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Balanced Literacy Learning Model to Enhance Creative Thinking and Problem Solving in Elementary School Mathematics Word Problems

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ABSTRACT

Persistent challenges in students' creative thinking and problem-solving capacities in mathematics — particularly in word problem contexts — call for innovative instructional models that bridge language comprehension and quantitative reasoning. This study aimed to examine the effectiveness of the *Balanced Literacy* learning model in enhancing creative thinking and problem-solving abilities among Phase C elementary school students in mathematics word problems. This study employed a quasi-experimental method using a non-equivalent control group design with pretest-posttest measurements. A total of 50 Grade V students from MI Assaidiyyah Cipanas, Cianjur Regency, were selected through purposive sampling and divided into an experimental class (n = 25) receiving *Balanced Literacy* instruction and a control class (n = 25) receiving conventional teaching. Data were collected through validated creative thinking tests, Likert-scale problem-solving questionnaires, and structured observation sheets, then analyzed using descriptive statistics and independent-samples t-tests via IBM SPSS Statistics 25. The results of this study indicate that the *Balanced Literacy* model significantly enhanced students' creative thinking (posttest mean: experimental 88.0 vs. control 80.8; N-Gain: 0.62 vs. 0.47) and problem-solving abilities (posttest mean: 95.48 vs. 93.04), with statistically significant inter-group differences (sig. < 0.05) for both outcomes. Observation data confirmed 100% implementation fidelity. The *Balanced Literacy* model, which integrates reading, writing, speaking, and listening within mathematical contexts, is recommended as an effective evidence-based approach for developing higher-order thinking in elementary mathematics.

Keywords: balanced literacy; creative thinking; elementary school; problem solving; word problems

INTRODUCTION

Mathematics education at the elementary school level continues to present significant pedagogical challenges, particularly in the domain of word problems (*soal cerita*). Students in Phase C (Grades IV–VI) frequently struggle to translate narrative contexts into mathematical representations, limiting their capacity for creative thinking and systematic problem solving. Data from the Programme for International Student Assessment consistently position Indonesian students below the international average in mathematics literacy, with a notable weakness in applying mathematical concepts to real world scenarios. National assessments similarly reveal that students demonstrate rote procedural fluency but lack the flexible, generative thinking required by contextual mathematical tasks. The disconnect between literacy competence and mathematical reasoning is a root cause of these persistent difficulties, underscoring the urgent need for instructional models that explicitly

bridge language comprehension and quantitative reasoning in elementary classrooms (NCTM, 2014; OECD, 2019).

A growing body of research has investigated strategies to strengthen students' mathematical thinking through integrated and innovative learning models. Azizah (2021) demonstrated that the *Balanced Literacy* model effectively enhanced reading comprehension a foundational competency for mathematical word problem understanding. Firman and Andayani (2020) showed that integrating literacy and numeracy in learning activities produces statistically significant gains in mathematical performance, as literacy scaffolding enables learners to decode problem statements more accurately. Lestari, Yuliati, and Widodo (2022) further confirmed that contextual teaching materials incorporating literacy-numeracy integration substantially improved problem-solving abilities among elementary school students. Abdullah (2020) found that literacy-based learning exerts a significant positive effect on creative thinking skills by providing structured opportunities for idea generation and flexible reasoning. Similarly, Anisah (2021) reported that innovative constructivist learning models meaningfully elevate students' creative mathematical thinking, particularly along the dimensions of fluency and originality.

Further support is drawn from international and national scholarship on creative thinking and problem solving in mathematics. Mann (2018) established that word problems serve as an effective medium for cultivating mathematical creativity, because their narrative structure demands flexible interpretation and multiple solution pathways. Sudirman (2018) demonstrated that problem-solving learning models meaningfully advance creative thinking in elementary school contexts, particularly when students engage in open-ended tasks requiring justification. Yulianti, Septian, and Sugiarni (2025) reported in *PRISMA* that the PACE-GeoGebra model significantly improved creative mathematical thinking linked to self-regulated learning. Afifah, Sudirman, and Rahardjo (2025), also in *PRISMA*, found that students' creative thinking processes in open-ended problems varied systematically with cognitive style. Zahroh, Anwar, and Chandra (2025), publishing in *PRISMA*, reported that creative thinking in culturally integrated mathematical contexts differed according to specialization, highlighting the importance of contextually rich instructional designs.

Despite this substantial evidence, a critical gap remains. Prior studies tend to examine literacy integration and creative thinking in isolation or within specific subject contexts that do not simultaneously target both creative thinking and problem solving as co-dependent outcomes within a unified instructional model. Very few quasi-experimental studies have been conducted specifically on the application of *Balanced Literacy* in the context of mathematics word problems at the Phase C elementary level within the Indonesian national curriculum. The existing research focuses primarily on literacy or reading skill outcomes, while the nexus between *Balanced Literacy* pedagogy and dual improvement of creative thinking and problem solving in mathematics has not been rigorously tested in controlled experimental settings in Indonesian elementary schools.

The novelty of the present study lies in its simultaneous examination of both creative thinking and problem-solving abilities as dependent outcomes under the influence of the *Balanced Literacy* learning model, applied specifically to mathematics word problems in Phase C. Unlike prior studies, this research operationalizes *Balanced Literacy* as an integrative instructional framework encompassing reading, writing, speaking, and listening,

and empirically tests its dual effectiveness through a quasi-experimental design providing the first quantitative evidence for the combined efficacy of this model in Indonesia. Based on this novelty, its potential impact on the field is substantial: theoretically, the findings extend the conceptual understanding of how integrated literacy models operate within STEM contexts; practically, they equip teachers, curriculum designers, and policymakers with evidence-based guidance for designing mathematics instruction that simultaneously develops linguistic comprehension and higher-order mathematical thinking in Phase C classrooms.

Based on the research gap identified above, this study addresses the following research problem: Is the Balanced Literacy learning model more effective than conventional instruction in simultaneously enhancing creative thinking and problem-solving abilities in mathematics word problems among Phase C (Grade V) elementary school students? More specifically, this study aims to: (1) examine whether there is a statistically significant difference in creative thinking posttest scores between students taught using the Balanced Literacy model and those receiving conventional instruction; and (2) determine whether the Balanced Literacy model produces significantly greater improvement in problem-solving abilities compared to conventional teaching. Answering these questions is significant both theoretically—by extending understanding of how integrated literacy frameworks operate within mathematical learning contexts—and practically, by providing Indonesian teachers and curriculum designers with an evidence-based instructional model capable of addressing the nation's documented weaknesses in mathematical literacy and higher-order thinking as reflected in PISA and national assessment data (OECD, 2019).

RESEARCH METHODS

This study employed a quantitative approach using a quasi-experimental design, specifically the non-euivalent control group design, which involves two pre-existing intact classroom groups without random assignment. The experimental class received the *Balanced Literacy* model, which integrates: (1) *read aloud* — the teacher reads word problems with clear intonation to scaffold contextual comprehension; (2) shared reading — collective meaning-making of problem texts; (3) guided writing — structured recording of solution steps; and (4) collaborative discussion — students articulate and justify their strategies orally. The control class received conventional instruction. Both classes underwent pretest and posttest measurements. Subjects were 50 Grade V students from MI Assaidiyyah Cipanas, Cianjur Regency (experimental: n = 25, 15 female/10 male; control: n = 25, 18 female/7 male), selected through purposive sampling based on criteria of parallel class availability, a learning environment conducive to the model, and teacher willingness to collaborate.

The data comprised two types: (1) primary quantitative data from student performance at pretest and posttest measurement points, and (2) process observational data. Creative thinking data were gathered using a validated multiple-choice written test measuring four sub-dimensions: fluency (generating diverse solution ideas), originality (producing unique approaches), problem-solving strategy (selecting appropriate methods), and understanding of the problem. Problem-solving data were collected via a Likert-scale

questionnaire (five-point scale: Strongly Disagree to Strongly Agree) comprising positively and negatively worded items assessing students' problem-solving dispositions. Observational data on implementation fidelity were recorded on a structured checklist during every instructional session to verify adherence to the *Balanced Literacy* stages.

All instruments underwent expert validity review and pilot testing prior to use. The creative thinking test was subjected to item-level analyses including Pearson product-moment validity testing, Cronbach's alpha reliability estimation, difficulty index, and discrimination index analyses. The problem-solving questionnaire was similarly validated for construct validity and reliability. Supplementary documentation data — including observation sheets, pretest and posttest papers, and photographic evidence — were collected to verify and substantiate research execution. Data collection proceeded through three structured phases: (1) preparation (instrument development, expert validation, baseline observation, and scheduling); (2) implementation (experimental group receives *Balanced Literacy*-based instruction across multiple sessions; control group undergoes conventional teaching); and (3) evaluation (posttest administered to both groups and data compiled).

Data analysis was conducted using IBM SPSS Statistics 25. Descriptive statistics (mean, median, mode, standard deviation, variance, range, minimum, maximum) were computed for pretest and posttest data of both groups. Inferential analysis began with normality testing using the Kolmogorov-Smirnov test ($\alpha = 0.05$) — pretest/posttest sig. values for creative thinking: control 0.24/0.20, experimental 0.32/0.25, all > 0.05 (normal) — and Levene's homogeneity test (Based on Mean sig. = 0.66 for creative thinking; 0.98 for problem solving, both > 0.05, confirming homogeneous variances). Meeting these parametric assumptions, independent-samples t-tests compared posttest scores between groups, and paired-samples t-tests compared within-group pre-post changes. Effect size was quantified using the normalized gain (N-Gain) formula by Hake (1999): N-Gain = (posttest – pretest) / (ideal max – pretest), categorized as low (< 0.30), medium (0.30–0.70), or high (> 0.70). Questionnaire data were interpreted using Likert percentage criteria: very weak (0–20%), weak (21–40%), moderate (41–60%), strong (61–80%), and very strong (81–100%).

RESULTS AND DISCUSSION

Learning Implementation Fidelity

Structured observation data, recorded across all instructional sessions, confirmed that the *Balanced Literacy* learning model was implemented with 100% fidelity in the experimental class. Every designated stage — *read aloud*, shared reading, guided writing, speaking, and listening — was executed as planned throughout the research period. The teacher consistently acted as a facilitator, guiding students in identifying mathematical problems from word contexts, devising and articulating solution strategies, and reflecting on their reasoning. This full procedural adherence strengthens the internal validity of the study, ensuring that observed differences in outcome variables are attributable to the *Balanced Literacy* model rather than implementation variability.

Creative Thinking

Table 1 presents the complete descriptive statistics for creative thinking pretest and posttest scores for both the control and experimental classes.

Table 1. Descriptive Statistics of Creative Thinking Scores

Statistical Measure	Control Pretest	Control Posttest	Experimental Pretest	Experimental Posttest
N	25	25	25	25
Mean	65.20	77.20	67.20	85.80
Median	65.00	75.00	65.00	90.00
Mode	65	85	70	90
Std. Deviation	9.50	10.71	9.02	11.42
Variance	90.50	114.75	81.41	130.58
Range	45	35	40	55
Minimum	50	60	55	45
Maximum	95	95	95	100

The pretest mean scores for creative thinking were comparable across both groups (control: 65.20; experimental: 67.20), confirming initial equivalence prior to treatment. Following intervention, the experimental class demonstrated a substantially higher posttest mean (85.80) compared to the control class (77.20), representing a gain of 18.60 points versus 12.00 points respectively. The experimental class also showed a higher posttest mode (90) and median (90.00) relative to the control, indicating that the majority of experimental students clustered at the upper end of the score distribution. These descriptive patterns provide strong preliminary evidence of the effectiveness of the *Balanced Literacy* model.

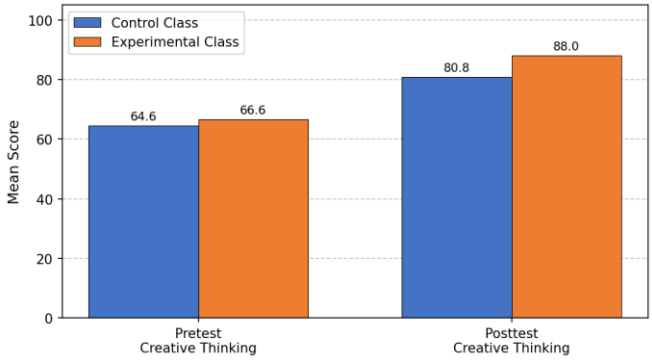

Figure 1. Comparison of Pretest and Posttest Mean Scores for Creative Thinking

Figure 1 illustrates the comparison of pretest and posttest mean scores for creative thinking between the experimental and control classes. As shown, both classes began with comparable pretest means (experimental: 67.20; control: 65.20), confirming initial equivalence. After the intervention, the experimental class demonstrated a substantially larger gain, with a posttest mean of 85.80 compared to 77.20 in the control class. This visual contrast underscores the superior effect of the Balanced Literacy model over conventional instruction in elevating students' creative thinking performance. The steeper increase in the experimental class reflects the model's capacity to activate multiple cognitive channels—

reading, writing, speaking, and listening—that collectively reinforce mathematical reasoning and creative ideation.

Problem Solving

Table 2. Descriptive Statistics of Problem Solving Scores

Statistical Measure	Control Pretest	Control Posttest	Experimental Pretest	Experimental Posttest
N	25	25	25	25
Mean	89.67	93.04	89.64	95.48
Median	88.50	90.00	88.00	94.00
Mode	88	106	86	92
Std. Deviation	8.80	8.11	8.79	8.11
Variance	78.40	65.70	77.32	65.71
Range	31	28	34	35
Minimum	73	78	72	63
Maximum	104	106	106	98

Table 2 presents descriptive statistics for problem-solving pretest and posttest scores. Prior to treatment, both groups exhibited nearly identical mean scores (control: 89.67; experimental: 89.64), reaffirming initial group equivalence. After intervention, the experimental class achieved a posttest mean of 95.48, exceeding the control class mean of 93.04. The experimental class also exhibited a higher mode (92) and an upward shift in its overall score distribution, as evidenced by the reduction in minimum scores coupled with gains at the upper intervals.

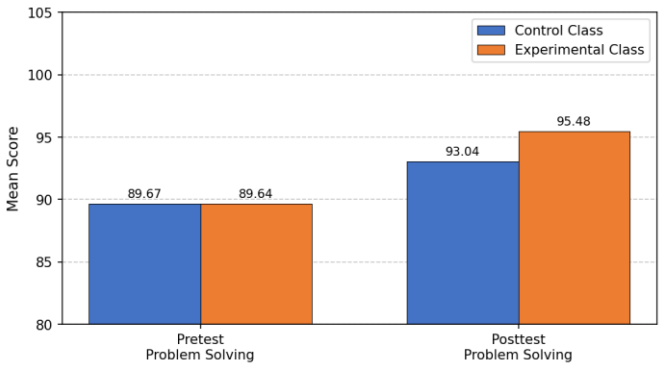

Figure 2. Comparison of Pretest and Posttest Mean Scores for Problem Solving

Figure 2 presents the pretest and posttest mean scores for problem-solving ability in both groups. The figure reveals that both groups entered the study with virtually equivalent mean scores (control: 89.67; experimental: 89.64), thereby satisfying the requirement for group equivalence. Following the intervention, the experimental class recorded a posttest mean of 95.48, surpassing the control class mean of 93.04. Although the magnitude of the difference is comparatively smaller than that observed for creative thinking, it nonetheless reflects a meaningful and statistically significant improvement attributable to the Balanced Literacy model. The narrower gap in problem-solving scores relative to creative thinking

scores may indicate that students' problem-solving dispositions were already at a moderately high baseline, thereby limiting the ceiling for further improvement, while creative thinking—a less frequently targeted skill in conventional instruction—showed greater responsiveness to the intervention.

Inferential Statistical Analysis

Table 3. Summary of Inferential Statistical Tests

Test	Variable	Sig. Value	Criterion	Decision
Kolmogorov-Smirnov (Control)	Creative Thinking	0.24 / 0.20	$\alpha > 0.05$	Normal
Kolmogorov-Smirnov (Experimental)	Creative Thinking	0.32 / 0.25	$\alpha > 0.05$	Normal
Levene's Homogeneity	Creative Thinking	0.66	$\alpha > 0.05$	Homogeneous
Independent t-test (posttest)	Creative Thinking	0.00	$\alpha < 0.05$	H_0 Rejected
Kolmogorov-Smirnov (Control)	Problem Solving	2.00 / 0.74	$\alpha > 0.05$	Normal
Kolmogorov-Smirnov (Experimental)	Problem Solving	2.00 / 2.00	$\alpha > 0.05$	Normal
Levene's Homogeneity	Problem Solving	0.98	$\alpha > 0.05$	Homogeneous
Independent t-test (posttest)	Problem Solving	0.00	$\alpha < 0.05$	H_0 Rejected

Table 3 presents a summary of all hypothesis testing results. For creative thinking, normality testing (Kolmogorov-Smirnov) yielded sig. values of 0.24 and 0.20 (control pretest/posttest) and 0.32 and 0.25 (experimental pretest/posttest), all > 0.05, confirming normal distribution. Homogeneity of variance (Levene's Based on Mean) was confirmed with sig. = 0.66 (> 0.05). The independent-samples t-test for posttest creative thinking scores produced sig. (2-tailed) = 0.00 (< 0.05), leading to rejection of H_0. For problem solving, normality was confirmed with sig. > 0.05 for all groups. Homogeneity was confirmed with sig. = 0.98 (> 0.05). The independent-samples t-test for posttest problem solving scores yielded sig. (2-tailed) = 0.00 (< 0.05), also rejecting H_0. These results confirm statistically significant differences between the experimental and control classes on both outcome variables.

Normalized Gain (N-Gain) Analysis

Table 4. N-Gain Scores for Creative Thinking

Class	Pretest Mean	Posttest Mean	N-Gain	Category
Control	64.60	80.80	0.47 (47.09%)	Medium
Experimental	66.60	88.00	0.62 (62.23%)	Medium

Table 4 presents the N-Gain scores for creative thinking. Both classes fall within the medium category (0.30–0.70); however, the experimental class (N-Gain = 0.62, 62.23%)

meaningfully outperforms the control class (N-Gain = 0.47, 47.09%). This difference demonstrates that the *Balanced Literacy* model accelerates learning gains beyond what conventional instruction achieves, even when both groups begin at comparable pretest levels. Figure 3 provides a visual comparison of the N-Gain scores.

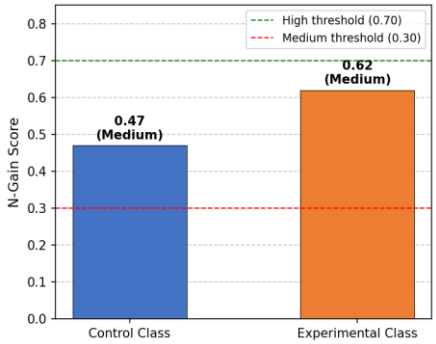

Figure 3. N-Gain Score Comparison Between Control and Experimental Classes

Figure 3 provides a visual comparison of the normalized gain (N-Gain) scores for creative thinking between the two groups. The bar chart clearly shows that the experimental class attained an N-Gain of 0.62 (62.23%), meaningfully exceeding the control class's N-Gain of 0.47 (47.09%). Both values fall within the medium category according to Hake's (1999) classification, yet the 15-percentage-point gap between them highlights the added instructional value of the Balanced Literacy approach. The figure reinforces the inferential findings and confirms that the observed improvement in the experimental class is not merely an artifact of ceiling or floor effects, but reflects genuine and accelerated learning progress relative to conventional instruction.

Creative Thinking by Indicator

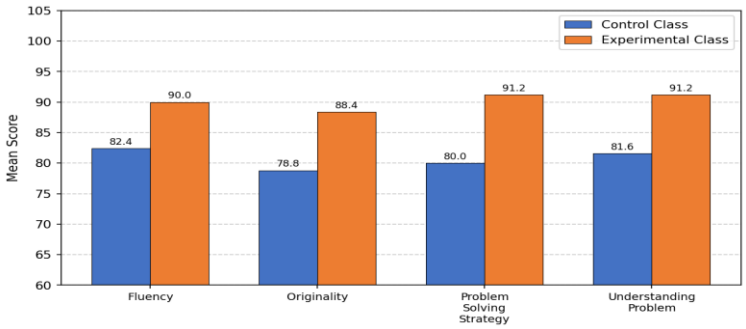

Figure 4. Posttest Scores by Creative Thinking Indicator for Each Class

Figure 4 presents posttest scores disaggregated by the four creative thinking indicators. At pretest, both groups were comparable across all four indicators (fluency, originality, problem-solving strategy, understanding of problem), with mean scores ranging from 64 to 76, confirming initial group equivalence. Following treatment, the experimental class consistently outperformed the control class on all four indicators. The greatest gains in the experimental class were observed on *planning strategy* (91.2) and *creative and reflective thinking* (91.2), while the control class ranged between 71.2 and 82.4. This pattern indicates that the *Balanced Literacy* model exerts a broad, multi-dimensional influence on creative thinking, rather than improving only isolated sub-skills.

Figure 4 disaggregates the posttest creative thinking scores across the four measured indicators—fluency, originality, problem-solving strategy, and understanding of the problem—for both the experimental and control classes. The figure demonstrates that the experimental class consistently outperformed the control class on every indicator following the intervention. Notably, the experimental class recorded its highest scores on planning strategy (91.2) and creative and reflective thinking (91.2), suggesting that the structured oral justification and guided writing components of the Balanced Literacy model are particularly effective in developing students' strategic and reflective capacities. The control class, by contrast, showed more modest gains ranging between 71.2 and 82.4 across all indicators. This multi-dimensional pattern confirms that the Balanced Literacy model exerts a broad and holistic influence on creative thinking development, rather than selectively improving only one cognitive dimension. The uniformity of improvement across all four indicators further strengthens the construct validity of the observed treatment effect.

The statistically significant improvement in creative thinking scores is consistent with the theoretical framework advanced by Mann (2018), who argued that mathematical word problems function as generative contexts for creativity by requiring students to construct multiple representations and justify diverse solution pathways. The *Balanced Literacy* model's structured engagement of reading, writing, speaking, and listening creates a dialogic mathematical environment in which students move beyond rote calculation toward reflective, generative reasoning — precisely the conditions theorized to foster fluency, originality, and elaboration (Torrance, 2020; Runco, 2014; Kozbelt, Beghetto, & Runco, 2010). Yulianti, Septian, and Sugiarni (2025) and Afifah, Sudirman, and Rahardjo (2025), both publishing in *PRISMA*, similarly report that instructional models embedding reflective and open-ended cognitive engagement significantly promote creative mathematical thinking, lending cross-study convergent validity to the present findings. The higher N-Gain in the experimental class (0.62 vs. 0.47) demonstrates that *Balanced Literacy* accelerates creative thinking development beyond what conventional instruction achieves, while the disaggregated indicator analysis confirms that this effect operates across all four dimensions — fluency, originality, problem-solving strategy, and understanding — rather than concentrating on a single sub-skill.

The improvement in problem-solving abilities is equally theoretically grounded. The *Balanced Literacy* model's emphasis on *read aloud* strategies reduces the linguistic barrier to mathematical problem comprehension — a barrier particularly acute in the Indonesian context, where word problem performance is frequently constrained by reading comprehension deficits rather than gaps in mathematical knowledge (Lestari, Yuliati, & Widodo, 2022). By foregrounding structured text engagement before numerical procedures, the model scaffolds students' transition from narrative context to mathematical representation (Firman & Andayani, 2020). The model's interactive discussion elements further develop students' metacognitive problem-solving capacity, encouraging them to evaluate, justify, and revise their strategies. Abdullah (2020) and Anisah (2021) corroborate this mechanism, reporting that literacy-embedded learning measurably improves both creative thinking and problem solving through sustained cognitive engagement with problem structure. The 100% observational fidelity across all sessions further strengthens the causal

inference that the observed improvements are attributable to the model's pedagogical mechanisms rather than to extraneous variables.

Compared to prior studies, the present findings extend the evidence base in two important ways. First, while Azizah (2021), Firman and Andayani (2020), and Abdullah (2020) demonstrate the benefits of literacy-integrated instruction on individual outcomes, the present study is the first to document simultaneous, statistically confirmed improvement in both creative thinking and problem solving under a single *Balanced Literacy* instructional framework in Phase C elementary mathematics. Second, the quasi-experimental design with matched control conditions provides a more rigorous test of causal efficacy than the correlational and developmental designs employed in much of the prior literature. Zahroh, Anwar, and Chandra (2025) in *PRISMA* highlight the importance of contextually integrated instruction for creative thinking — a principle directly realized in the word problem contexts used in the present study. Together, these findings position *Balanced Literacy* as a theoretically coherent and empirically validated instructional approach for advancing higher-order mathematical thinking in the elementary classroom.

The practical implications of these findings are significant. For classroom teachers, the Balanced Literacy model offers a structured, replicable framework that can be integrated into regular mathematics instruction without requiring major curriculum overhaul. For school principals and curriculum developers, the findings provide evidence to support the allocation of professional development resources toward literacy-integrated pedagogies in mathematics. At the policy level, the results contribute to ongoing national efforts to improve Indonesia's PISA performance by equipping Phase C students with both the linguistic and mathematical competencies required for complex problem-solving tasks. Nevertheless, several limitations of this study must be acknowledged. First, the sample was drawn from a single school in Cianjur Regency, which limits the generalizability of the findings to other geographical, socioeconomic, and institutional contexts. Second, the study was conducted over a bounded period; the long-term retention of creative thinking and problem-solving gains was not assessed. Third, the problem-solving instrument relied primarily on a Likert-scale questionnaire measuring dispositions rather than performance, which may not fully capture the breadth of students' actual problem-solving competencies. Fourth, although the teacher implemented the model with 100% fidelity, variations in teacher experience, subject knowledge, and facilitation style in other schools may yield different outcomes. Future research should address these limitations by replicating the study across diverse school settings, employing performance-based problem-solving assessments, and investigating the longitudinal effects of Balanced Literacy instruction on students' mathematical development.

CONCLUSION

This study demonstrated that the *Balanced Literacy* learning model significantly improved both creative thinking and problem-solving abilities in Phase C elementary school mathematics word problems. The experimental class achieved a posttest creative thinking mean of 88.0 (N-Gain = 0.62, medium category) compared to 80.8 (N-Gain = 0.47) in the control class, and a posttest problem-solving mean of 95.48 versus 93.04. Statistically significant inter-group differences were confirmed for both outcomes by independent-

samples t-tests (sig. = 0.00 < 0.05). Disaggregated analysis of four creative thinking indicators — fluency, originality, problem-solving strategy, and understanding of the problem — confirmed that the model's positive effects are broad and multi-dimensional, not restricted to a single cognitive sub-skill. Observation data documented 100% implementation fidelity throughout, strengthening the internal validity of these causal inferences.

It is recommended that elementary school teachers, particularly those working in Phase C contexts, systematically incorporate the *Balanced Literacy* model — through structured *read aloud*, guided writing, oral strategy justification, and collaborative listening — as part of routine mathematics word problem instruction. Educational policymakers and curriculum developers should consider embedding *Balanced Literacy* principles within Phase C mathematics learning designs to address Indonesia's persistent challenges in international assessments of mathematical literacy and creativity. Future research should investigate the model's effectiveness across different grade levels, subject areas, and socioeconomic contexts, and should explore its longer-term effects on students' mathematical literacy dispositions and creative self-efficacy.

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