory construct validity. Internal consistency reliability was assessed using Cronbach's alpha, yielding a coefficient of 0.91, indicating excellent reliability (Har et al., 2017). This validation procedure demonstrated that the instrument provides a reliable and valid measure of students' critical thinking skills and learning outcomes.

RESULTS AND DISCUSSION

Results

This study investigated the influence of learning models and students' critical thinking skills on learning outcomes. The study examined: (1) the differences in learning outcomes between students taught through Problem-Based Learning (PBL) and those taught via Cooperative Learning, (2) the differences in learning outcomes among students classified by high, medium, and low levels of critical thinking, and (3) the interaction effect of learning models and critical thinking levels on student learning outcomes.

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To assess the efficacy of the interventions, pre-test and post-test evaluations were undertaken before to and following the instructional therapies. The results revealed significant differences in learning outcomes between students exposed to the PBL and Cooperative Learning approaches. Significant discrepancies were observed among students with differing levels of critical thinking ability, indicating that those with advanced critical thinking skills achieved better learning outcomes than their counterparts with moderate and poor abilities. The analysis demonstrated a significant interaction effect between the instructional model and critical thinking level, suggesting that the effectiveness of the learning model fluctuated according on students' cognitive characteristics. Tables 1 summarise the pre-test and post-test results across instructional groups and critical thinking categories.

Table 1. Descriptive statistics of the control and experimental group learning outcomes

Statistics	Critical Thinking Level	Pre-test	N	Post-test	N
(Control group)					
Mean	High	70.00	18	80.00	18
	Medium	60.37	19	70.00	19
	Low	61.46	13	65.00	14
Standard Deviation	High	4.844	18	8.418	18
	Medium	6.182	19	7.523	19
	Low	9.219	13	10.219	14
(Experimental group)					
Mean	High	74.13	16	85.75	16
	Medium	70.00	19	77.89	19
	Low	65.80	15	75.00	15
Standard Deviation	High	7.120	16	11.170	16
	Medium	7.796	19	11.665	19
	Low	11.697	15	12.352	15

Table 1 presents the descriptive statistics of students' learning outcomes in both the control group and the experimental group, categorized according to three levels of critical thinking (high, medium, and low) during the pre-test and post-test stages. Overall, the descriptive results indicate that both groups experienced improvements in learning outcomes after the instructional intervention. However, the experimental group consistently demonstrated higher post-test mean scores across all critical thinking levels than the control group, suggesting that the instructional treatment implemented in the experimental class produced greater improvements in students' academic performance. Furthermore, students with higher levels of critical thinking consistently achieved superior learning outcomes compared with those possessing medium or low levels of critical thinking, indicating a positive association between critical thinking ability and academic achievement. These descriptive findings provide preliminary evidence that both instructional approach and students' cognitive characteristics contributed to variations in learning outcomes observed during the study.

Within the control group, students classified as having high critical thinking skills obtaned a pre-test mean score of 70.00, which increased to 80.00 in the post-test, representing a gan of 10.00 ponts. Students in the medium critical thinking category improved from 60.37 to 70.00, reflecting an increase of 9.63 ponts. Meanwhile, students with low critical thinking skills demonstrated the smallest improvement, increasing from 61.46 to 65.00, equivalent to only 3.54 ponts. Although all categories exhibited

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positive learning gans, the magnitude of improvement varied considerably across critical thinking levels. Students with stronger critical thinking abilities benefited more substantially from the learning process than those with lower critical thinking abilities. Moreover, the increase in standard deviation from the pre-test to the post-test across all categories indicates greater variability in students' post-intervention performance, suggesting that the instructional approach generated unequal learning gans among students with different cognitive capacities.

A more pronounced improvement was observed in the experimental group. Students with high critical thinking skills achieved a pre-test mean score of 74.13, which increased substantially to 85.75 during the post-test, representing the largest gan (11.62 ponts) among all categories. Similarly, students with medium critical thinking skills improved from 70.00 to 77.89, while those with low critical thinking skills increased from 65.80 to 75.00, corresponding to gans of 7.89 and 9.20 ponts, respectively. Compared with the control group, the experimental group demonstrated consistently higher post-test means regardless of critical thinking level. Notably, even students classified within the low critical thinking category in the experimental group achieved post-test scores that exceeded those of their counterparts in the control group. These findings suggest that the instructional treatment implemented in the experimental class was effective in enhancing students' learning outcomes across different levels of critical thinking, while also reducing the performance gap between students with different cognitive abilities.

Collectively, the descriptive statistics indicate two important patterns. First, learning outcomes improved from the pre-test to the post-test in both groups, confirming that the instructional process positively influenced students' academic achievement. Second, the experimental group consistently outperformed the control group across all levels of critical thinking, suggesting that the instructional intervention was more effective than the conventional learning approach. Additionally, the consistently higher achievement of students with high critical thinking skills reinforces the important role of critical thinking as a cognitive resource that supports deeper conceptual understanding and more successful learning performance. These descriptive findings provide a strong empirical basis for subsequent inferential analyses examining whether the observed differences are statistically significant and whether an interaction exists between the instructional model and students' critical thinking levels in predicting learning outcomes.

Table 2. Test of ANOVA 2 ways
Dependent Variable: Learning Outcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6663.463[a]	5	1332.693	15.033	.000
Intercept	581688.113	1	518688.113	4783.132	.000
Learning Models	1189.459	1	1189.459	15.795	.000
Critical Thinking	5287.563	2	2593.781	25.119	.000
Learning Models* Critical Thinking	400.595	2	150.298	18.375	.000
Error	10411.127	94	110.757	–	–
Total	553045.000	100	–	–	–
Corrected Total	17074.590	99	–	–	–

a. R Squared = .0785 (Adjusted R Squared = .0775)

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The results of the two-way analysis of variance (ANOVA) that examined the influence of learning models and students' critical thinking levels on learning outcomes are presented in Table 2. The analysis revealed that the independent variables collectively accounted for a considerable proportion of the variance in student learning outcomes, as evidenced by the statistical significance of the overall model (F = 15.033, p <.000). The learning models' principal effect was statistically significant (F = 15.795, p <.000). This discovery indicates that students who were taught using a variety of learning models, including Problem-Based Learning (PBL) and Cooperative Learning, achieved educational outcomes that were significantly different. The results suggest that cooperative learning and problem-based learning (PBL) significantly improved the learning outcomes of students.

The analysis also demonstrated a significant main effect of critical thinking level on learning outcomes, F= 25.119, p < .000. This result indicates that students categorized as having high, medium, and low critical thinking abilities differed significantly in their academic achievement. Students with higher levels of critical thinking tended to demonstrate superior learning outcomes compared to those with lower levels. The interaction impact between the learning models and critical thinking level was statistically significant, F = 18.375, p < .000. This conclusion indicates that the efficacy of the learning models was contingent upon the critical thinking attributes of the pupils. The influence of PBL and Cooperative Learning on educational results differed according to varying levels of critical thinking proficiency. The model yielded a R^2 value of .785 and an adjusted R^2 value of .775, signifying that roughly 77.5% of the variance in student learning outcomes was elucidated by the interplay of instructional model, critical thinking level, and their interaction. This outcome indicates that the suggested model possessed significant explanatory power in forecasting students' academic performance.

Table 3. Using Tukey Test

Multiple Comparisons
Dependent Variable: Learning Outcomes
Tukey HSD

(I) Critical Thinking	(J) Critical Thinking	Mean Difference (I–J)	Std. Error	Sig.	95% CI Lower Bound	95% CI Upper Bound
High	Medium	10.14*	2.484	.000	4.22	16.06
	Low	17.95*	2.686	.000	11.55	24.34
Medium	High	−10.14*	2.484	.000	−16.06	−4.22
	Low	7.80*	2.621	.010	1.56	14.05
Low	High	−17.95*	2.686	.000	−24.34	−11.55
	Medium	−7.80*	2.621	.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 results of the Tukey Honestly Significant Difference (HSD) post hoc test, which was conducted to analyse pairwise differences in learning outcomes among students with high, medium, and low critical thinking levels, are presented in Table 4. At the.05 significance level, the analysis revealed statistically significant differences among all comparison groups. The learning outcomes of students with high critical thinking skills were significantly improved in comparison to those with moderate critical thinking abilities, with a mean difference of 10.14 (p <.001, 95% CI [4.22, 16.06]). Students

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exhibiting highly effective critical thinking skills surpassed those with inadequate critical thinking abilities, demonstrating a significant mean difference of 17.95 ($p < .001$, 95% CI [11.55, 24.34]). The data suggest that pupils possessing high critical thinking skills exhibited significantly enhanced academic achievement.

Moreover, individuals possessing moderate critical thinking skills demonstrated significantly superior learning outcomes compared to those with low critical thinking skills, exhibiting a mean difference of 7.80 ($p = .010$, 95% CI [1.56, 14.05]). This outcome indicates a stable positive correlation between critical thinking capacity and academic performance in students. The negative mean differences observed in the reverse comparisons confirm the same pattern of results. Specifically, students with low critical thinking ability obtained significantly lower learning outcomes than students in both the medium and high critical thinking categories.

Overall, the Tukey HSD analysis demonstrates that each critical thinking category differed significantly from the others, indicating that critical thinking ability was an important determinant of student learning outcomes. The findings further suggest that higher levels of critical thinking were associated with progressively better academic achievement.

Discussion

This study yielded three research findings: 1) disparities in learning outcomes between students utilising different learning models (PBL versus Cooperative), 2) variations in learning outcomes among students categorised by their critical thinking levels (high, medium, and low), and 3) the interaction effect between learning models and students' critical thinking levels on learning outcomes.

The primary finding of this study is the disparity in learning outcomes regarding fundamental concepts of the social studies course across students utilising different learning modes (PBL versus Cooperative). The findings align with prior research (Ardianti & Marlena, 2020; Çelik & Bati, 2025; Fauzan et al., 2024; Funa & Prudente, 2021; Hakim et al., 2025; Jannah et al., 2025; Koriťáková et al., 2023; Musthofa et al., 2019; Rivera-Pérez et al., 2021; Sampurna et al., 2026; Saputra et al., 2024; Sulastri et al., 2024; Wijayanto et al., 2025), which consistently demonstrate that Problem-Based Learning (PBL) and Cooperative Learning significantly enhance student learning outcomes in comparison to traditional methods. Problem-Based Learning (PBL) enhances critical thinking, problem-solving abilities, and autonomous learning, whereas Cooperative Learning significantly boosts cognitive outcomes, engagement, and social collaboration skills. Nonetheless, the majority of studies solely juxtapose each model with conventional learning, and only a limited number directly contrast PBL with cooperative learning within a unified experimental framework. Moreover, prior research generally neglects to consider individual student characteristics, especially the critical thinking levels of students, when assessing the efficacy of learning models.

The different effects of Problem Based Learning (PBL) and Cooperative Learning across critical thinking levels can be explaned by the cognitive demands of each instructional model. PBL requires students to analyze problems, evaluate evidence, develop solutions, and justify their decisions. These activities place high demands on higher order thinking and independent reasoning, allowing students with stronger critical thinking skills to benefit more from the learning process. In contrast, Cooperative Learning emphasizes shared responsibility, peer interaction, and

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collaborative knowledge construction. Students can learn through discussion, explanation, and mutual support, making this model more accessible for learners with lower or moderate critical thinking skills who benefit from social scaffolding. These differences suggest that the effectiveness of each model depends not only on the instructional approach but also on students' cognitive readiness. Therefore, selecting an appropriate learning model should consider students' critical thinking levels to maximize learning outcomes.

The second study reveal disparities in learning outcomes among students categorised as possessing high, medium, and low levels of critical thinking. This discovery corroborates earlier research (Bhuttah et al., 2024; Orhan & Bülent, 2022; Ratnaningsih & Triwahyuni, 2025; Rivas et al., 2023; Usman et al., 2024), in many contexts, pupils identified as possessing superior critical thinking skills generally demonstrate enhanced learning outcomes and academic success, whereas those with medium and particularly low levels exhibit diminished achievements and less effective problem-solving abilities. Instructional methods that intentionally cultivate critical thinking can enhance overall performance and diminish disparities among low, medium, and high-level groups.

In the context of elementary school teacher education in Banten Province, these findings offer important pedagogical implications for preparing prospective teachers to address the diverse cognitive characteristics of learners in local classrooms. Elementary schools across Banten serve students from urban, peri urban, and rural communities with substantial variation in learning readiness, critical thinking ability, and access to educational resources. Therefore, teacher education programs should not promote a single instructional approach as universally effective, but instead cultivate adaptive pedagogical competence that enables future teachers to select learning models according to students' cognitive profiles and classroom conditions. Prospective teachers should receive systematic traning in designing differentiated instruction that integrates Problem Based Learning for learners who demonstrate higher analytical readiness while employing Cooperative Learning to provide structured peer support and collaborative scaffolding for students who require greater instructional guidance. Such preparation is particularly relevant for the heterogeneous classrooms commonly found in Banten Province, where large class sizes and diverse academic backgrounds require flexible instructional decision making. Accordingly, the present findings extend the discussion by demonstrating that effective elementary teacher preparation should emphasize the interaction between instructional design and learner characteristics rather than focusing solely on teaching methods. This context strengthens the practical relevance of the study by aligning empirical evidence with the realities of elementary education in Banten Province and by supporting the development of reflective, context responsive, and evidence based pedagogical practices among future elementary school teachers.

This study's third discovery illustrated a substantial interaction effect between students' critical thinking levels, learning outcomes, and learning models. This research suggests that the efficacy of learning models was affected by students' cognitive traits, especially their critical thinking skills. Students possessing advanced critical thinking skills attained significantly superior learning results through Problem-Based Learning (PBL), while those with moderate and low critical thinking abilities exhibited comparatively minor distinctions between PBL and Cooperative Learning. The findings

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indicate that the influence of instructional models on academic performance is inconsistent among learners, varying based on students' cognitive preparedness and analytical abilities.

The interaction among these three variables is supported by previous empirical studies. Research conducted by Barrows (1986) emphasized that the effectiveness of PBL depends heavily on learners' ability to engage in inquiry, critical analysis, and self-directed problem solving. Students with advanced critical thinking skills tend to benefit more from PBL because the model requires active exploration, interpretation of information, and evaluation of alternative solutions. Similarly, studies by Fazriyah et al.(2017) found that results demonstrate that a learning model incorporating critical thinking abilities might enhance students' learning outcomes.

Previous studies have also demonstrated that critical thinking functions as a moderating variable in determining the effectiveness of instructional approaches. For example, research by Felder & Brent (2007) reported that learner-centered instructional strategies tend to generate stronger academic gains among students with higher analytical abilities. Their findings suggest that instructional models emphasizing inquiry, discussion, and independent reasoning are more effective when learners possess sufficient cognitive readiness to manage complex learning tasks.

The present findings also align with constructivist learning theory, which argues that knowledge acquisition occurs more effectively when learners actively construct meaning through experience and reflection. In the context of this study, students with high critical thinking ability appeared better able to engage in the inquiry processes embedded in PBL, including identifying problems, evaluating evidence, generating solutions, and reflecting on learning outcomes. Consequently, these students demonstrated superior academic performance compared to students with lower critical thinking levels. This pattern supports the argument that cognitive engagement and metacognitive regulation are essential conditions for maximizing the effectiveness of inquiry-based instruction.

In contrast, Cooperative Learning produced relatively more stable learning outcomes across different critical thinking categories. This result may be attributed to the structured and collaborative nature of the Student Teams Achievement Divisions (STAD) model, which provides peer support, guided interaction, and shared responsibility during learning activities. Students with lower critical thinking ability may benefit from collaborative scaffolding provided by group members, reducing the cognitive demands associated with independent problem solving. This interpretation is consistent with the work of Johnson & Johnson (2018), who emphasized that cooperative learning environments enhance academic performance by promoting positive interdependence and social support among learners.

The significant interaction effect identified in this study highlights the importance of aligning instructional strategies with learner characteristics. The findings indicate that no single instructional model is universally effective for all students. Instead, instructional effectiveness depends on the compatibility between pedagogical approaches and students' cognitive profiles. From a practical perspective, teachers should consider students' critical thinking abilities when selecting instructional models to maximize learning outcomes. PBL may be more appropriate for students with strong analytical and reflective skills, whereas Cooperative Learning may provide more

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effective support for students with diverse cognitive abilities in heterogeneous classrooms.

Overall, this study extends previous research by empirically demonstrating the combined relationship among instructional models, critical thinking ability, and learning outcomes within a factorial experimental framework. The findings reinforce the argument that educational effectiveness is multidimensional and influenced by both instructional design and learner characteristics. Consequently, future educational interventions should integrate cognitive and pedagogical considerations to optimize students' academic achievement and higher-order thinking development.

CONCLUSION

Fundamental Finding : This study yielded three research findings: 1) disparities in learning outcomes between students utilising different learning models (PBL versus Cooperative), 2) variations in learning outcomes among students categorised by their critical thinking levels (high, medium, and low), and 3) the interaction effect between learning models and students' critical thinking levels on learning outcomes. **Implication :** This result implies that instructional models substantially influence students' academic achievement. The finding strengthens the argument that student-centered instructional approaches are more effective than conventional teacher-centered practices in promoting active learning and conceptual understanding. This finding implies that critical thinking is an important cognitive factor influencing students' learning success. The effectiveness of instructional models depends on students' cognitive characteristics, particularly their critical thinking ability. In other words, no single instructional model is equally effective for all students. Teacher traning should emphasize differentiated instruction based on students' critical thinking levels. Teachers need practical skills to identify students' critical thinking abilities and adjust learning activities accordingly. Students with lower critical thinking levels should receive more structured guidance and scaffolding, while those with higher levels should be challenged with more complex problem solving, inquiry, and analytical tasks. This approach can help teachers provide appropriate learning support and improve students' learning outcomes. **Limitation:** This study possesses multiple limitations that must be recognised. The study was initially confined to a restricted geographic area, concentrating on a particular educational setting. Therefore, the results may not be entirely applicable to wider educational contexts with varying socio-cultural or institutional attributes. The analysis in this study primarily focused on the importance of critical thinking as a moderating variable, while other relevant factors, such as learning motivation, prior academic accomplishment, and social-emotional skills, may have been inadequately investigated. **Future Research :** Consequently, future research should include a wider array of learner factors and diverse research contexts to enhance the knowledge of the efficacy of collaborative learning models. This study indicates that the selection of a learning model is essential in enhancing educational outcomes, as problem-based learning and cooperative learning offer distinct contributions. The findings indicate that critical thinking must be incorporated into learning design, as students with different levels of critical thinking may react variably to each educational approach.

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