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Integrating Treasure Hunt Games into Problem-Based Learning for Mathematical Problem Solving

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Abstract

Although Problem-Based Learning (PBL) and educational games have been used to support mathematical problem solving, there is limited evidence on integrating PBL with Treasure Hunt activities, particularly for teaching the perimeter and area of plane figures in elementary schools. This study investigated differences in mathematical problem-solving ability between fifth-grade students taught using PBL with a Treasure Hunt game and those taught using a scientific approach. A quasi-experimental posttest-only control group design involved 64 students selected through saturated sampling, with 32 students in each group. Mathematical problem-solving ability was assessed using a descriptive test based on four Polya indicators: understanding the problem, devising a plan, carrying out the plan, and looking back. The experimental group obtained a higher mean posttest score (M = 87.03) than the control group (M = 78.47). Higher achievement was also found in devising a plan, reaching 92% in the experimental group and 80% in the control group, and in carrying out the plan, reaching 85% and 64%, respectively. An independent-samples t-test showed a statistically significant difference between the groups ($p < .001$). These findings indicate that PBL assisted by Treasure Hunt activities supports stronger mathematical problem-solving performance.

Keywords: Elementary School, Mathematical Learning, Problem-Based Learning, Problem-Solving Ability, Treasure Hunt Games.

Abstrak

Meskipun Pembelajaran Berbasis Masalah (PBL) dan permainan edukasi telah digunakan untuk mendukung pemecahan masalah matematika, bukti terbatas mengenai integrasi PBL dengan aktivitas Perburuan Harta Karun, terutama dalam pengajaran figur perimeter dan luas bidang di sekolah dasar. Studi ini menyelidiki perbedaan kemampuan pemecahan masalah matematika antara siswa kelas lima yang diajarkan melalui PBL dengan bantuan permainan Treasure Hunt dan mereka yang diajarkan melalui pendekatan ilmiah. Desain kelompok kontrol pasca-eksperimental yang hanya melibatkan 64 siswa yang dipilih melalui sampling jenuh, dengan 32 siswa di setiap kelompok. Kemampuan pemecahan masalah matematika dinilai menggunakan tes deskriptif berdasarkan empat indikator Polya: memahami masalah, merancang rencana, melaksanakan rencana, dan melihat ke belakang. Kelompok eksperimental memperoleh skor rata-rata pasca-tes yang lebih tinggi (M = 87,03) dibandingkan kelompok kontrol (M = 78,47). Pencapaian yang lebih tinggi juga ditemukan dalam merancang rencana, mencapai 92% pada kelompok eksperimental dan 80% pada kelompok kontrol, serta dalam pelaksanaan rencana mencapai 85% dan 64% secara berturut-turut. Uji t sampel independen menunjukkan perbedaan signifikan secara statistik antara kelompok tersebut ($p < 0{,}001$). Temuan ini menunjukkan bahwa PBL yang dibantu oleh aktivitas Treasure Hunt mendukung kinerja pemecahan masalah matematika yang lebih kuat.

Kata Kunci: Kemampuan Pemecahan Masalah, Pembelajaran Matematika, *Problem Based Learning*, Sekolah Dasar, *Treasure Hunt Games*.

INTRODUCTION

Twenty-first-century education emphasizes the development of communication, collaboration, critical thinking, creativity, and problem-solving competencies to prepare students for increasingly complex challenges (González-Pérez & Ramírez-Montoya, 2022). In mathematics, problem solving is particularly important because students are required not only to perform calculations but also to interpret information, determine relevant mathematical concepts, select appropriate strategies, and evaluate the reasonableness of their solutions (Suryaningsih et al., 2026). These processes are highly relevant to learning perimeter and area of plane figures. Contextual problems involving these topics often require students to identify dimensions from a given situation, distinguish between perimeter and area, select appropriate formulas, perform calculations in a logical sequence, and interpret the results in relation to the original problem. Therefore, learning perimeter and area provides an important context for developing mathematical problem-solving ability in elementary school.

The importance of problem-solving is consistent with the National Council of Teachers of Mathematics, which identifies it as one of the fundamental mathematical processes that students need to develop (NCTM, 2009). International evidence also indicates that strengthening students' ability to apply mathematics in contextual situations remains an important challenge in Indonesia. PISA 2022 reported an average mathematics score of 366 for Indonesian students, compared with the OECD average of 472 (OECD, 2023). Rather than merely indicating low mathematical achievement, this result highlights the need to provide students with more opportunities to interpret contextual problems, formulate mathematical relationships, and use appropriate strategies to obtain and evaluate solutions.

A similar issue was identified at SDN Kalideres 06 Pagi. Preliminary interviews with two Grade V teachers, conducted in January 2025 before the experimental treatment, indicated that students had difficulty solving contextual mathematical problems, particularly those involving the perimeter and area of plane figures. Students often had difficulty identifying relevant information, selecting appropriate solution strategies and formulas, carrying out calculations accurately, and reviewing their answers. An initial review of students' mathematics work also indicated that approximately 60% of the 64 fifth-grade students had difficulty correctly completing contextual problem-solving tasks. Common errors included misunderstanding information presented in word problems, selecting inappropriate perimeter or area formulas, incomplete solution procedures, and failure to verify final answers. These preliminary findings are consistent with Suryaningsih 2019), who found that 56.2% of fifth-grade students were in the low category of mathematical problem-solving ability in geometry, with particular difficulties in exploring and planning solutions and reflecting on their answers. Thus, students' difficulties in geometry involve not only computational procedures but also several stages of mathematical problem solving.

The preliminary interviews further indicated that mathematics instruction at the research site was still largely dominated by teacher explanations, note-taking, and routine exercises. Although such practices may help students master basic procedures, they provide limited opportunities to engage with non-routine problems, compare alternative solution strategies, and reflect on the accuracy of their reasoning. Consequently, students may be able to recall and apply formulas in familiar situations but still experience difficulties when required to interpret contextual problems, determine appropriate strategies, and justify their solutions (Suryaningsih & Zulfatunnisa, 2025). This situation highlights the need for a learning approach that actively involves students in understanding problems, formulating and discussing solution strategies, systematically implementing solutions, and evaluating the results of their work.

Problem-Based Learning (PBL) provides an appropriate instructional framework for developing mathematical problem-solving ability by engaging students in meaningful problems through inquiry, discussion, and collaboration. Rather than merely receiving procedures, students are encouraged to identify relevant information, formulate possible strategies, implement their plans, and evaluate the solutions obtained. Through problem orientation, collaborative investigation, solution development, presentation, and evaluation, PBL provides opportunities for students to construct mathematical understanding actively (Arrul et al., 2024; Habibullah et al., 2024). Recent evidence also indicates that elementary students' mathematical problem-solving performance can be strengthened when interactive learning media support structured problem-solving activities.

Suryaningsih & Zulfatunnisa (2025), for example, found that students taught using a Creative Problem Solving model, assisted by fraction-puzzle media, achieved higher mathematical problem-solving scores than students in the control group. This evidence reinforces the importance of providing elementary students with structured opportunities to analyze problems, develop strategies, carry out solutions, and evaluate the results. Accordingly, these processes were aligned in the present study with Polya's four stages of problem solving: understanding the problem, devising a plan, carrying out the plan, and looking back (Polya, 1945). Thus, PBL and Polya's framework are complementary: PBL provides a contextual and collaborative learning environment, while Polya's stages provide a systematic cognitive structure for guiding students through the mathematical problem-solving process.

Although PBL provides a structured environment for mathematical problem solving, its implementation can be strengthened through game-based activities that sustain students' participation and engagement. In elementary mathematics, game-based learning can combine cognitive challenges with meaningful interaction and has been shown to support mathematical skills, motivation, and engagement (Hui & Mahmud, 2023). Similar evidence in primary mathematics indicates that well-designed games can support mathematical understanding, reasoning, and problem-solving. However, their educational value depends on how the game mechanics align with specific learning objectives, rather than on the game's entertainment features alone (Dan et al., 2024a; Debrenti, 2024). Previous empirical studies have also demonstrated the potential of combining mathematical learning with educational games. (Melathi & Putra, 2022), For example, found that PBL, aided by a Monopoly game, significantly improved fourth-grade elementary students' mathematical problem-solving ability. However, Monopoly primarily organizes mathematical tasks within a board-game structure.

In contrast, Treasure Hunt introduces a different pattern of participation, in which students progress through a sequence of clues and mathematical challenges while exploring the learning environment and collaborating. The potential of this approach in elementary mathematics is supported by Martia & Nurafni (2023), who found significant differences in mathematics learning outcomes between second-grade students who participated in a Treasure Hunt game and those who received regular instruction. Nevertheless, previous studies have generally examined educational games or Treasure Hunt separately, rather than integrating Treasure Hunt systematically into PBL to support the stages of mathematical problem solving. Therefore, this study extends previous research by embedding Treasure Hunt activities within PBL to support students in understanding problems, devising plans, carrying out solutions, and reviewing their results.

Treasure Hunt provides a learning mechanism that integrates mathematical challenges with exploration, collaboration, and sequential problem solving. Game-based learning can strengthen mathematical problem-solving when game activities require students to apply relevant conceptual and procedural knowledge rather than merely participate for enjoyment (Pan & Ke, 2023). In elementary mathematics, Treasure Hunt has also been shown to promote active participation, motivation, and collaboration by engaging students in mathematical tasks across different learning locations (Hiyum & Bakhtiar, 2024). More recent evidence indicates that integrating Treasure Hunt with a collaborative learning model can significantly improve both student activity and mathematics learning outcomes at the elementary level (Aissyah et al., 2025). In the present study, students worked in groups, followed maps or clues to game posts, and solved contextual perimeter and area problems. At each post, they identified information, selected strategies, performed calculations, and checked their answers in line with Polya's four stages of problem solving. Thus, Treasure Hunt was integrated into PBL through clue-based progression, exploration, collaboration, and reflective checking to support the mathematical problem-solving process.

Accordingly, the gap addressed in this study is not merely the limited use of games in mathematics learning, but also the limited evidence on whether a clue-based, physically exploratory Treasure Hunt game can be systematically integrated into PBL to support the four stages of mathematical problem solving in elementary school. This study, therefore, aimed to determine whether fifth-grade students taught using PBL assisted by a Treasure Hunt game demonstrated different mathematical problem-solving performance from students taught using a scientific approach, particularly in the topics of perimeter and area of plane figures. The research hypothesis (H1) stated that there would be a statistically significant difference in mean posttest scores between the experimental and control groups. In contrast, the null hypothesis (H0) stated that there would be no such difference.

RESEARCH METHODS

This study employed a quasi-experimental design with a posttest-only control group. The study was conducted at SDN Kalideres 06 Pagi in West Jakarta during the 2024/2025 academic year. The population consisted of all 64 fifth-grade students enrolled in two existing classes. Because the entire accessible population was included, saturated sampling was employed. One class of 32 students was assigned to the experimental group, while the other class of 32 students served as the control group. The experimental group received

PBL assisted by Treasure Hunt activities, whereas the control group followed the regular scientific approach without the Treasure Hunt intervention.

A posttest-only design was used to compare students' mathematical problem-solving performance after the instructional period. No pretest was administered; therefore, the study did not measure individual learning gains from before to after the intervention. Consequently, the findings were interpreted as differences in posttest performance between the experimental and control groups rather than as direct evidence of within-student improvement. To reduce potential initial-group differences, both groups consisted of intact Grade V classes from the same school, followed the same mathematics curriculum, studied the same topic of perimeter and area of plane figures, and completed the intervention within the same academic period.

Table 1. Research Design

Group	**Instructional Condition**	**Posttest**
Experimental (n = 32)	PBL assisted by Treasure Hunt (X)	O_1
Control (n = 32)	Scientific approach without Treasure Hunt	O_2

In the experimental group, PBL was implemented through five stages: problem orientation, organization for learning, group investigation, development and presentation of solutions, and analysis and evaluation of the problem-solving process. Students were divided into five groups and used a Treasure Hunt map to locate hidden game posts containing contextual problems on the perimeter and area of plane figures. Each group was required to solve the problem at one post before proceeding to the next. After completing the challenges, the groups presented their solutions and participated in a class evaluation of the answers. In contrast, the control group learned the same mathematical content through the scientific approach, which consisted of observing, questioning, collecting information, reasoning, and communicating.

Data were collected through a written mathematical problem-solving test and documentation. Documentation consisted of photographs of the research process and classroom learning activities, as well as school profile documents, and served as supporting evidence for the study's implementation. Mathematical problem-solving ability was measured using nine essay items covering the perimeter, area, and combinations of plane figures. The test aligned with the Phase C learning outcome, which requires students to determine the perimeter and area of triangles, quadrilaterals, polygons, and their combinations. Each item assessed four stages of Polya's problem-solving process:

understanding the problem, devising a plan, carrying out the plan, and looking back. Student responses were scored using an analytic rubric. Understanding the problem was scored from 0 to 2, devising a plan from 0 to 2, carrying out the plan from 0 to 4, and looking back from 0 to 2. Thus, the maximum score for each item was 10.

Before being used in the study, the instrument was pilot-tested on 30 sixth-grade students at SDN Kalideres 06 Pagi who had previously studied perimeter and area. Ten essay items were initially tested. Item validity was examined using the Pearson Product-Moment correlation with rtable = .361 at the 5% significance level. Nine items were found to be valid, with item-total correlation coefficients ranging from .420 to .802, while Item 10 was excluded because its correlation coefficient was .039. The nine retained items demonstrated high internal consistency, with a Cronbach's alpha coefficient of .811. Item analysis further showed that seven items were classified as easy and two as moderate, while discrimination indices indicated that two items were very good, five were good, and two were adequate. Therefore, nine items were retained for the final posttest.

After data collection, descriptive statistics were calculated for both groups. Normality was examined using the Kolmogorov–Smirnov test at $\alpha = .05$, following the statistical procedure used in the original study, while homogeneity of variance was assessed using Levene's test. Data were considered normally distributed and homogeneous when the significance values were greater than .05. The Kolmogorov–Smirnov results were $p = .200$ for the experimental group and $p = .148$ for the control group. At the same time, Levene's test yielded $p = .596$, indicating homogeneous variances. An independent-samples t-test was used to compare the mean posttest scores of the experimental and control groups. The analysis tested whether the difference in students' mathematical problem-solving performance between the two instructional conditions was statistically significant. A significance level of $\alpha = .05$ was applied, with differences considered statistically significant when $p < .05$.

RESULTS AND DISCUSSION

Results

The study involved fifth-grade students at SDN Kalideres 06 Pagi, who completed a posttest on mathematical problem solving at the end of the instructional period. The posttest was administered to both the experimental and control groups to measure students' final problem-solving performance. Table 2 presents the total and mean posttest scores obtained by each group.

Table 2. Posttest Results of Problem-Solving Ability

Statistic	**Experimental Group**	**Control Group**
Total Score	2785	2511
Mean Score	87.03	78.47

As shown in Table 2, the experimental and control groups obtained different posttest mean scores. The experimental group achieved a total score of 2785 with a mean of 87.03, whereas the control group obtained a total score of 2511 with a mean of 78.47. At this descriptive stage, the higher mean score of the experimental group indicates better posttest performance, although statistical significance is determined through subsequent inferential analysis. The two groups received different instructional conditions on the same topic of perimeter and area of plane figures. The experimental group learned through Problem-Based Learning assisted by the Treasure Hunt game. In contrast, the control group followed the scientific approach, consisting of observing, questioning, collecting information, reasoning, and communicating. Because no pretest was administered, the observed difference should be interpreted cautiously as a difference in posttest performance rather than direct evidence of learning gains caused solely by the instructional treatment. To provide a more detailed description of students' performance, Figure 1 compares the achievement of the four mathematical problem-solving indicators in the experimental and control groups.

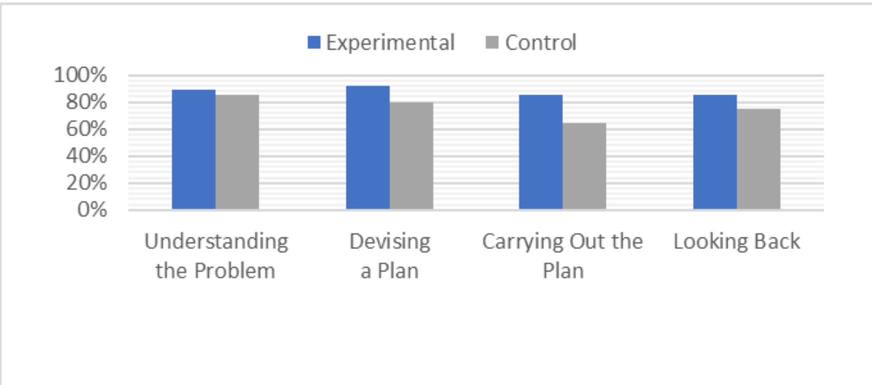

Figure 1. Comparison Diagram of Math Problem-Solving Ability Test Results

As shown in Figure 1, the experimental group achieved higher percentages than the control group across all four indicators of mathematical problem solving. For understanding the problem, the experimental group achieved 89%, compared with 85% in the control group. In devising a plan, the experimental group reached 92%, while the control group achieved 80%. The largest difference was observed in plan execution, with the experimental group achieving 85% and the control group 64%. Looking back, the experimental group achieved 85%, compared with 75% in the control group. Descriptively, these results indicate that students in the experimental group demonstrated stronger performance across the four stages of mathematical problem solving, particularly in planning and carrying out solutions. To determine whether the observed difference in posttest performance between the two groups was statistically significant, prerequisite analyses were conducted before the independent-samples t-test. The normality test results are presented in Table 3.

Table 3. Normality Test Results

No	Class	Sig
1	Exprimental	0.200
2	Control	0.148

As shown in Table 3, the Kolmogorov–Smirnov test yielded significance values of .200 for the experimental group and .148 for the control group. Because both values were greater than .05, the normality assumption was not rejected for either group. Homogeneity of variance was subsequently examined using Levene's test.

Table 4. Homogeneity test results

Levene Test	df1	df2	Sig
0.284	1	62	0.596

As shown in Table 4, Levene's test yielded a p-value of .596, which was greater than .05. This result indicates that the variances of posttest scores were homogeneous across the experimental and control groups. Based on these prerequisite analyses, the data were subsequently analyzed using an independent-samples t-test.

Table 5. T-test results

Variable	Variance Assumption	Levene's Test F	Sig.	*t*	df	Sig. (2-tailed)
Mathematical Problem-Solving Ability	Equal variances assumed	0.284	0.596	3.815	62	0.000
	Equal variances not assumed	—	—	3.815	61.6999	0.000

The independent-samples t-test showed a statistically significant difference in posttest scores on the mathematical problem-solving task between the experimental and control groups, $t(62) = 3.815$, $p < .001$. Levene's test was not significant ($F = 0.284$, $p = .596$), indicating that the assumption of equal variances was met. The experimental group obtained a higher mean posttest score ($M = 87.03$) than the control group ($M = 78.47$). These results indicate that students who learned through PBL assisted by the Treasure

Hunt game demonstrated higher mathematical problem-solving performance than those who learned through the scientific approach. However, given the posttest-only design, the findings should be interpreted as a difference in posttest performance between the two groups rather than as evidence of individual learning gains.

Discussion

The findings suggest that PBL, assisted by Treasure Hunt, supports students' mathematical problem-solving by combining contextual problems, collaborative inquiry, and sequential, game-based challenges. This is consistent with previous studies showing that PBL encourages students to analyze information, develop strategies, and evaluate solutions (Kurniyawati et al., 2019; Widyastuti & Airlanda, 2021), while game-based activities can strengthen engagement in mathematical problem solving (Melathi & Putra, 2022; Wahyuni et al., 2024) In this study, Treasure Hunt was integrated into the PBL process through clues, physical exploration, group discussion, and sequential tasks aligned with Polya's stages of understanding, planning, implementing, and reviewing solutions (Polya, 1945).

The classroom implementation provides a plausible explanation for the observed performance pattern, although the process evidence should not be interpreted as an independent measure of learning effectiveness. In the experimental condition, the 32 students were organized into five groups. Each group received a Treasure Hunt map and followed clues to several locations containing contextual problems involving perimeter, area, and combinations of plane figures. Students were required to complete the problem at a location before proceeding to the next challenge. The teacher monitored the activity and provided guidance when necessary rather than delivering complete solution procedures. This design positioned the game as part of the problem-solving process itself rather than as an additional recreational activity.

Research on game-based mathematics learning emphasizes that the educational value depends on how game mechanics and learning supports align with mathematical reasoning and task goals (Hui & Mahmud, 2023; Pan & Ke, 2023). Systematic reviews in primary mathematics further show that well-designed game-based learning can support mathematical knowledge, problem solving, engagement, and motivation, although outcomes depend on the quality of instructional integration (Dan et al., 2024; Debrenti, 2024). Treasure Hunt activities have likewise been reported to encourage participation, exploration, and collaboration in elementary mathematics (Hiyum & Bakhtiar, 2024).

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Figure 2. Treasure Hunt Map Used in the Experimental Group

As illustrated in Figure 2, the Treasure Hunt map operationalized clue-based progression, physical exploration, and collaborative task completion. Students interpreted each clue, moved to the corresponding location, solved a contextual mathematical problem, and then continued to the next challenge. In this way, progression through the game depended on mathematical problem-solving rather than movement alone. This mechanism is consistent with previous Treasure Hunt studies in elementary mathematics that emphasize exploration and collaborative task completion (Aissyah et al., 2025; Hiyum & Bakhtiar, 2024).

Understanding the Problem

For the first indicator, students in the experimental group generally demonstrated a stronger ability to identify the information provided in the problem and determine what was being asked before performing calculations. This pattern can be related to the problem-orientation stage of PBL, in which students were confronted with contextual problems involving perimeter and area and were encouraged to examine the problem before deciding on a solution procedure. The teacher supported this process by asking questions and providing clarification rather than directly providing the complete solution.

This process is important because successful mathematical problem solving begins with constructing an appropriate representation of the problem before selecting computational procedures. PBL provides opportunities for students to examine and discuss the information embedded in a problem, which may strengthen their attention to what is known, what is required, and how these elements are related. Kurniyawati et al. (2019) similarly found that problem-based learning supports mathematical problem-solving skills by placing problems at the center of the learning process. The result is also consistent with evidence that elementary students often have difficulty interpreting story problems before performing calculations (Buyung & Sumarli, 2021).

In the control group, students also encountered contextual problems through the scientific approach, which consisted of observing, questioning, collecting information, reasoning, and communicating. Therefore, the difference should not be attributed simply to the control students being passive. Rather, classroom documentation indicates that the two conditions differed in how the problem-solving experience was organized: the experimental group repeatedly encountered problems as challenges within the Treasure Hunt sequence, whereas the control group addressed them through teacher-guided presentation, LKPD activities, discussion, and communication. This distinction may have provided the experimental group with more repeated opportunities to identify relevant information before progressing to subsequent challenges.

Devising a Plan

The second indicator concerned students' ability to devise an appropriate solution plan, including selecting a relevant formula or mathematical strategy. Students in the experimental group generally demonstrated a more systematic approach to planning their solutions before carrying out calculations. In contrast, some students in the control group tended to proceed directly to computation or select an inappropriate formula without clearly formulating a solution plan.

This difference is consistent with the group-investigation stage of PBL. During the Treasure Hunt activity, students discussed strategies with group members before solving each challenge. The learning process, therefore, required students not merely to retrieve a formula but to determine which mathematical relationship was appropriate to the problem's context. Collaborative problem solving can provide opportunities for students to articulate, compare, and revise possible strategies before implementing them. Previous PBL research has shown that this type of structured problem engagement can support mathematical problem solving (Kurniyawati et al., 2019; Widyastuti & Airlanda, 2021). Similarly, Wahyuni et al (2024) reported positive results when PBL was combined with a game in elementary school mathematical problem-solving instruction.

The findings are also relevant to Buyung & Sumarli (2021), who reported that students may omit the planning stage and move directly to calculations when they are not accustomed to explicitly formulating a solution plan. In the present study, the repeated requirement to discuss a strategy before advancing through the Treasure Hunt sequence may have provided additional practice in making the planning stage explicit.

Carrying Out the Plan

The second indicator concerned students' ability to devise an appropriate solution plan, including selecting a relevant formula or mathematical strategy. Students in the experimental group generally demonstrated a more systematic planning process before carrying out calculations. In contrast, some students in the control group tended to proceed directly to computation or select an inappropriate formula without clearly formulating a solution plan. This pattern is consistent with the group-investigation stage of PBL. During the Treasure Hunt activity, students discussed possible strategies with group members before solving each challenge, which required them to determine the mathematical relationship most appropriate to the problem's context rather than merely recall a formula. Such collaborative problem solving provides opportunities for students to articulate, compare, and refine strategies before implementation.

Previous studies have similarly shown that structured problem engagement in PBL can support mathematical problem-solving (Kurniyawati et al., 2019; Widyastuti & Airlanda, 2021), while integrating game-based activities can further strengthen students' involvement in the problem-solving process (Wahyuni et al., 2024). This finding is also consistent with Buyung and Sumarli (2021), who reported that students may skip the planning stage and move directly to calculation when they are not accustomed to explicitly formulating a solution strategy. In the present study, repeated discussion before progressing through the Treasure Hunt sequence may have provided students with additional opportunities to make the planning stage more explicit and systematic.

Looking Back

For the final indicator, students in the experimental group generally demonstrated a stronger ability to review and communicate their solutions. They were more likely to present the final result in a clear concluding statement after completing the calculations. However, writing a conclusion should not be interpreted as direct evidence that students independently rechecked every step of their work. In this study, the looking-back process is better understood through the instructional procedure and scoring rubric, which required students to review the solution, check the result, and clearly communicate the conclusion.

The learning activities also included an explicit evaluation stage. After completing the Treasure Hunt challenges, each group presented its solution, with one group presenting a problem on the board. The class then reviewed the answers presented together, and the teacher facilitated discussion and corrections before the activity concluded with a reflection. Thus, checking was embedded not only in students' written responses but also in the classroom evaluation process. This corresponds to the final PBL stage of analyzing and evaluating the problem-solving process and to Polya's *looking back* stage. Evaluation of mathematical solutions is important because it encourages students to consider whether the procedure and result are consistent with the original problem, rather than treating the numerical answer as the endpoint of problem-solving (Sianturi & Dirgantoro, 2023).

Taken together, the indicator-level findings suggest that the potential value of PBL assisted by Treasure Hunt lies in the alignment between the instructional sequence and the cognitive stages of mathematical problem solving. Problem orientation supported the identification of information; collaborative investigation provided opportunities to devise and implement strategies; sequential Treasure Hunt challenges required students to apply their plans; and presentation, class evaluation, and reflection provided opportunities to review solutions. The game, therefore, served as an organizational mechanism for repeated mathematical problem-solving rather than merely an entertaining addition to PBL.

These findings extend previous studies in several ways. Melathi & Putra (2022) demonstrated the potential of P, assisted by Monopoly, for improving elementary students' mathematical problem-solving ability, while Wahyuni et al. (2024) reported positive results from PBL combined with the "Jelajah Waktu" game. Research has also shown that Treasure Hunt can be implemented effectively in elementary mathematics (Hiyum & Bakhtiar, 2024), and more recent work has integrated Treasure Hunt with Think-Pair-Share to support student activity and mathematics learning outcomes (Aissyah et al., 2025). However, these studies used different game structures or focused primarily on learning outcomes and student activity. The contribution of the present study is therefore not the use of games or Treasure Hunt alone, but the systematic integration of Treasure Hunt mechanisms - maps and clues, physical movement between locations, sequential contextual challenges, collaborative decision making, presentation, and reflective checking - within the stages of PBL and in relation to Polya's four indicators of mathematical problem solving. This study further applies that integration specifically to fifth-grade perimeter and area problems, including composite plane figures.

Accordingly, the results provide evidence that PBL assisted by Treasure Hunt is a promising instructional alternative for organizing mathematical problem-solving experiences in elementary classrooms. However, this conclusion should remain within the scope of the research design. Because the study used intact classes and a posttest-only design without pretest equivalence, the findings indicate stronger posttest performance in the experimental condition but do not establish individual learning gains or rule out all possible pre-existing differences between the groups. Future studies could strengthen this evidence by employing pretest-posttest designs, systematically measuring implementation fidelity and student engagement, and examining whether the same Treasure Hunt-PBL structure yields comparable effects across different mathematical topics and school contexts.

CONCLUSION

The findings suggest that integrating the Treasure Hunt Game into PBL can support elementary students' mathematical problem-solving performance by embedding problem-solving within a structured sequence of contextual challenges, group discussion, strategy selection, solution execution, and answer checking. The main contribution of this study lies in showing how Treasure Hunt mechanics can be aligned with PBL stages and Polya's problem-solving processes, so that the game functions as part of the learning structure rather than merely as an entertaining activity. The findings should nevertheless be interpreted within the limitations of the study. The posttest-only design did not establish students' initial equivalence or individual learning gains, and the study was conducted at a single school with a limited sample size and focused solely on perimeter and area. In addition, engagement, collaboration, and implementation fidelity were not measured as separate variables. Future research should therefore use pretest–posttest or stronger experimental designs, involve broader school contexts and mathematical topics, and include process measures to clarify how and under what conditions PBL assisted by Treasure Hunt supports mathematical problem solving.

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