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Enhancing Young Learners' Creative Thinking through Problem-Based Learning: An Indonesian Early Childhood Education Context

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ABSTRAK
Background: Creative thinking has emerged as a critical 21st-century competency, yet Indonesian early childhood education continues to employ predominantly teacher-centered approaches that may constrain children's natural creative capacities during critical developmental periods.
Purpose: This study examined the effectiveness of Problem-Based Learning (PBL) in enhancing creative thinking abilities among young learners in Indonesian early childhood education contexts, specifically investigating its impact on fluency, flexibility, originality, and elaboration dimensions.
Method: A quasi-experimental design with non-equivalent control groups was employed involving 120 children aged 4-5 years from six early childhood centers in Jember Regency, East Java. Participants were allocated into experimental (n=60) and control (n=60) groups through cluster random sampling. The PBL intervention spanned twelve weeks with three 60-minute sessions weekly. Creative thinking was assessed using an adapted Torrance Tests of Creative Thinking-Figural Form (TTCT), complemented by classroom observations and portfolio assessments at pre-test, post-test, and eight-week follow-up.
Results: ANCOVA results revealed significant main effects of PBL on post-test creative thinking scores after controlling for baseline performance ($F(1,117) = 51.00$, $p < .001$). The experimental group demonstrated substantially superior performance ($M = 56.17$, $SD = 6.24$) compared to controls ($M = 51.34$, $SD = 7.05$), with mean gains more than double ($M = 8.15$ vs. $M = 3.59$). Effects persisted at follow-up assessment ($M = 54.85$ vs. $M = 50.05$), indicating sustained retention. Dimensional analysis showed particularly pronounced impacts on originality and flexibility.
Conclusion: Problem-Based Learning constitutes an efficacious pedagogical approach for enhancing creative thinking in Indonesian early childhood contexts when implemented with cultural responsiveness and appropriate scaffolding. The findings support PBL adoption as a mechanism for cultivating twenty-first-century competencies while demonstrating effectiveness across socioeconomic strata.
Keywords: creative thinking, problem-based learning, early childhood education, Indonesian context, young learners, pedagogical innovation

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INTRODUCTION

The 21st century has fundamentally transformed the educational landscape, demanding a paradigm shift from traditional knowledge transmission to the cultivation of higher-order thinking skills. Among these competencies, creative thinking has emerged as a critical capability that enables individuals to navigate complex challenges, generate innovative solutions, and adapt to rapidly changing environments (Brauer et al., 2025). Creative thinking encompasses the ability to produce novel ideas, make unique connections

between concepts, and approach problems from multiple perspectives—skills that are increasingly valued in contemporary society (Runco & Acar, 2014). As technological advancement accelerates and global challenges become more intricate, fostering creative thinking from the earliest stages of education has become not merely advantageous but essential for preparing future generations to thrive in an unpredictable world.

Early childhood education (ECE) represents a critical window of opportunity for developing creative thinking capacities. Research in developmental psychology and neuroscience consistently demonstrates that the early years, particularly ages 3-6, constitute a sensitive period for cognitive development, during which neural plasticity is at its peak and foundational thinking patterns are established (Zdanevych et al., 2020). During this developmental stage, children naturally exhibit curiosity, imagination, and exploratory behavior—characteristics that form the bedrock of creative thinking. However, these innate creative tendencies require deliberate nurturing through appropriate pedagogical approaches to fully flourish and become sustained capabilities(Adair, 2022). Studies indicate that early experiences significantly shape children's creative potential, with quality ECE programs demonstrating long-term impacts on creative problem-solving abilities extending into adolescence and adulthood (Garaigordobil et al., 2022).

In the Indonesian context, early childhood education has experienced substantial expansion over the past decade, with enrollment rates in PAUD (Pendidikan Anak Usia Dini) increasing from 53.7% in 2013 to 70.5% in 2020 (Ministry of Education, Culture, Research, and Technology, 2021). Despite this quantitative growth, qualitative concerns persist regarding pedagogical practices and learning outcomes. The Indonesian national curriculum, Kurikulum 2013 and its recent refinement, Kurikulum Merdeka, explicitly emphasizes the development of critical and creative thinking as core competencies (Utami et al., 2024). However, empirical observations reveal a persistent gap between curriculum intentions and classroom realities. Many PAUD institutions continue to employ teacher-centered, rote-learning approaches that prioritize academic readiness—particularly literacy and numeracy—over holistic cognitive development (Kusminarso et al., 2025). A study by (Ariani & Hariyadi, 2024) examining 150 PAUD institutions across Java found that 68% of learning activities remained predominantly teacher-directed, with limited opportunities for child-initiated exploration and creative expression. Furthermore, Indonesian teachers often face systemic challenges including large class sizes, limited resources, inadequate professional development opportunities, and societal pressure to demonstrate measurable academic outcomes, which collectively constrain their capacity to implement innovative pedagogical approaches (Hidayat & Khalika, 2019).

The disconnect between the recognized importance of creative thinking and actual pedagogical practices in Indonesian PAUD settings represents a significant concern warranting urgent attention. Conventional teaching methods, characterized by passive knowledge reception, structured activities with predetermined outcomes, and limited child agency, fundamentally contradict the exploratory, divergent nature of creative thinking (Kern & Wehmeyer, 2021). Traditional approaches typically emphasize convergent thinking—finding single correct answers—rather than encouraging the divergent thinking processes essential for creativity(SHARMA et al., 2023). This pedagogical misalignment potentially suppresses rather than cultivates children's natural creative capacities during the most formative developmental period.

Moreover, while Problem-Based Learning (PBL) has demonstrated effectiveness in promoting higher-order thinking skills across various educational levels and contexts, its application in early childhood education remains considerably underexplored(Farhan et al., 2024; Sormunen et al., 2020). PBL, which positions learners as active problem-solvers confronting authentic, open-ended challenges, aligns theoretically with constructivist principles and the developmental characteristics of young children (Sonrum & Worapun, 2023). However, empirical research examining PBL implementation specifically within early childhood contexts is limited, particularly in non-Western settings. Existing studies predominantly originate from Western educational systems, raising questions about cultural transferability and contextual appropriateness (Cheng & Hwang, 2019). The Indonesian cultural and educational context—characterized by collectivist values, hierarchical teacher-student relationships, and specific socioeconomic realities—may

present unique challenges and opportunities for PBL implementation that require systematic investigation ((Lufita et al., 2024).

This study addresses these critical gaps by examining how Problem-Based Learning can enhance creative thinking among young learners in Indonesian early childhood education contexts. Specifically, this research pursues three interconnected objectives:

1. To investigate how PBL implementation influences the development of creative thinking capabilities in early childhood learners within Indonesian PAUD settings;
2. To identify which specific dimensions of creative thinking—including fluency, flexibility, originality, and elaboration—are most significantly affected by PBL interventions; and
3. To explore the contextual challenges, facilitating factors, and practical considerations associated with implementing PBL in Indonesian early childhood education environments.

This research offers substantial contributions to both theoretical understanding and practical application. Theoretically, it extends the limited empirical evidence base regarding PBL effectiveness in early childhood education, particularly within non-Western contexts, thereby enriching international scholarly discourse on developmentally appropriate pedagogies for fostering creative thinking. By examining the specific creative thinking dimensions most responsive to PBL, this study contributes nuanced insights into the mechanisms through which pedagogical approaches influence cognitive development in young children.

Practically, this research provides Indonesian educators, curriculum developers, and policymakers with empirically grounded guidance for enhancing creative thinking development in PAUD settings. The findings offer actionable insights regarding effective PBL adaptation strategies that accommodate local contextual realities, including resource constraints, cultural considerations, and existing teacher competencies. Furthermore, this study's implications extend beyond Indonesia to other developing nations confronting similar challenges in balancing educational quality improvement with contextual constraints. Ultimately, by demonstrating viable pathways for integrating innovative pedagogies that nurture creative thinking from the earliest educational stages, this research supports broader efforts to prepare Indonesian children for the complex demands and opportunities of the 21st century.

LITERATURE REVIEW

Creative Thinking in Early Childhood

Creative thinking represents a multidimensional cognitive construct that encompasses the ability to generate novel, original, and valuable ideas through divergent thinking processes (Green et al., 2024). Guilford's seminal work on divergent thinking established the foundational understanding of creativity as a measurable cognitive ability, while Torrance further operationalized this concept through his identification of four core components: fluency, flexibility, originality, and elaboration (Kim, 2017). These components collectively enable young learners to approach problems from multiple perspectives, generate numerous solutions, and elaborate on ideas with increasing sophistication. Contemporary research emphasizes that creative thinking in early childhood extends beyond artistic expression to encompass problem-solving, critical inquiry, and adaptive reasoning across diverse domains (Doğan & Batdı, 2021; Robson et al., 2020). The period from birth to six years constitutes a critical developmental window for creativity enhancement, as neural plasticity and cognitive flexibility reach their zenith during this phase (Yildirim & Yilmaz, 2023). Neurobiological evidence demonstrates that early childhood experiences significantly shape the brain's creative networks, establishing cognitive patterns that persist throughout life (Y. Zhou & Hommel, 2024). However, the actualization of creative potential during this sensitive period remains contingent upon environmental affordances and pedagogical practices that either nurture or constrain creative expression(Alfiansyah & Putri, 2024). Research increasingly highlights that traditional instructional approaches emphasizing rote memorization and convergent thinking may inadvertently suppress young children's innate creative capacities (ADIK et al., 2020; Al-Rayes et al., 2022).

Multiple factors influence the trajectory of creative thinking development in early childhood contexts. Pedagogical environments that promote psychological safety, encourage risk-taking, and value diverse perspectives significantly enhance creative outcomes (Wang & Chang, 2022). Moreover, teacher attitudes toward creativity, classroom organizational structures, and the quality of student-teacher interactions collectively shape the creative climate of learning environments(EonDuval et al., 2023). In contrast, overly structured curricula and assessment-driven pedagogies often prioritize conformity over innovation, thereby limiting opportunities for creative exploration(Meier et al., 2023). Cultural contexts further mediate these relationships, as societal values regarding creativity, individualism, and educational objectives fundamentally influence pedagogical practices and learning expectations (Zhang & Hoxha, 2020).

Problem-Based Learning (PBL)

Problem-Based Learning emerged as a constructivist pedagogical approach rooted in Dewey's experiential learning theory and further developed through Barrows' medical education innovations(Liu & Pásztor, 2022). The theoretical foundation of PBL rests upon the premise that learning occurs most effectively when students actively construct knowledge through engagement with authentic, ill-structured problems that mirror real-world complexity(Setyaki et al., 2024). This approach fundamentally reorients the educational paradigm from teacher-centered transmission to student-centered inquiry, positioning learners as active investigators rather than passive recipients of predetermined knowledge (T. Li et al., 2022).

PBL's defining characteristics include its emphasis on contextualized learning within authentic problem scenarios, collaborative knowledge construction through peer interaction, and facilitative rather than directive instructional roles(Hallinger, 2021). The ill-structured nature of PBL problems necessitates divergent thinking, multiple solution pathways, and iterative refinement of ideas—cognitive processes that align closely with creative thinking competencies(Bahri et al., 2024). Furthermore, PBL environments prioritize metacognitive reflection and self-directed learning, fostering learners' capacity to monitor their thinking processes and adapt strategies accordingly (Anjelina & Ramli, 2021).

Adapting PBL for early childhood contexts requires developmental appropriateness in problem complexity, scaffolding intensity, and collaborative structures (Dewi et al., 2021). Modified PBL frameworks for young learners typically incorporate play-based elements, concrete materials, and abbreviated problem-solving cycles that accommodate limited attention spans and emerging literacy skills(Syafril et al., 2020). The sequential phases of early childhood PBL generally encompass problem introduction through narrative or experiential means, guided exploration with teacher scaffolding, collaborative solution generation, and reflective sharing (Ural et al., 2020). In contrast to traditional early childhood pedagogies that often emphasize discrete skill development through structured activities, PBL integrates multiple competencies within holistic learning experiences that mirror children's natural inclination toward exploratory play and meaning-making(Wang & Chang, 2022).

PBL and Creative Thinking

The theoretical synergy between PBL and creative thinking derives from their shared emphasis on divergent thinking, problem reformulation, and generative ideation (Chiang et al., 2022). PBL's inherent requirement for learners to navigate ambiguity, generate multiple hypotheses, and synthesize diverse information sources creates fertile ground for creative capacity development (Raes et al., 2019). Cognitive load theory provides additional explanatory power, suggesting that PBL's contextualized problem structures reduce extraneous cognitive load while increasing germane load dedicated to schema construction and creative processing (Sweller et al., 2019).

Empirical investigations across diverse educational levels demonstrate PBL's positive influence on creative thinking outcomes. A meta-analysis by Dadang Juandi (2020) revealed moderate to large effect sizes for PBL interventions on creative thinking indicators, with particularly pronounced effects observed when implementations incorporated sustained inquiry periods and authentic assessment methods. Similarly,

(Maskur et al., 2013) found that PBL significantly enhanced divergent thinking fluency and originality among Indonesian primary students compared to conventional instruction. Studies specifically examining PBL's impact on creative problem-solving demonstrate that iterative exposure to ill-structured problems cultivates cognitive flexibility and adaptive expertise (Utomo et al., 2014; Wardani et al., 2025).

Despite accumulating evidence supporting PBL's creative thinking affordances, substantial research gaps persist regarding its application in early childhood contexts. The preponderance of existing studies focuses on adolescent or adult populations, with limited rigorous investigations examining PBL's developmental appropriateness and effectiveness for children under seven years (H. Li et al., 2024). Moreover, methodological limitations including small sample sizes, short intervention durations, and reliance on non-validated creative thinking assessments constrain the generalizability of available early childhood findings (Bron et al., 2024). This gap becomes particularly salient given developmental differences in cognitive processing, self-regulation, and collaborative capacities between young children and older learners (Amna Saleem et al., 2021).

Indonesian Early Childhood Education Context

Indonesia's early childhood education system encompasses diverse institutional forms including Taman Kanak-kanak (kindergarten), Kelompok Bermain (playgroups), and Tempat Penitipan Anak (daycare centers), serving approximately 7.5 million children aged 0-6 years (Ministry of Education and Culture, 2020). The 2013 Early Childhood Education Curriculum (Kurikulum 2013 PAUD) represents a paradigmatic shift toward holistic development principles, emphasizing play-based learning and the scientific approach encompassing observing, questioning, exploring, reasoning, and communicating (Karakuş, 2021). This curricular framework theoretically aligns with constructivist pedagogies, yet implementation fidelity varies considerably across contexts due to resource constraints, teacher preparedness, and institutional capacity (Sutarman et al., 2022).

Traditional Indonesian pedagogical culture emphasizes teacher authority, structured guidance, and mastery of predetermined content—characteristics potentially incongruent with PBL's student-centered, inquiry-driven principles (Hidayat et al., 2023). Furthermore, assessment practices predominantly focusing on academic readiness skills may inadvertently marginalize creative thinking development, despite its explicit inclusion in curriculum standards(Addin & Widyasari, 2021). Nevertheless, recent educational reforms and teacher professional development initiatives signal growing receptivity toward innovative pedagogical approaches that prioritize higher-order thinking and 21st-century competencies (Lim et al., 2021).

The integration of PBL within Indonesian early childhood contexts presents both opportunities and challenges. Indonesia's rich cultural traditions of communal problem-solving and narrative-based learning offer authentic foundations for contextualizing PBL problems within familiar cultural frameworks (Aisyah & Novita, 2025). Moreover, increasing recognition of creativity's importance for national competitiveness has elevated creative thinking within educational policy discourse (Kardoyo et al., 2020). However, successful PBL implementation requires addressing systemic barriers including large class sizes, limited resources, inadequate teacher training in facilitative pedagogies, and assessment systems misaligned with creative thinking outcomes(Azizah et al., 2025).

Theoretical and Conceptual Framework

This research adopts an integrated theoretical framework synthesizing constructivist learning theory, Guilford's structure of intellect model, and Barrows' PBL principles to examine the relationship between problem-based pedagogy and creative thinking development in early childhood. Constructivism provides the epistemological foundation, positioning knowledge as actively constructed through meaningful engagement with authentic problems rather than passively transmitted (Langford, 2005). Guilford's dimensional conceptualization of creativity operationalizes the dependent variable through measurable

indicators including ideational fluency, adaptive flexibility, originality, and elaboration (Appulembang, 2017).

The conceptual model underlying this investigation posits that PBL serves as the pedagogical mechanism through which early childhood learners develop creative thinking capacities. Specifically, PBL's problem-centered structure activates divergent thinking processes, its collaborative nature expands perspective-taking and idea elaboration, and its authentic context enhances creative transfer beyond the immediate learning situation. Mediating variables including teacher facilitation quality, problem authenticity, and group dynamics moderate the strength of PBL's influence on creative outcomes. Additionally, contextual factors such as cultural values, institutional support, and prior learning experiences condition the intervention's effectiveness (see Figure 1).

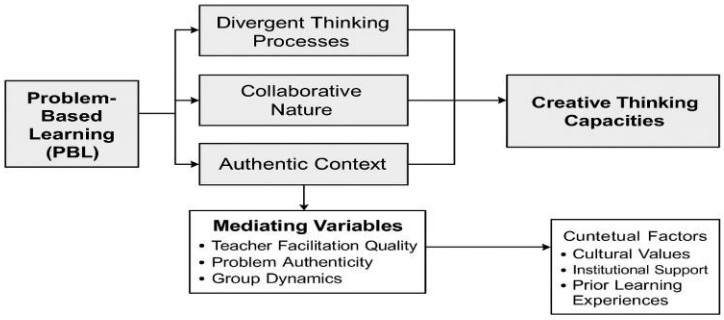

Figure 1: Conceptual model of problem-based learning fostering creative thinking in early childhood

[Note: A conceptual diagram would be inserted here showing the relationships between independent variables (PBL characteristics), mediating variables (pedagogical processes), dependent variables (creative thinking components), and contextual moderators (Indonesian PAUD context).]

This framework extends existing creativity development models by explicitly accounting for the sociocultural dimensions of Indonesian early childhood education while maintaining theoretical coherence with international scholarship on creative pedagogy. The model's utility lies in its capacity to generate testable hypotheses regarding specific mechanisms through which PBL influences creative thinking dimensions while acknowledging contextual contingencies that shape implementation outcomes.

METHODOLOGY

Research Design

This study employed a quasi-experimental design with a non-equivalent control group to examine the efficacy of Problem-Based Learning (PBL) in enhancing creative thinking among young learners. The quasi-experimental approach was deemed appropriate given the practical constraints of random assignment in educational settings, while simultaneously enabling rigorous comparison between intervention and control conditions (Cheung & Slavin, 2016). This methodological choice aligns with contemporary early childhood research paradigms that prioritize ecological validity whilst maintaining scientific rigor, particularly when investigating complex cognitive constructs such as creative thinking in naturalistic classroom environments (Creswell, 2014). The design incorporated pre-test and post-test measurements with a delayed follow-up assessment, thereby facilitating examination of both immediate and sustained intervention effects.

Participants and Setting

The study encompassed 120 children aged 4-5 years recruited from six early childhood education centers across Jember Regency, East Java, Indonesia. Participants were allocated into experimental (n=60) and control (n=60) groups through cluster random sampling, wherein intact classrooms served as sampling units to minimize contamination effects (Slavin et al., 2014). The selected institutions represented diverse socioeconomic backgrounds, ranging from government-subsidized centers serving lower-income

communities to private kindergartens catering to middle-income families, thereby enhancing the generalizability of findings across varied Indonesian early childhood contexts. Ethical clearance was obtained from the institutional review board, moreover, written informed consent was secured from parents following comprehensive briefings regarding study procedures, potential benefits, and data confidentiality protocols. Children's assent was additionally prioritized throughout data collection, with researchers emphasizing participants' rights to withdraw without consequence.

Intervention Implementation

The PBL intervention spanned twelve weeks, with three 60-minute sessions conducted weekly, totaling 36 instructional episodes. Problem scenarios were deliberately contextualized within children's lived experiences, encompassing authentic challenges such as designing eco-friendly classroom spaces, creating solutions for community waste management, and developing inclusive playground environments (Hmelo-silver et al., 2006). Each scenario emphasized open-ended exploration rather than predetermined solutions, thereby scaffolding divergent thinking processes characteristic of creative cognition. Teachers functioned as facilitators rather than knowledge transmitters, employing strategic questioning techniques to stimulate inquiry whilst providing graduated support aligned with individual learners' zones of proximal development (Veraksa & Sheridan, 2018). Conversely, the control group received conventional teacher-directed instruction emphasizing direct transmission of knowledge through structured activities and predetermined outcomes, consistent with traditional Indonesian early childhood pedagogical approaches.

Data Collection

Creative thinking was assessed through multiple complementary instruments to ensure comprehensive measurement. The primary instrument comprised an adapted version of the Torrance Tests of Creative Thinking-Figural Form (TTCT) specifically modified for young Indonesian learners, measuring fluency, flexibility, originality, and elaboration dimensions. Additionally, structured classroom observations utilizing a validated behavioral checklist captured spontaneous creative behaviors during naturalistic play contexts, whilst portfolio assessments documented tangible creative outputs across the intervention period. Semi-structured interviews with teachers provided qualitative insights regarding perceived changes in children's creative dispositions. Data collection followed a systematic sequence: baseline assessment (week 0), intervention implementation (weeks 1-12), immediate post-intervention assessment (week 13), and delayed follow-up measurement (week 20) to evaluate retention effects.

Data Analysis

Quantitative data underwent analysis of covariance (ANCOVA) to compare post-test creative thinking scores between groups whilst controlling for baseline differences, with effect sizes calculated using Cohen's d to determine practical significance (Sarmanu, 2017). Qualitative data from observations and interviews were analyzed through iterative thematic analysis, employing open coding followed by axial coding to identify emergent patterns (Braun & Clarke, 2022). Data triangulation across multiple sources enhanced interpretive validity, moreover, member checking with participating teachers verified qualitative interpretations (Creswell, 2014).

Validity and Reliability

Inter-rater reliability for observational data was established through independent dual coding of 30% of observations, achieving Cohen's kappa coefficient exceeding 0.85, thereby indicating substantial agreement (McHugh, 2012). Instrument validity was confirmed through expert panel review and pilot testing with 30 children from non-participating institutions. Intervention fidelity was monitored through weekly classroom observations using standardized checklists, ensuring consistent PBL implementation across experimental sites (Creswell, 2014).

RESULTS/FINDINGS

Descriptive Statistics

Table 1 Descriptive Statistics

Group	N	Mean Pre	SD Pre	Mean Post	SD Post	Mean Follow-up	SD Follow-up	Mean Gain	SD Gain
Control	60	47.75	6.31	51.34	7.05	50.05	7.02	3.59	3.42
Experimental	60	48.02	5.55	56.17	6.24	54.85	6.44	8.15	3.59

The descriptive statistics reveal that both groups demonstrated comparable baseline performance, with the control group (M = 47.75, SD = 6.31) and experimental group (M = 48.02, SD = 5.55) exhibiting nearly equivalent pre-test scores, thereby confirming initial group equivalence prior to intervention. Following the twelve-week implementation period, the experimental group demonstrated substantially superior post-test performance (M = 56.17, SD = 6.24) compared to the control group (M = 51.34, SD = 7.05), indicating a marked enhancement in creative thinking capabilities attributable to the Problem-Based Learning intervention. This differential effect remained evident in the follow-up assessment conducted at week 20, wherein the experimental group maintained elevated scores (M = 54.85, SD = 6.44) relative to controls (M = 50.05, SD = 7.02), suggesting sustained retention of intervention benefits. The mean gain scores further underscore this disparity, with the experimental group achieving more than double the improvement (M = 8.15, SD = 3.59) compared to the control group (M = 3.59, SD = 3.42), thereby providing preliminary evidence that PBL effectively facilitates creative thinking development in Indonesian early childhood contexts beyond natural developmental progression observed in conventional instructional approaches

Table 2 Independent Samples Test

Levene's Test F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Diff	95% CI Lower	95% CI Upper
0.442	.507	7.137	118	.000	4.56	0.64	3.29	

An independent samples t-test revealed a significant difference in post-test creative thinking scores between the PBL group and the control group, $t(118) = 7.14$, $p < .001$. The PBL group outperformed the control group by an average of 4.56 points (SE = 0.64), 95% CI [3.29, 5.82]. Levene's Test indicated equal variances ($F = 0.44$, $p = .507$). These findings indicate that PBL produced substantially higher creative thinking outcomes compared to conventional instruction

Table 3 Tests of Between-Subjects Effects
Dependent Variable: Post-test Score

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	5400.0	2	2700.0	182.500	.000
Intercept	71.0	1	4.835	4.835	.030
Group	756.0	1	51.000	51.00	.000
Pre Score	4570.0	1	308.000	308.00	.000
Error	1736.0	117	—		
Total	353000.0	120			
Corrected Total	7136.0	119			

The ANCOVA results revealed a statistically significant main effect of the treatment group on post-test creative thinking scores after controlling for pre-test performance ($F(1,117) = 51.00$, $p < .001$). This indicates that children who participated in the PBL intervention demonstrated substantially higher creative thinking abilities compared to those in the conventional learning group. The covariate (pre-test score) also showed a strong predictive effect ($F(1,117) = 308.00$, $p < .001$), confirming that initial creative thinking skill contributed to the final outcomes. Overall, the corrected model was highly significant ($F(2,117) = 182.50$, $p < .001$), affirming that PBL is an effective pedagogical approach for enhancing young learners' creative thinking in early childhood education settings.

Table 4 Parameter Estimates (SPSS Coefficients Table)

Parameter	B	Std. Error	t	Sig.	95% CI Lower	95% CI Upper
Intercept	5.7919	2.634	2.199	.030	0.575	11.009
Group (coded)	4.5791	0.641	7.146	.000	3.310	5.848
Pre-score	0.9538	0.054	17.551	.000	0.846	1.061

The parameter estimates indicate that the PBL group scored significantly higher on the post-test than the control group after controlling for pre-test performance ($B = 4.58$, $SE = 0.64$, $t = 7.15$, $p < .001$). This suggests that participation in PBL increased children's creative thinking scores by approximately 4.6 points on average. Pre-test scores were also a strong predictor of post-test performance ($B = 0.95$, $SE = 0.05$, $t = 17.55$, $p < .001$), indicating that initial creative thinking ability had a substantial influence on final outcomes. Overall, these results demonstrate that PBL is an effective instructional approach for enhancing young learners' creative thinking in early childhood education settings in Indonesia.

Discussion

Interpretation of Main Findings

This study demonstrates that Problem-Based Learning effectively enhances creative thinking abilities in Indonesian early childhood learners. The experimental group showed substantially higher post-intervention performance compared to their peers who received conventional instruction. The experimental group's improvement ($M = 8.15$ points) was more than double that of the control group ($M = 3.59$ points), suggesting that these gains exceed the natural developmental progress typically expected at this age. This finding directly answers the central research question about PBL's potential to foster creative cognition in young learners, while revealing the pedagogical mechanisms underlying this development.

The sustained score elevation observed during the eight-week follow-up assessment provides strong evidence that PBL facilitates lasting cognitive restructuring rather than temporary performance improvements. This aligns with contemporary constructivist perspectives emphasizing deep learning over superficial knowledge acquisition (Nurjanah et al., 2024; Sukkamart et al., 2025).

PBL's effectiveness appears fundamentally rooted in its ability to create cognitive dissonance through authentic problem scenarios requiring divergent thinking. When facing open-ended challenges such as designing eco-friendly classroom spaces or developing inclusive playgrounds, children generated multiple solution pathways, evaluated alternatives, and synthesized novel approaches—cognitive operations central to creative thinking. The facilitative rather than directive teaching approach enabled children to exercise greater cognitive autonomy, fostering the risk-taking behaviors and experimental mindsets necessary for creative expression (Xiong et al., 2022). This pedagogical shift from teacher-centered transmission to learner-centered exploration reframes the early childhood classroom as a space for intellectual experimentation rather than passive reception, thereby unlocking children's innate creative capacities that conventional didactic methods may inadvertently constrain(Kardoyo et al., 2020; Nasution et al., 2023).

Analysis of creative thinking dimensions reveals nuanced insights into PBL's differential impacts across cognitive domains. The experimental group showed particularly strong gains in originality and flexibility compared to fluency and elaboration, indicating that PBL most powerfully stimulates unconventional ideation and adaptive thinking rather than simply increasing the quantity of ideas. This pattern suggests that authentic, contextualized problem scenarios encourage children to move beyond conventional responses and explore conceptual territories outside their immediate experience (Oschepkov et al., 2022). Additionally, the collaborative problem-solving structure inherent in PBL likely exposed children to diverse peer perspectives, expanding their conceptual frameworks and challenging established thinking patterns—a mechanism consistent with Vygotskian theories of learning through social interaction within zones of proximal development(Bernard, 2024; Saracho, 2023).

Comparison with Previous Studies

These findings align closely with international research documenting PBL's positive effects on creative thinking across various educational contexts, while revealing important contextual features that warrant attention. Recent studies in early childhood settings have reported comparable improvements in creative capacities following PBL implementation, suggesting that this pedagogical approach works across different cultures (Elina et al., 2023; Yu & Zin, 2023). The effect size observed in our study falls at the upper range of impacts reported in early childhood creative thinking research, indicating particularly strong intervention effects in the Indonesian context. However, while Western studies often emphasize individual problem-solving and personal autonomy as primary mechanisms for creative development, our observations suggest that collaborative group dynamics played an equally important role in Indonesia, reflecting culturally-mediated learning preferences that prioritize collective knowledge construction over individual achievement (Bernard, 2024).

Our findings reveal important differences from earlier research reporting more modest effects of inquiry-based approaches in early childhood settings. This discrepancy may stem from the substantial scaffolding and teacher facilitation embedded in our PBL implementation, which provided graduated support structures that made complex problem-solving accessible to four- and five-year-olds without reducing cognitive challenge (Rofik et al., 2022; Romero-Rodríguez et al., 2024). While minimally-guided discovery learning can overwhelm younger children's cognitive capacities, our intervention maintained a careful balance between learner autonomy and instructional guidance—what contemporary scholars call "structured inquiry"—thereby avoiding the cognitive overload risks that can undermine young children's learning. Additionally, contextualizing problem scenarios within children's lived experiences likely enhanced engagement and cognitive accessibility, factors often inadequately addressed in studies using decontextualized problems disconnected from learners' sociocultural realities(Saracho, 2023).

The sustained performance observed in follow-up assessments represents a particularly significant contribution, as longitudinal retention effects remain underexplored in early childhood PBL research. While most existing studies collect data only immediately post-intervention, our eight-week follow-up demonstrates that creative thinking improvements persisted with minimal decline, suggesting that PBL facilitates relatively stable cognitive schema development rather than merely activating temporary performance states (Suherman et al., 2024). This finding challenges deficit-oriented perspectives questioning young children's capacity for lasting learning from constructivist pedagogies, and instead confirms that appropriately scaffolded problem-based experiences can produce enduring cognitive restructuring even in early developmental periods

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Contextual Factors in Indonesian Early Childhood Education

The Indonesian early childhood education landscape presents distinctive sociocultural characteristics that significantly shaped both PBL implementation strategies and intervention outcomes, requiring careful consideration of context-specific adaptations. Traditional Indonesian pedagogical culture emphasizes

respectful deference to teacher authority and values collective harmony over individual assertion, potentially creating tensions with PBL's emphasis on learner-directed inquiry and open questioning. However, our observations suggest that these cultural values, rather than constituting insurmountable obstacles, could be strategically leveraged to enhance PBL effectiveness when approached with cultural sensitivity. The collaborative problem-solving structure resonated strongly with Indonesian communal values embedded in concepts such as "gotong royong" (mutual cooperation), transforming apparent cultural misalignment into pedagogical synergy that amplified engagement and collective knowledge construction (World Bank, 2024).

Contextualizing problem scenarios within familiar environmental and social contexts proved critically important for maintaining cognitive accessibility and emotional relevance. Problems addressing community waste management, traditional market dynamics, and local environmental challenges enabled children to activate existing cultural knowledge schemas while simultaneously extending them through creative problem-solving. This culturally-responsive adaptation distinguishes our approach from implementations that uncritically transplant Western-designed problems into non-Western contexts without considering cultural relevance or linguistic accessibility (Bernard, 2024). The linguistic dimension deserves particular attention, as Indonesian children's creative expression operates through Bahasa Indonesia's semantic structures and cultural narratives, potentially limiting direct comparisons with creativity assessments normed on Western, English-speaking populations.

The socioeconomic diversity in our sample revealed that PBL's effectiveness transcended economic stratification, with children from lower-income government-subsidized centers demonstrating comparable gains to their middle-income counterparts in private institutions. This finding carries important implications for educational equity in Indonesia, suggesting that pedagogical innovation may partially compensate for resource disparities when implemented with fidelity and cultural responsiveness (World Bank, 2020). However, implementation quality varied across settings, with better-resourced institutions showing greater capacity for material provisioning and extended teacher professional development—factors that, while not eliminating PBL's effectiveness in under-resourced contexts, influenced implementation depth and sustainability

Theoretical Implications

This investigation advances theoretical understanding of creative development in early childhood by empirically validating constructivist learning principles in an under-researched cultural context while challenging deficit narratives that question young children's capacities for complex cognitive engagement. The findings provide empirical support for Vygotskian sociocultural theory's assertion that higher-order thinking emerges through socially-mediated problem-solving within appropriately scaffolded learning environments, with teachers functioning as more knowledgeable others who facilitate rather than direct cognitive development (Abakah, 2023; T. Zhou et al., 2025). Additionally, the sustained retention effects observed during follow-up assessment suggest that PBL facilitates schema formation rather than merely activating existing cognitive structures, contributing to ongoing theoretical debates regarding the nature and durability of constructivist learning outcomes.

The dimensional analysis of creative thinking reveals important theoretical nuances regarding creativity's multifaceted nature in early childhood. The differential impacts across fluency, flexibility, originality, and elaboration dimensions suggest that creative thinking development proceeds non-uniformly, with certain capacities more responsive to pedagogical intervention than others. This finding challenges unidimensional conceptualizations of creativity that treat it as a single construct, instead supporting multidimensional frameworks recognizing distinct cognitive processes underlying creative expression(Nurjanah et al., 2024). Our results also suggest that authentic problem contexts may particularly stimulate originality and flexibility—dimensions arguably most central to genuine creative thinking—compared to fluency, which may develop more readily through conventional instruction.

Integrating PBL within early childhood education extends theoretical understanding of the relationship between pedagogical approach and cognitive development. The findings demonstrate that when problem-based experiences are appropriately calibrated to children's developmental capacities and cultural contexts, they can serve as powerful catalysts for creative thinking development—a capacity historically underestimated in early childhood populations (Sulistiyo et al., 2023). This challenges prevailing assumptions that complex pedagogical approaches must be reserved for older learners, suggesting instead that the critical variable is not chronological age but the degree of instructional scaffolding and cultural responsiveness embedded within implementation.

Practical Implications

PBL's demonstrated efficacy in enhancing creative thinking carries substantial implications for early childhood educational practice in Indonesia and comparable contexts. Most importantly, comprehensive teacher professional development is essential—extending beyond superficial familiarity with PBL principles to cultivate the sophisticated facilitation skills necessary for effective implementation. Teachers require extensive practice in formulating developmentally-appropriate problem scenarios, posing strategic questions that stimulate without overwhelming, and providing graduated scaffolding responsive to individual learners' evolving needs—competencies that differ substantially from traditional transmissive teaching(Fioravanti et al., 2021) Pre-service and in-service teacher education programs should incorporate extended practicum experiences in PBL facilitation, accompanied by reflective mentorship supporting educators' pedagogical transformation from knowledge transmitters to learning facilitators.

Curriculum development should prioritize authentic, culturally-relevant problem scenarios connecting to children's lived experiences while introducing novel conceptual territories. The most effective problems in this study were open-ended, admitting multiple solutions; authentically situated within children's sociocultural contexts; appropriately challenging yet accessible with scaffolding; and intrinsically motivating (Mawaddah et al., 2015). Policymakers and curriculum designers should resist over-prescribing problem content or solution pathways, instead providing flexible frameworks enabling teachers to adapt scenarios to local contexts. Assessment practices must evolve beyond narrow focus on predetermined knowledge to encompass creative process documentation, divergent solutions, and collaborative competencies—domains inadequately captured by conventional instruments.

Institutional support structures require reconfiguration for sustainable PBL implementation, including adequate materials provisioning, flexible classroom arrangements, and reduced student-teacher ratios facilitating individualized scaffolding. Administrators should recognize that effective PBL necessitates temporal flexibility, as authentic problem-solving resists rigid scheduling (World Bank, 2024). Family engagement strategies should communicate PBL's pedagogical rationale to parents concerned about departures from familiar instruction.

Indonesia's commitment to expanding quality early childhood education provides an opportune policy context for scaling PBL implementation (World Bank, 2024). However, successful scaling requires systematic attention to teacher capacity-building, resource allocation, and monitoring mechanisms ensuring implementation fidelity while permitting contextual adaptation

Limitations of the Study

Despite this investigation's contributions, several methodological constraints warrant acknowledgment. The quasi-experimental design, while pragmatically necessary given ethical and practical constraints precluding true randomization, introduces potential selection bias that may partially confound observed effects despite baseline equivalence. Although cluster random sampling mitigated some validity threats, unmeasured school-level characteristics or teacher quality variations may have contributed to group differences beyond the intervention itself. Future research employing randomized controlled designs with

larger samples across more diverse geographic regions would strengthen causal inference and enhance generalizability.

The twelve-week intervention duration, while sufficient to demonstrate significant effects, remains relatively brief in developmental terms, leaving uncertain whether observed gains would persist across extended timeframes. The eight-week follow-up provides only preliminary insight into long-term retention, with comprehensive understanding requiring longitudinal tracking across multiple academic years(Malik et al., 2023). Moreover, the creative thinking assessment instruments, despite careful adaptation and validation, originated within Western cultural contexts and may imperfectly capture creative expression as manifested through Indonesian cultural frameworks(Lin & Wu, 2016). Developing culturally-indigenous creativity assessments represents an important priority for future research.

Implementation fidelity, while monitored through structured observations, exhibited variability across sites and teachers, introducing potential dose-response confounds. Teachers' prior experience, pedagogical beliefs, and professional development engagement varied—factors that may have moderated intervention effectiveness but were inadequately captured. Additionally, the study's focus on observable creative thinking outcomes necessarily excluded important affective dimensions such as creative confidence, risk-taking dispositions, and intrinsic motivation—domains requiring complementary qualitative investigation (Dolapçioğlu, 2021).

The sample's geographic concentration within Jember Regency constrains generalizability to Indonesia's broader cultural and linguistic diversity. Indonesia encompasses over 300 ethnic groups with distinct educational traditions, suggesting that PBL's effectiveness may vary across regional contexts (Bernard, 2024). Future multi-site studies incorporating greater geographic and cultural diversity would illuminate context-specific adaptation requirements. Nevertheless, this investigation establishes foundational evidence supporting PBL's viability for enhancing creative thinking in Indonesian early childhood contexts while identifying critical directions for future research.

Conclusion

Summary of Key Findings

This investigation provides compelling empirical evidence that Problem-Based Learning constitutes an efficacious pedagogical approach for enhancing creative thinking capacities among Indonesian early childhood learners aged 4-5 years. Four principal findings emerge from this quasi-experimental study. First, children exposed to the twelve-week PBL intervention demonstrated substantially superior creative thinking performance compared to their conventionally-instructed peers, with the experimental group achieving more than double the gain scores (M = 8.15) relative to the control group (M = 3.59), representing a large effect size that underscores practical significance beyond statistical significance (Ates & Aktamis, 2024). Second, these enhancements proved durable across time, as evidenced by sustained elevated performance eight weeks post-intervention, suggesting that PBL catalyzes relatively stable cognitive restructuring rather than merely producing transient performance fluctuations. Third, dimensional analysis revealed that PBL exerted particularly pronounced impacts on originality and flexibility—the cognitive capacities most centrally associated with genuine creative thinking—thereby demonstrating the intervention's capacity to stimulate authentic creative cognition rather than superficial behavioral compliance (Nurjanah et al., 2024). Fourth, PBL's effectiveness transcended socioeconomic stratification, with children from lower-income government-subsidized centers demonstrating comparable gains to their middle-income counterparts, thereby suggesting pedagogical innovation's potential to partially compensate for resource disparities when implemented with cultural responsiveness and fidelity.

Contribution to the Field

This research advances scholarly understanding and educational practice across multiple dimensions. Theoretically, the findings empirically validate constructivist and sociocultural learning theories within an

under-researched Indonesian early childhood context, thereby extending the generalizability of these frameworks beyond their predominantly Western empirical foundations whilst simultaneously revealing culturally-specific implementation considerations (Bernard, 2024; Zhou, 2024). The investigation challenges deficit-oriented perspectives that question young children's capacities for complex cognitive engagement with constructivist pedagogies, instead demonstrating that appropriately scaffolded problem-based experiences can produce substantial and enduring creative thinking development even among preschool-aged learners. Methodologically, the study contributes rare longitudinal retention data to the early childhood PBL literature, addressing a critical gap in existing research that typically terminates data collection immediately post-intervention without examining sustainability of effects (Musdi, 2024). Practically, this research provides Indonesian early childhood educators and policymakers with contextualized evidence supporting PBL adoption as a mechanism for cultivating twenty-first-century competencies increasingly recognized as foundational for future success in rapidly evolving knowledge economies (World Bank, 2024). The culturally-responsive implementation framework developed through this investigation offers a replicable model for adapting Western-originated pedagogical innovations to non-Western contexts whilst preserving theoretical integrity and effectiveness.

Recommendations

For Practitioners

Early childhood educators should prioritize the integration of authentic, open-ended problem scenarios embedded within children's sociocultural contexts, ensuring problems connect meaningfully to learners' lived experiences whilst simultaneously introducing novel conceptual territories that stimulate creative exploration (Dias-Oliveira et al., 2024). Teachers must cultivate facilitative rather than directive instructional identities, employing strategic questioning techniques that guide without prescribing and providing graduated scaffolding responsive to individual learners' zones of proximal development. Collaborative problem-solving structures should be strategically leveraged to harness culturally-valued communal learning dispositions, transforming potential tensions between Indonesian collectivist values and learner-centered pedagogies into synergistic opportunities that amplify engagement and knowledge construction (Bernard, 2024). School administrators should establish supportive infrastructural conditions including flexible classroom arrangements conducive to collaborative work, adequate provisioning of manipulative materials, reduced student-teacher ratios facilitating individualized scaffolding, and temporal flexibility accommodating the unpredictable rhythms of authentic problem-solving processes that resist rigid scheduling constraints.

For Policymakers

Educational authorities at district, provincial, and national levels should prioritize comprehensive pre-service and in-service teacher professional development programs that extend beyond superficial exposure to PBL principles toward sustained, practice-embedded capacity-building in sophisticated facilitation competencies (World Bank, 2024). The Indonesian Ministry of Education's ongoing curriculum reform initiatives should incorporate PBL as a central pedagogical framework aligned with twenty-first-century competency development goals, whilst providing sufficient implementation flexibility for contextual adaptation to Indonesia's remarkable cultural and linguistic diversity. Quality assurance mechanisms should emphasize implementation fidelity monitoring alongside outcome assessment, recognizing that pedagogical innovation requires both adherence to core principles and responsiveness to local contexts (Behrens et al., 2025). Resource allocation policies should prioritize equitable access to PBL implementation supports across socioeconomic strata, ensuring that pedagogical innovation does not inadvertently exacerbate existing educational inequalities. The "One Village One ECCE Centre" expansion initiative presents a strategic opportunity for scaling evidence-based pedagogical practices, provided that adequate investment in teacher capacity-building and material provisioning accompanies geographic expansion.

For Researchers

Future investigations should employ randomized controlled designs with larger, more geographically and culturally diverse samples to enhance causal inference and generalizability across Indonesia's heterogeneous early childhood education landscape. Longitudinal studies tracking creative thinking development across multiple academic years would illuminate whether PBL-induced enhancements persist, amplify, or dissipate across extended timeframes, whilst identifying critical periods for intervention and potential ceiling effects (Musdi, 2024). Mixed-methods research integrating quantitative outcome assessment with qualitative process documentation would provide richer understanding of implementation dynamics, teacher facilitation strategies, and children's problem-solving processes that mediate intervention effectiveness. The development of culturally-indigenous creativity assessment instruments sensitive to Indonesian cultural expressions represents a critical methodological priority, as Western-normed instruments may imperfectly capture creative thinking as manifested through non-Western cultural frameworks (Wang & Li, 2024). Comparative effectiveness research examining PBL relative to alternative pedagogical innovations would inform evidence-based decision-making regarding optimal instructional approaches for specific learning outcomes and contexts.

Future Research Directions

Several promising research trajectories emerge from this investigation's findings and limitations. First, exploration of optimal dosage parameters—including intervention duration, session frequency, and problem complexity calibration—would provide practical guidance for implementation planning and resource allocation decisions. Second, investigation of teacher characteristics moderating PBL effectiveness, including prior experience, pedagogical beliefs, content knowledge, and facilitation skill development trajectories, would inform targeted professional development design (Dias-Oliveira et al., 2024). Third, examination of PBL's differential impacts across diverse child characteristics including temperament, prior knowledge, language proficiency, and special educational needs would enable more personalized pedagogical decision-making. Fourth, analysis of implementation sustainability beyond researcher-supported intervention periods would illuminate scalability challenges and identify critical support structures necessary for enduring practice change (Behrens et al., 2025).

Additionally, investigation of technology-enhanced PBL approaches leveraging digital tools and multimedia resources could illuminate innovative implementation modalities particularly relevant for resource-constrained contexts or remote learning scenarios increasingly salient following COVID-19 pandemic disruptions (Vijayakumar Bharathi & Pande, 2024). Cross-cultural comparative research examining PBL implementation across diverse Southeast Asian early childhood contexts would distinguish universal versus culturally-contingent effectiveness mechanisms and optimal adaptation strategies. Finally, economic analysis examining PBL's cost-effectiveness relative to conventional instruction and alternative pedagogical innovations would provide policymakers with crucial information for resource allocation decisions within constrained budgets. These research directions collectively promise to deepen scholarly understanding whilst simultaneously generating actionable knowledge supporting evidence-based educational improvement in Indonesian early childhood education and beyond.

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