



Effects of Problem-Based Learning Integrated with Teaching at the Right Level and Self-Efficacy on Students' Numeracy Literacy

*Mardiani Sukri, Sutji Rochaminah, Sukayasa, Rita Lefrida, Dasa Ismailmuza

Mathematics Education Study Program, Universitas Tadulako, Palu, Indonesia.

*Corresponding author e-mail: acamardiani@gmail.com

Received: June 2026; Revised: June 2026; Published: October 2026

Abstract

Although Problem-Based Learning (PBL) and Teaching at the Right Level (TaRL) have been widely investigated separately, empirical evidence regarding their integration in algebra instruction remains limited. This quasi-experimental study employed a 2×3 factorial design to examine the effect of PBL integrated with the TaRL approach on students' numeracy literacy across different levels of self-efficacy and to examine the interaction between the learning model and self-efficacy. The participants were 92 seventh-grade students from SMP Negeri 1 Sarjo and SMP Negeri 2 Sarjo. Data were collected using an essay test and a self-efficacy questionnaire and analyzed using Two-Way ANOVA. The results showed that the experimental group achieved higher mean post-test scores than the conventional group across all self-efficacy levels: high (91.03 vs. 85.83), medium (76.81 vs. 66.35), and low (59.17 vs. 47.50). The learning model had a significant effect on numeracy literacy ($F = 13.022$, $p = 0.001$, $\eta^2 = 0.132$), while self-efficacy contributed a larger effect ($F = 53.107$, $p < 0.001$, $\eta^2 = 0.553$). No significant interaction effect was found ($F = 0.576$, $p = 0.564$, $\eta^2 = 0.013$). These findings suggest that PBL integrated with the TaRL approach has the potential to serve as a more inclusive instructional strategy for improving students' numeracy literacy.

Keywords: Algebraic expressions; Numeracy literacy; Problem-based learning; TaRL; Self-efficacy.

How to Cite: Sukri, M., Rochaminah, S., Sukayasa, S., Lefrida, R., & Ismailmuza, D. (2026). Effects of Problem-Based Learning Integrated with Teaching at the Right Level and Self-Efficacy on Students' Numeracy Literacy. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 14(4), 2208–2231. <https://doi.org/10.33394/j-ps.v14i4.21281>



<https://doi.org/10.33394/j-ps.v14i4.21281>

Copyright© 2026, Sukri et al.

This is an open-access article under the [CC-BY License](#)



INTRODUCTION

The implementation of the Merdeka Curriculum at the junior secondary school level places numeracy literacy as a core competency that students are expected to master during Phase D (Kemendikbud, 2024). Numeracy literacy is not merely the ability to perform calculations but also the ability to formulate, apply, and interpret mathematical concepts in various real-life contexts to solve problems effectively (Nasution et al., 2024). It also encompasses the ability to analyze numerical information presented in different forms, such as graphs, tables, and diagrams, as well as to interpret and use mathematical representations for decision-making (Tim Gerakan Literasi Numerasi, 2017).

The importance of numeracy literacy has been emphasized as a fundamental competency in the information era for data-driven decision-making (Utama et al., 2023). Nevertheless, a substantial gap remains between curriculum expectations and students' actual achievement. The Programme for International Student Assessment (PISA) 2022 reported that Indonesian students obtained an average mathematics score of 366, which was considerably lower than the OECD average of 472, placing Indonesia 70th out of 81 participating countries (OECD, 2023).

At the local level, data from the 2025 Education Report Card indicated that numeracy achievement at SMP Negeri 1 Sarjo (44.44%) and SMP Negeri 2 Sarjo (37.21%) remained in the low category. This condition is closely associated with conventional instructional practices

that have not adequately accommodated differences in students' learning readiness (Mustafa et al., 2024; Utama et al., 2023), particularly in learning Algebraic Expressions in Grade VII, where students frequently encounter difficulties in translating contextual problems into mathematical models.

To address these challenges, a student-centered instructional approach is required, one of which is Problem-Based Learning (PBL). PBL is an instructional model that uses authentic problems as the starting point of learning, encouraging students to investigate and construct their own understanding (Barrows et al., 1980). Previous studies have demonstrated that PBL is effective in improving problem-solving skills, critical thinking, and competencies related to numeracy literacy (Boye & Agyei, 2023; Romadhon et al., 2024; Utama et al., 2023). However, the implementation of PBL may encounter challenges due to differences in students' prior knowledge and readiness to engage with complex problems.

To overcome these limitations, the Teaching at the Right Level (TaRL) approach offers a promising solution. The TaRL approach emphasizes differentiated instruction based on students' actual learning levels through diagnostic assessment and flexible grouping (Afandi et al., 2024; Asrini et al., 2024; Fambolan et al., 2025). This approach ensures that learning activities are aligned with students' readiness levels, thereby preventing frustration among lower-achieving students and boredom among higher-achieving students. Consequently, the TaRL approach is expected to complement PBL by making instruction more inclusive and adaptive to students' diverse learning needs.

Empirical studies have shown that PBL integrated with the TaRL approach can improve students' conceptual understanding and learning engagement (Mustafa et al., 2024). Similar findings also indicate that this integration enhances mathematics learning outcomes (Sukmawati et al., 2025). In practice, this integration is implemented by grouping students according to diagnostic assessment results and providing differentiated scaffolding based on students' ability levels, thereby ensuring that learning activities remain within students' Zone of Proximal Development.

In addition to instructional factors, psychological variables also play an important role in learning success, particularly self-efficacy. Self-efficacy refers to an individual's belief in their capability to accomplish tasks and achieve goals, which influences motivation, persistence, and academic achievement (Bandura, 1995). Recent studies have shown that mathematics self-efficacy is positively associated with students' academic achievement and numeracy literacy (Nisa & Arliani, 2023; Salsabilah & Kurniasih, 2022; Yang et al., 2024). Students with high self-efficacy tend to demonstrate better performance on mathematical tasks than those with low self-efficacy.

Nevertheless, several research gaps remain. First, previous studies on Problem-Based Learning (PBL) have primarily focused on problem-solving skills, critical thinking, and conceptual understanding. Second, research on the Teaching at the Right Level (TaRL) approach has mainly emphasized differentiated instruction and general learning outcomes. Unlike the study by Mustafa et al. (2024), which focused on improving conceptual understanding and student engagement through the integration of PBL and the TaRL approach, and the study by Sukmawati et al. (2025), which evaluated mathematics learning outcomes, the present study examines the effect of PBL integrated with the TaRL approach on students' numeracy literacy by considering different levels of self-efficacy through a 2×3 factorial design in Grade VII algebra. Therefore, this study not only extends the application of PBL integrated with the TaRL approach to a different dependent variable but also provides empirical evidence on whether the effect of the learning model is consistent across different levels of students' self-efficacy.

Theoretically, PBL integrated with the TaRL approach is expected to produce complementary effects. PBL promotes students' active engagement in solving authentic problems that require reasoning and numeracy skills, whereas the TaRL approach ensures that

instruction is tailored to students' levels of learning readiness. In addition, self-efficacy may influence how students respond to learning challenges. Students with higher self-efficacy tend to demonstrate greater persistence and confidence in solving mathematical problems. Therefore, both the main effects and the interaction effect between the learning model and self-efficacy warrant empirical investigation.

In line with this rationale, the novelty of the present study lies not only in integrating PBL with the TaRL approach but also in examining its effect on students' numeracy literacy in Grade VII algebra while considering different levels of self-efficacy and the interaction between these two variables through a 2×3 factorial design. Accordingly, this study aims to examine the effect of PBL integrated with the TaRL approach on students' numeracy literacy across different levels of self-efficacy and to examine the interaction between the learning model and self-efficacy on students' numeracy literacy. Based on this conceptual framework, the following hypotheses were formulated:

- H₁: There is a significant difference in numeracy literacy between students who learn through PBL integrated with the TaRL approach and those who learn through conventional instruction.
- H₂: There are significant differences in numeracy literacy across students with different levels of self-efficacy (high, medium, and low).
- H₃: There is a significant interaction effect between the instructional model and self-efficacy on students' numeracy literacy.

METHOD

This study employed a quantitative approach using a quasi-experimental non-equivalent control group design with a 2×3 factorial design. This design was selected because the participants were drawn from pre-existing intact classes; therefore, students were not randomly assigned to the treatment groups at the individual level.

The 2×3 factorial design enabled the researchers to examine the effect of the instructional model, the effect of self-efficacy, and the interaction between these two variables on students' numeracy literacy. The first factor was the instructional model, which consisted of two levels: Problem-Based Learning (PBL) integrated with the Teaching at the Right Level (TaRL) approach as the experimental group (A₁) and conventional instruction as the control group (A₂). The second factor was the moderator variable, namely students' self-efficacy, which was classified into three levels: High (B₁), Medium (B₂), and Low (B₃). The factorial research design is presented in Table 1.

Table 1. The 2×3 Factorial Research Design

Treatment	Self-Efficacy		
	High (B ₁)	Medium (B ₂)	Low (B ₃)
PBL integrated with the TaRL approach (A ₁)	A ₁ B ₁	A ₁ B ₂	A ₁ B ₃
Conventional Learning (A ₂)	A ₂ B ₁	A ₂ B ₂	A ₂ B ₃

Note.

- A₁ B₁ : Implementation of the PBL model integrated with the TaRL approach among students with high self-efficacy.
 A₁ B₂ : Implementation of the PBL model integrated with the TaRL approach among students with medium self-efficacy.
 A₁ B₃ : Implementation of the PBL model integrated with the TaRL approach among students with low self-efficacy.
 A₂ B₁ : Conventional learning among students with high self-efficacy.
 A₂ B₂ : Conventional learning among students with medium self-efficacy.
 A₂ B₃ : Conventional learning among students with low self-efficacy.

The study population comprised all Grade VII students of SMP Negeri 1 Sarjo and SMP Negeri 2 Sarjo, Pasangkayu Regency, during the second semester of the 2025/2026 academic year. The population consisted of 141 students distributed across six intact classes. The sample

was selected using cluster random sampling from the pre-existing classes. Through a lottery process, two classes were selected as the research sample and assigned as the experimental group ($n = 46$) and the control group ($n = 46$), resulting in a total of 92 participants.

The participants consisted of 42 male students and 50 female students, aged between 12 and 13 years. The study was conducted over seven instructional meetings, each lasting 3×40 minutes, and focused on Algebraic Expressions. To minimize the influence of variations in teaching style on the research outcomes, the learning process in both groups was conducted by the same mathematics teacher.

During the first meeting, students completed an initial diagnostic assessment designed to identify their initial numeracy literacy levels, determine learning groups for implementing the TaRL approach, and examine the baseline equivalence between the experimental and control groups. This diagnostic assessment was not used as the study's pre-test instrument; rather, it served as the basis for mapping students' initial abilities and determining their learning groups. The diagnostic instrument consisted of ten open-ended questions assessing students' basic numeracy literacy, covering integer and mixed-number operations, ratio and proportion, basic statistical data analysis, and geometry and measurement.

Based on the diagnostic assessment results, students were classified into four levels of numeracy literacy adapted from the guidelines of the Ministry of Education, Culture, Research, and Technology: Advanced (86–100), Proficient (66–85), Basic (41–65), and Beginning (≤ 40). This classification served as the basis for providing differentiated learning support and varying levels of task complexity during the implementation of the TaRL approach.

The intervention was implemented over five instructional meetings (Meetings 2–6). In the experimental group, PBL integrated with the TaRL approach was implemented through flexible learning groups formed according to the diagnostic assessment results. Each group received different levels of scaffolding, learning activities, and problem complexity that were aligned with students' numeracy literacy characteristics.

Meanwhile, the control group received Conventional Learning, which consisted of direct instruction through teacher explanations, question-and-answer sessions, worked examples, and individual practice using the same instructional materials without applying the PBL syntax or TaRL-based differentiated instruction.

The fidelity of the instructional implementation was monitored using an observation checklist based on the syntax of PBL integrated with the TaRL approach. Observations were conducted by an observer during every instructional meeting to ensure that each stage of the learning process was implemented in accordance with the Lesson Plan (RPP). In addition, the classroom teacher used an implementation checklist to maintain consistency across instructional sessions. The observation results were used to evaluate the fidelity of the intervention, thereby ensuring consistency between the intended instructional design and its classroom implementation. A detailed description of the intervention procedures and instructional syntax for both groups is presented in Table 2.

Table 2. Syntax and Procedures for Treatment Implementation

Meeting and Topic	PBL Phase	PBL–TaRL Integrated Treatment Procedures	Duration
Meeting 1: Diagnostic Assessment	Pre-treatment assessment	Students complete an initial numeracy literacy diagnostic assessment. The results are used to identify students' learning readiness and classify them into four TaRL levels: Beginning, Basic, Proficient, and Advanced. These classifications serve as the basis for grouping students and differentiating learning activities during subsequent treatment sessions.	3×40 minutes

Meeting and Topic	PBL Phase	PBL–TaRL Integrated Treatment Procedures	Duration
Meeting 2: Algebraic Expressions (<i>Variables, Coefficients, Constants, and Terms</i>)	Phase 1: Problem Orientation	The teacher presents a contextual problem involving variables, coefficients, constants, and algebraic terms. The problem is connected to familiar situations and designed to activate students' prior knowledge and mathematical reasoning.	3 × 40 minutes
	Phase 2: Organizing Students	Students work in homogeneous learning-readiness groups based on the diagnostic assessment. Each group receives differentiated Student Worksheets (SWs) aligned with its TaRL level.	
	Phase 3: Guiding Investigation	Students collaboratively investigate the problem with differentiated levels of instructional support. The Beginning and Basic groups receive more explicit guidance, concrete or visual representations, worked examples, and scaffolded questions. The Proficient and Advanced groups receive more complex tasks and guiding questions that encourage symbolic reasoning, generalization, and independent problem-solving.	
	Phase 4: Developing and Presenting Results	Representatives of each group present and explain their solutions. Other groups compare strategies, ask questions, and provide feedback.	
	Phase 5: Analyzing and Evaluating the Problem-Solving Process	The teacher facilitates reflection, confirms essential concepts, addresses misconceptions, and provides adaptive follow-up questions based on students' learning readiness.	
Meeting 3: Algebraic Operations I (<i>Addition and Subtraction</i>)	Phase 1: Problem Orientation	The teacher introduces a contextual problem involving the addition and subtraction of algebraic expressions. The complexity of examples and representations is adjusted to students' readiness levels.	3 × 40 minutes
	Phase 2: Organizing Students	Students work within their TaRL groups using differentiated SWs focused on identifying like terms and performing addition and subtraction of algebraic expressions.	
	Phase 3: Guiding Investigation	Beginning and Basic groups receive scaffolded exercises using visual representations, step-by-step examples, and simplified expressions. Proficient and Advanced groups solve more complex expressions and contextual problems requiring multiple operations and mathematical justification.	
	Phase 4: Developing and Presenting Results	Groups present their solution procedures and explain how like terms are identified and combined. Class discussion is used to compare alternative strategies.	
	Phase 5: Analyzing and Evaluating the	The teacher provides feedback, corrects misconceptions related to signs and like terms, and conducts differentiated formative assessment.	

Meeting and Topic	PBL Phase	PBL–TaRL Integrated Treatment Procedures	Duration
Meeting 4: Algebraic Operations II (<i>Multiplication and Division</i>)	Problem-Solving Process		
	Phase 1: Problem Orientation	Students are presented with contextual problems involving multiplication and division of algebraic expressions.	3 × 40 minutes
	Phase 2: Organizing Students	Students work in their readiness-based groups and receive differentiated SWs according to the level of conceptual and procedural complexity appropriate to each group.	
	Phase 3: Guiding Investigation	Beginning and Basic groups receive structured support using numerical patterns, visual models, and guided procedures. Proficient and Advanced groups investigate more complex multiplication and division problems and explain the mathematical principles underlying their solutions.	
	Phase 4: Developing and Presenting Results	Each group presents its problem-solving strategy and discusses similarities and differences among solution methods.	
Meeting 5: Properties of Algebra (<i>Commutative, Associative, and Distributive Properties</i>)	Phase 5: Analyzing and Evaluating the Problem-Solving Process	The teacher reinforces key concepts, addresses procedural errors, and provides adaptive exercises to consolidate students' understanding.	3 × 40 minutes
	Phase 1: Problem Orientation	The teacher presents contextual situations that require students to recognize and apply commutative, associative, and distributive properties.	
	Phase 2: Organizing Students	Students work in TaRL groups with differentiated SWs containing tasks of increasing conceptual complexity.	
	Phase 3: Guiding Investigation	Beginning and Basic groups explore algebraic properties using numerical examples, diagrams, and guided comparisons. Proficient and Advanced groups analyze symbolic expressions, justify the use of specific algebraic properties, and generalize emerging patterns.	
	Phase 4: Developing and Presenting Results	Groups explain the algebraic properties identified in their problems and demonstrate how these properties simplify mathematical operations.	
Meeting 6: Contextual Algebraic Modeling (<i>Substitution and Problem Solving</i>)	Phase 5: Analyzing and Evaluating the Problem-Solving Process	The teacher facilitates reflection on the usefulness of algebraic properties, clarifies misconceptions, and provides differentiated formative questions.	3 × 40 minutes
	Phase 1: Problem Orientation	The teacher presents authentic problems requiring students to translate contextual information into algebraic expressions and use substitution to determine solutions.	
	Phase 2: Organizing Students	Students work in readiness-based groups with differentiated modeling tasks appropriate to their current TaRL level.	
	Phase 3: Guiding Investigation	Beginning and Basic groups receive structured prompts for identifying known	

Meeting and Topic	PBL Phase	PBL–TaRL Integrated Treatment Procedures	Duration
Meeting 7: Final Evaluation		quantities, variables, algebraic expressions, and substitution procedures. Proficient and Advanced groups solve multi-step contextual problems, construct algebraic models independently, and justify their mathematical reasoning.	3 × 40 minutes
	Phase 4: Developing and Presenting Results	Groups present their mathematical models, solution processes, and interpretations of the results. Different modeling strategies are compared through class discussion.	
	Phase 5: Analyzing and Evaluating the Problem-Solving Process.	The teacher guides students in evaluating the accuracy and reasonableness of their models and solutions, provides corrective feedback, and conducts a final formative reflection on the treatment sessions.	
	Post-treatment assessment	Students complete an individual numeracy literacy post-test to measure their achievement after participating in the PBL–TaRL treatment. The post-test is administered under standardized conditions and is used to determine changes in students' numeracy literacy performance.	

In this study, a diagnostic assessment was administered before the intervention to identify students' learning readiness as the basis for implementing the Teaching at the Right Level (TaRL) approach. In addition to serving as the basis for grouping students, the diagnostic assessment results were analyzed to examine baseline equivalence between the experimental and control groups.

The results of the Shapiro–Wilk normality test indicated that the diagnostic assessment scores were normally distributed in both the experimental group (Sig. = 0.079) and the control group (Sig. = 0.111). Since the significance values for both groups were greater than 0.05 ($p > 0.05$), the data were considered to be normally distributed. Furthermore, Levene's test for homogeneity of variances indicated that the variances of the two groups were homogeneous (Sig. = 0.634, $p > 0.05$).

Accordingly, the assumptions for subsequent parametric inferential analyses were satisfied. The results of the Independent Samples t-test (Equal variances assumed) yielded a significance value of 0.588 ($p > 0.05$), indicating that there was no statistically significant difference in baseline numeracy literacy between the experimental and control groups. Therefore, the two groups were considered equivalent prior to the intervention. Descriptive statistics for the diagnostic assessment are presented in Table 3.

Table 3. Descriptive Statistics of the Initial Diagnostic Assessment

Treatment	N	Min	Max	Mean	Std. Deviation
Experimental Class	46	25	100	65.13	20.026
Control Class	46	25	100	67.46	20.966

Data collection in this study involved two types of instruments, namely test and non-test instruments. The test instrument consisted of a set of questions designed to assess students' numeracy literacy competencies related to Algebraic Expressions. Students' self-efficacy was measured using a questionnaire as the non-test instrument.

Data on students' cognitive achievement were collected using an essay test developed based on numeracy literacy indicators. The final assessment (post-test) was intentionally designed as a concise instrument consisting of three comprehensive essay questions. The

limited number of items was deliberately chosen to allow each question to integrate a specific Algebra content area while simultaneously assessing the three cognitive process components of numeracy literacy, namely formulating, employing, and interpreting.

Accordingly, each item represented multiple numeracy literacy indicators simultaneously, thereby maintaining adequate construct coverage despite the relatively small number of test items. The essay format was selected to provide students with opportunities to demonstrate their mathematical reasoning processes and problem-solving procedures, which cannot be adequately captured through multiple-choice questions. Students' responses were assessed using a standardized scoring rubric with a score range of 0 – 4 for each cognitive process component in every test item. A summary of the indicators, cognitive levels, and characteristics of each test item is presented in Table 4.

Table 4. Description of the Post-Test Items

Item	Numeracy Literacy Indicator	Cognitive Level	Characteristics of the Algebraic Expressions Item
1	Using various numbers or mathematical symbols to formulate contextual problems.	Applying	Students transform a canteen bread price situation into an algebraic expression and explain the meaning of the variables.
2	Analyzing information presented in tables and graphs.	Analyzing	Students analyze a table of mango weights to calculate the total weight, identify patterns in the data, and perform variable substitution.
3	Using mathematical reasoning to make predictions and decisions.	Reasoning	Students determine whether their savings are sufficient to purchase school supplies and calculate the minimum weekly savings required.

Data on student self-efficacy were collected using a questionnaire-based survey employing a 1 – 4 Likert scale, adapted from the dimensions of Bandura, (1995) theory. The instrument consisted of 30 statements, including 26 positive statements and 4 negative statements. Each statement was rated using four response options: Always (A), Often (O), Rarely (R), and Never (N). The instrument was organized into three main dimensions:

1. Magnitude : Measures students' beliefs in their ability to cope with various levels of difficulty in mathematics problems.
2. Strength : Measures students' perseverance, resilience, and persistence in completing tasks despite encountering obstacles.
3. Generality : Measures the extent to which students' confidence in their mathematical abilities can be applied across different situations, contexts, and mathematical topics.

The 2×3 factorial design employed in this study required the categorization of students' self-efficacy scores into three levels: High, Medium, and Low. The classification criteria were adapted from (Pertiwi et al., 2022), as presented in Tables 5 and 6.

Table 5. Criteria for Categorizing Students' Self-Efficacy Levels in the Experimental Class

Interval	Self-Efficacy Level	Empirical Score Range
$X \geq (\bar{x} + 0.5SD)$	High (B_1)	$X \geq 95.3$
$(\bar{x} - 0.5SD) < X < (\bar{x} + 0.5SD)$	Medium (B_2)	$87.6 < X < 95.3$
$X \leq (\bar{x} - 0.5SD)$	Low (B_3)	$X \leq 87.6$

Table 6. Criteria for Categorizing Students' Self-Efficacy Levels in the Control Class

Interval	Self-Efficacy Level	Empirical Score Range
$X \geq (\bar{x} + 0.5SD)$	High (B_1)	$X \geq 92.5$
$(\bar{x} - 0.5SD) < X < (\bar{x} + 0.5SD)$	Medium (B_2)	$84.4 < X < 92.5$
$X \leq (\bar{x} - 0.5SD)$	Low (B_3)	$X \leq 84.4$

Through this categorization, the self-efficacy levels of students in the Experimental Class and Control Class were objectively identified based on their questionnaire scores. Furthermore, to ensure data quality, instrument feasibility testing was conducted prior to the main data collection. For the numeracy literacy test instrument, the analyses included validity, reliability, item difficulty, and item discrimination. Meanwhile, the non-test instrument measuring students' self-efficacy was evaluated only in terms of validity and reliability.

Validity, Reliability, Item Difficulty, and Item Discrimination Analyses of the Test Instrument

The validity and reliability of the numeracy literacy test instrument were examined before the instrument was administered to the research sample. These analyses were conducted to ensure that the instrument produced valid, consistent, and scientifically accountable data (Sugiyono, 2013).

Item validity was examined using Pearson's Product–Moment correlation, in which an item was considered valid if $r_{calculated} \geq r_{table}$ at the 5% significance level. Subsequently, the reliability of the instrument was estimated using Cronbach's Alpha, with $r_{11} \geq 0.60$ indicating that the instrument was reliable (Arikunto, 2018). A summary of the empirical results of the validity and reliability analyses for the numeracy literacy test instrument is presented in Tables 7 and 8.

Table 7. Item Validity Test of the Numeracy Literacy Instrument

Item	$r_{calculated}$	$r_{table} (\alpha = 0.05; dk = n-2)$	Conclusion
No.1	0.916	0.3494	Valid
No.2	0.923	0.3494	Valid
No.3	0.929	0.3494	Valid

Based on Table 7, all three numeracy literacy test items had $r_{calculated} > r_{table}(0.3494)$. Therefore, all test items were considered valid and appropriate for measuring students' cognitive abilities.

Table 8. Reliability Test of the Numeracy Literacy Instrument

Reliability Coefficient (r_{11})	Category
0.831	Very High Reliability

Based on Table 8, the reliability analysis of the numeracy literacy test instrument yielded a Cronbach's Alpha (r_{11}) coefficient of 0.831. According to the classification criteria, this value falls within the range of $0.80 \leq r_{11} \leq 1.00$, indicating a very high level of reliability. Therefore, the test instrument was considered consistent and highly appropriate for collecting the research data.

The item difficulty analysis was conducted to determine the level of difficulty of each test item. The item difficulty index (P) was classified into three categories based on the criteria proposed by Arikunto, (2018): difficult ($0.00 \leq P \leq 0.30$), medium ($0.31 \leq P \leq 0.70$), and easy ($0.71 \leq P \leq 1.00$).

The item discrimination analysis was conducted to determine the ability of each test item to distinguish between students with high and low levels of ability. The interpretation of the item discrimination index (D) followed the criteria proposed by Arikunto, (2018): poor ($D \leq 0.20$), fair ($0.21 \leq D \leq 0.40$), good ($0.41 \leq D \leq 0.70$), and excellent ($0.71 \leq D \leq 1.00$). The classification of the item difficulty index (P) and the item discrimination index (D) for each numeracy literacy test item is presented in Tables 9 and 10.

Table 9. Item Difficulty Analysis of the Numeracy Literacy Instrument

Item	P Value	Difficulty Classification(P)	Conclusion
No.1	0.62	$0.31 \leq P \leq 0.70$	Medium
No.2	0.63	$0.31 \leq P \leq 0.70$	Medium

Item	P Value	Difficulty Classification(P)	Conclusion
No.3	0.50	$0.31 \leq P \leq 0.70$	Medium

Based on Table 9, all numeracy literacy test items were classified as having a medium level of difficulty, with difficulty indices ranging from 0.50 to 0.63.

Table 10. Item Discrimination Analysis of the Numeracy Literacy Instrument

Item	D Value	Discrimination Index(D)	Conclusion
No.1	0.56	0.41 – 0.70	Good
No.2	0.61	0.41 – 0.70	Good
No.3	0.67	0.41 – 0.70	Good

Based on Table 10, all test items demonstrated good discrimination indices, ranging from 0.56 to 0.67. Therefore, all test items met the empirical quality criteria and were considered appropriate for use in the main data collection.

Validity and Reliability Analyses of the Non-Test Instrument

The quality of the non-test instrument, namely the self-efficacy questionnaire, was first evaluated through an empirical validity analysis using Pearson's Product–Moment correlation. Based on the analysis of the initial 35 questionnaire items administered during the pilot test at a significance level of $\alpha = 0.05$ ($r_{tabel} = 0.3494$), 30 items were found to have $r_{calculated} \geq r_{tabel}$ and were therefore considered valid. Meanwhile, the remaining 5 items (Items 21, 24, 27, 29, and 34) were excluded because they had $r_{calculated} < r_{tabel}$. Consequently, only the 30 valid items were retained and used to measure students' self-efficacy in this study.

Following the validity analysis, the valid questionnaire items were subjected to a reliability analysis using Cronbach's Alpha. A summary of the reliability analysis results for the self-efficacy questionnaire is presented in Table 11.

Table 11. Reliability Analysis of the Self-Efficacy Questionnaire

Reliability Coefficient (r_{11})	Category
0.92	Very High Reliability

Based on Table 11, the reliability analysis of the self-efficacy questionnaire yielded a Cronbach's Alpha (r_{11}) coefficient of 0.92. According to the classification criteria, this value falls within the range of $0.80 \leq r_{11} \leq 1.00$, thus, the self-efficacy questionnaire instrument was determined to possess a very high level of reliability and was deemed suitable for use as a data collection tool for the moderator variable.

After the questionnaire data had been collected, students in both treatment classes were classified into three levels of self-efficacy. The distribution of students across each cell of the 2×3 factorial design is presented in Table 12.

Table 12. Distribution of Participants Across the 2×3 Factorial Design Cells

Treatment	Self-Efficacy			Total
	High (B ₁)	Medium (B ₂)	Low (B ₃)	
PBL integrated with the TaRL approach (A ₁) Experimental Class)	13	23	10	46
Conventional Learning (A ₂) (Control Class)	10	26	10	46
Total	23	49	20	92

As presented in Table 12, there was an imbalance in sample sizes across several cells of the 2×3 factorial design. This condition was a consequence of employing intact classes in the quasi-experimental design and classifying students into self-efficacy categories based on their self-efficacy questionnaire scores. Consequently, the number of participants in each factorial cell could not be controlled to achieve perfectly balanced group sizes. This imbalance in cell sizes is acknowledged as a methodological limitation because it may reduce the statistical

power to detect the interaction effect between the learning model and self-efficacy. Therefore, the results of the interaction effect analysis should be interpreted with caution in light of this limitation.

Significance Analysis

Descriptive and inferential statistics were employed to analyze the data in this quantitative study. Inferential statistics were used to draw conclusions from the sample data and generalize the findings to the target population (Rinaldi et al., 2020). To ensure the accuracy of the results, all stages of the data analysis were conducted systematically using SPSS.

1. Descriptive Statistics

Descriptive statistics were used to summarize the data by presenting the mean, median, mode, maximum value, minimum value, and standard deviation of students' numeracy literacy scores for each sample class (Ramayani & Lubis, 2025).

2. Assumption Testing

Before conducting hypothesis testing using inferential statistics, the assumptions for parametric analysis were examined as follows:

- a) Normality Test: The normality of the data was examined using the Shapiro–Wilk test at a significance level of $\alpha = 0.05$ to determine whether the numeracy literacy scores of both sample classes were normally distributed. The decision criterion was based on the Sig. value. If Sig. > 0.05 , H_0 was accepted, indicating that the data were normally distributed. The results of the normality test, together with the homogeneity of variance test, were used to determine the appropriateness of applying the Two-Way ANOVA. If either assumption was violated, the data analysis would be performed using a non-parametric statistical test, such as the Mann–Whitney U test.
- b) Homogeneity of Variance Test: The homogeneity of variance was examined using Levene's Test of Equality of Error Variances at a significance level of $\alpha = 0.05$ to determine whether the variances of the numeracy literacy scores were homogeneous across all groups. The decision criterion was based on the Sig. value. If Sig. > 0.05 , H_0 was accepted, indicating that the variances among the sample groups were homogeneous. Satisfying this assumption, together with the normality assumption, was a prerequisite for conducting the subsequent Two-Way ANOVA.

3. Hypothesis Testing

Hypothesis testing in this study, which employed a 2×3 factorial design, was conducted using the parametric statistical technique of Two-Way Analysis of Variance (Two-Way ANOVA). This analysis was used to examine the main effect of the learning model, the main effect of self-efficacy level, and the interaction effect between the two variables on students' numeracy literacy at a significance level of $\alpha = 0.05$. Decisions regarding hypothesis testing were based on a significance value (Sig.) < 0.05 . When the Two-Way ANOVA indicated statistically significant differences, the analysis was followed by a post hoc multiple comparison test to identify which groups differed significantly.

Although self-efficacy scores are inherently continuous data, they were categorized into three levels high, medium, and low to align with the 2×3 factorial design employed in this study. This methodological decision was based on pedagogical considerations, namely to facilitate the interpretation of the learning model's effect across different self-efficacy levels while examining whether the effect of the PBL model integrated with the TaRL approach varied among students with different levels of self-efficacy. In addition to supporting the examination of interaction effects, this categorization provides practical implications for teachers in identifying students' characteristics and designing more differentiated instruction. Although categorizing self-efficacy scores that were originally continuous may reduce statistical power, this approach was considered the most appropriate for achieving the objectives of the study and accommodating the factorial experimental design.

RESULTS AND DISCUSSION

Descriptive Analysis

Based on the categorization of the self-efficacy questionnaire distribution results administered to a total of 92 respondents, as presented in Table 13.

Table 13. Percentage of Self-Efficacy Categories

Self-Efficacy	Experimental Class		Control Class	
	Number of Students	Percentage	Number of Students	Percentage
High	13	28.3%	10	21.7%
Medium	23	50.0%	26	56.6%
Low	10	21.7%	10	21.7%
Total	46	100%	46	100%

Based on Table 13, the self-efficacy profiles of students in both research classes showed a similar distribution. In the Experimental Class, the data were dominated by the Medium category (50.0%), followed by the High (28.3%) and Low (21.7%) categories. Similarly, in the Control Class, most students were classified in the Medium category (56.6%), whereas the High and Low categories had identical proportions (21.7% each). To objectively confirm the equivalence of these initial characteristics, a Chi-Square Test of Independence was conducted using IBM SPSS Statistics. The results of the cross-tabulation and Chi-Square analysis are presented in Table 14.

Table 14. Chi-Square Test Results for the Distribution of Students' Self-Efficacy Categories

	Value	df	Asymp. Sig.	Annotation
Pearson Chi-Square	.575 ^a	2	.750	Equivalent, Homogeneous, and Balanced
N of Valid Cases	92			

Based on Table 14, the analysis yielded a χ^2 value of 0.575 with a significance value of $p = 0.750 > 0.05$. These findings provide empirical evidence that there was no significant difference in the distribution of self-efficacy categories between the Experimental Class and the Control Class. Therefore, the initial self-efficacy characteristics of students in both classes can be considered equivalent and homogeneous, ensuring that subsequent comparisons of numeracy literacy achievement between the two classes following the treatment were conducted on an objective basis.

After confirming the equivalence of the initial conditions, both classes completed a numeracy literacy post-test consisting of three essay items designed to assess students' competencies based on the three main indicators of numeracy literacy. The descriptive statistics of the post-test scores for both classes are presented in Table 15.

Table 15. Descriptive Statistics of the Mean Post-Test Scores

Treatment	Self-Efficacy		
	High	Medium	Low
(PBL) integrated with the TaRL approach (Experimental Class)	91.03	76.81	59.17
Conventional Learning (Control Class)	85.83	66.35	47.50
Mean Difference	5.20	10.46	11.67

Based on the data presented in Table 15, a consistent difference in students' achievement was observed between the Experimental and Control Classes across all levels of self-efficacy (High, Medium, and Low). Overall, students in the Experimental Class, who received Problem-Based Learning (PBL) integrated with the Teaching at the Right Level (TaRL) approach, achieved a mean post-test score of 76.99, compared with 66.49 for students in the Control Class who received conventional learning. This represents an overall mean difference of 10.50 points in favor of the Experimental Class, indicating higher numeracy literacy achievement among students exposed to the PBL–TaRL intervention.

When examined according to self-efficacy level, the Experimental Class consistently obtained higher mean scores than the Control Class. Among students with high self-efficacy, the Experimental Class achieved a mean score of 91.03 compared with 85.83 in the Control Class, yielding a difference of 5.20 points. For students with medium self-efficacy, the mean scores were 76.81 and 66.35, respectively, representing a difference of 10.46 points. The largest difference was observed among students with low self-efficacy, where the Experimental Class achieved a mean score of 59.17 compared with 47.50 in the Control Class, resulting in a difference of 11.67 points. These descriptive results indicate that students taught through the PBL-TaRL approach demonstrated higher numeracy literacy achievement across all self-efficacy levels, with the greatest descriptive difference occurring among students with low self-efficacy.

Inferential Analysis

Before testing the hypotheses, the post-test data were analyzed inferentially through parametric assumption tests, including the normality test and the homogeneity of variance test, using IBM SPSS Statistics. The results of these assumption tests are presented in Table 16 and Table 17.

Table 16. Normality Test of Post-test Results in the Experimental and Control Classes

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
Post-Test Numeracy Literacy	Experimental Class	.954	46	.066
	Control Class	.954	46	.108

Based on the results of the Shapiro–Wilk normality test in Table 16 (considering the sample size per class was $N = 46$), the significance value (Sig.) for the Experimental Class was 0.066, whereas the Control Class obtained a significance value of 0.108. Since the significance values for both classes were greater than 0.05 ($p > 0.05$), The post-test numeracy literacy data were normally distributed. In addition to the results of the Shapiro–Wilk test for the experimental and control groups, an evaluation of the residuals from the Two-Way ANOVA model also indicated that the normality assumption was satisfied. Therefore, the data were considered to meet the assumptions required for parametric analysis using Two-Way ANOVA within the 2×3 factorial design.

Table 17. Homogeneity of Variance Test in the Experimental and Control Classes

Basis of Levene's Test	Levene Statistic	df1	df2	Sig.
Based on Mean	1.382	1	90	.243
Based on Median	1.315	1	90	.255
Based on Median and with Adjusted df	1.315	1	88.487	.255
Based on Trimmed Mean	1.420	1	90	.237

Based on Table 17, the significance value based on the mean was 0.243 ($p > 0.05$). This result indicates that the variances of the data across the compared groups were homogeneous, meaning that all assumptions required for parametric statistical analysis had been satisfied.

The next step was to conduct hypothesis testing using Two-Way ANOVA to examine the main effects of the instructional treatment and self-efficacy level, as well as their interaction effect on students' numeracy literacy achievement. The results of the analysis are presented in Table 18.

Table 18. Post-Test Numeracy Literacy Results Using Two-Way ANOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15614.046 ^a	5	3122.809	25.363	.000	.596
Intercept	397006.747	1	397006.747	3224.438	.000	.974
Class	1603.266	1	1603.266	13.022	.001	.132

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Self-Efficacy	13077.450	2	6538.725	53.107	.000	.553
Class * Self-Efficacy	141.961	2	70.980	.576	.564	.013
Error	10588.693	86	123.124			
Total	499968.000	92				
Corrected Total	26202.739	91				

Main Effect of the Instructional Treatment (Class)

The analysis showed that the instructional treatment variable had a significant effect on students' numeracy literacy ($F(1, 86) = 13.022$; $p = 0.001$). The rejection of H_0 indicates that there was a significant difference in numeracy literacy between students who learned through PBL integrated with the TaRL approach and those who learned through Conventional Learning.

The partial eta squared was $\eta p^2 = 0.132$. This indicates that the instructional treatment contributed 13.2% of the variance in students' numeracy literacy achievement, which can be categorized as a medium effect approaching a large effect.

Main Effect of Self-Efficacy Level

The self-efficacy variable was found to have a highly significant effect on students' numeracy literacy ($F(2, 86) = 53.107$; $p < 0.001$). This result indicates significant differences in numeracy literacy achievement among students with High, Medium, and Low self-efficacy.

The partial eta squared value for this variable was $\eta p^2 = 0.553$. This indicates that self-efficacy independently contributed 55.3% of the variance in students' numeracy literacy. This effect size can be classified as very large (large effect) and represents an important finding, suggesting that students' psychological confidence contributes far more substantially to explaining variations in numeracy literacy performance than the instructional treatment implemented in the classroom.

Interaction Effect (Class $\times$ Self-Efficacy)

When viewed descriptively from Table 15, manual calculations indicated variations in the mean differences of post-test achievement between the two classes across each self-efficacy level (5.20 for the High level, 10.46 for the Medium level, and 11.67 for the Low level). However, these descriptive differences should be interpreted with considerable caution. The observed fluctuations in the manually calculated mean differences were relatively small and insufficient to establish a meaningful interaction trend.

This interpretation was confirmed by the inferential results of the Two-Way ANOVA presented in Table 18, where the significance value for the interaction effect between instructional treatment and self-efficacy (Class $\times$ Self-Efficacy) was 0.564 ($p > 0.05$), with a very small partial eta squared value ($\eta p^2 = 0.013$). Statistically, the absence of a significant interaction effect demonstrates that the variations in mean differences observed in the descriptive analysis did not represent meaningful statistical differences among the factorial cells.

Therefore, the absence of a significant interaction effect indicates that the superiority of numeracy literacy achievement among students taught through PBL integrated with the TaRL approach, compared with those taught through Conventional Learning, tended to be consistent across all self-efficacy levels (High, Medium, and Low), without being specifically influenced by any particular combination of instructional treatment and students' psychological characteristics.

Post Hoc Test Analysis

Given that the main effect of the self-efficacy variable was highly significant and dominant ($p < 0.001$), the analysis was continued with a Post Hoc Test using the Bonferroni

method to identify the significance of pairwise differences among the self-efficacy levels. The results are reported together with the 95% Confidence Interval (CI) in Table 19.

Table 19. Multiple Comparisons (Bonferroni Post Hoc Test) for the Self-Efficacy Variable

(I) Self-efficacy		Mean Difference (I-J)	Std. Error	Sig.	95% CI	
					Lower	Upper
High	Medium	17.4969*	2.80463	.000	10.6488	24.3450
High	Low	35.4326*	3.39256	.000	27.1490	43.7162
Medium	Low	17.9357*	2.94431	.000	10.7466	25.1249

Based on the Bonferroni post-hoc test results presented in Table 19, statistically significant differences in numeracy literacy achievement were identified across all pairs of self-efficacy levels. Students classified as having High self-efficacy significantly outperformed those in the Medium category, with a mean difference of 17.4969 ($p < .001$). The corresponding 95% confidence interval, ranging from 10.6488 to 24.3450, did not include zero, providing further evidence that the observed difference was statistically meaningful. An even larger difference emerged between students with High and Low self-efficacy. The mean difference between these two groups reached 35.4326 ($p < .001$), with a 95% confidence interval extending from 27.1490 to 43.7162. This result demonstrates that students with High self-efficacy consistently achieved substantially higher numeracy literacy scores than students with Low self-efficacy. A significant difference was also found between the Medium and Low self-efficacy groups, with a mean difference of 17.9357 ($p < .001$) and a 95% confidence interval ranging from 10.7466 to 25.1249.

Taken together, these pairwise comparisons reveal a clear and systematic pattern in numeracy literacy achievement according to students' self-efficacy levels. Students with High self-efficacy demonstrated the highest numeracy literacy achievement, followed by those with Medium self-efficacy, whereas students with Low self-efficacy obtained the lowest scores. The consistent direction of these differences suggests that higher self-efficacy is positively associated with stronger numeracy literacy performance. Nevertheless, these results should be interpreted as evidence of differences among self-efficacy groups rather than as proof of a causal effect of self-efficacy. Furthermore, although self-efficacy was significantly associated with numeracy literacy achievement, the analysis did not indicate a significant interaction between instructional treatment and self-efficacy level. Therefore, to illustrate the pattern of scores across treatment conditions and self-efficacy categories more clearly, the Estimated Marginal Means plot is presented in Figure 1.

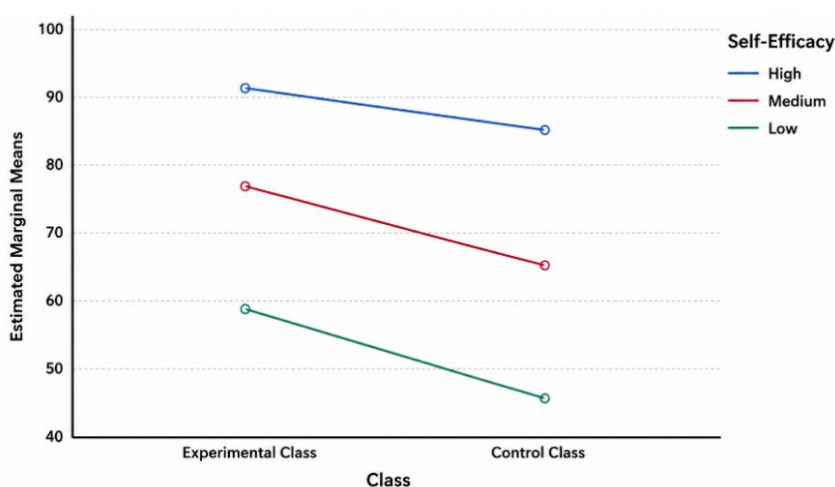


Figure 1. Estimated Marginal Means Plot of Post-Test Numeracy Literacy

Based on the Estimated Marginal Means plot presented in Figure 1, the pattern of the relationship between the learning model and self-efficacy indicates that no significant interaction effect on numeracy literacy was detected. Visually, the Estimated Marginal Means

lines for the experimental and control groups appear relatively parallel and do not intersect across the different levels of self-efficacy. This pattern is consistent with the results of the Two-Way ANOVA, which indicate that the effect of the learning model on numeracy literacy remained relatively consistent across the different levels of self-efficacy.

Discussion

The Effect of the PBL Integrated with the TaRL Approach on Students' Numeracy Literacy

The primary finding of this study indicates that the integration of Problem-Based Learning (PBL) with the Teaching at the Right Level (TaRL) approach made a significant contribution to students' numeracy literacy ($F(1, 86) = 13.022$; $p = 0.001$), with a partial eta squared was $\eta p^2 = 0.132$. This result provides empirical evidence that this instructional treatment accounted for 13.2% of the variance in students' numeracy literacy achievement, representing a medium effect size that approaches a large effect. The superior performance of the Experimental Class compared with the Control Class indicates that problem-based instruction aligned with students' actual readiness levels effectively optimized the reconstruction of their mathematical understanding.

From a theoretical perspective, PBL emphasizes learning through authentic problems to stimulate students' critical, analytical, and systematic thinking in solving numeracy-related problems (Suhirman & Yusuf, 2020; Tabun et al., 2020). Mathematics instruction that begins with real-life contextual problems enables students to construct mathematical concepts within meaningful contexts, thereby facilitating both conceptual understanding and practical application in everyday situations (Rigusti et al., 2020).

The integration of PBL with the TaRL approach further strengthened instructional effectiveness by differentiating the learning process within heterogeneous classrooms. Consequently, students were not required to follow a single uniform standard but instead received learning experiences tailored to their respective ability levels (Tembang et al., 2024; Yusuf et al., 2024). The emphasis on contextual problems that corresponded to students' initial competencies made mathematics learning more adaptive and meaningful (Afandi et al., 2024).

Furthermore, the novelty of this study lies in the effectiveness of the specific instructional activities that successfully bridged students' difficulties in understanding the abstract concepts of Algebraic Expressions. Through an initial diagnostic assessment, students' learning barriers were identified and addressed adaptively. During instruction on variables and constants, students in the lower readiness groups were not immediately introduced to abstract algebraic symbols. Instead, they were guided through authentic contextual problems for example, representing the number of objects in a hidden container using the variable x . This approach enabled them to distinguish visually between quantities that change (variables) and quantities that remain constant (constants).

Similarly, during activities involving substitution and contextual mathematical modeling, the implementation of PBL integrated with the TaRL approach through Right Level grouping enabled teachers to provide intensive instructional scaffolding using group problem cards to help students construct mathematical models from everyday situations. These differentiated instructional activities, which were specifically designed to address students' learning needs, proved effective in improving numeracy literacy by providing learning experiences that were better aligned with students' readiness levels and individual characteristics (Andini & Siregar, 2024; Imala et al., 2024; Koponen et al., 2021).

Critical Analysis of the Effect Size of Self-Efficacy on Students' Numeracy Literacy

A fundamental finding of this study is that self-efficacy exerted a very strong influence on students' numeracy literacy ($F(2, 86) = 53.107$; $p < 0.001$), with a partial eta squared value for this variable was $\eta p^2 = 0.553$. This finding indicates that approximately 55.3% of the variance in numeracy literacy can be explained by differences in students' self-efficacy levels.

Therefore, this affective factor contributed substantially more to students' numeracy literacy than the instructional treatment implemented in this study.

These findings suggest that success in mathematics learning is determined not only by the quality of the instructional strategies employed by teachers but also by students' confidence in their own ability to accomplish mathematical tasks. Students with High self-efficacy tend to set more challenging learning goals, persist when encountering difficulties, and employ more effective problem-solving strategies than students with Low self-efficacy (Schunk & Dibenedetto, 2021).

These findings are consistent with those reported by Muhazir et al., (2020), who found that students with higher levels of self-efficacy tended to demonstrate better mathematical literacy than those with lower self-efficacy. This consistency reinforces the notion that confidence in one's own abilities is an important predictor of success in completing mathematical literacy tasks. Students who believe in their capabilities are generally more willing to explore various solution strategies, more persistent when dealing with complex problems, and less likely to give up even after making mistakes during the initial stages of problem solving.

The present findings are further supported by the systematic review conducted by Street et al., (2024), which demonstrated that mathematics self-efficacy is consistently associated with mathematics achievement, learning persistence, and problem-solving ability across different educational levels. Likewise, Živković et al., (2023) reported that self-efficacy contributes positively to mathematics performance, whereas mathematics anxiety hinders academic achievement. Similarly, Fatwana et al., (2023) confirmed that the dimensions of self-efficacy are significantly associated with students' numeracy literacy.

This phenomenon can be explained through Social Cognitive Theory Bandura, (1995), which proposes that self-efficacy influences individuals' choice of activities, level of effort, persistence, and self-regulation when facing academic challenges. Consequently, self-efficacy contributes not only directly to learning outcomes but also shapes how students regulate their thinking processes, select problem-solving strategies, and sustain their efforts throughout mathematics learning.

The results of the Bonferroni post-hoc test reinforce the finding that students' numeracy literacy performance differed significantly across the High, Medium, and Low self-efficacy categories ($p < .001$). The pattern of differences indicates that higher levels of self-efficacy were associated with progressively higher numeracy literacy achievement. Students with High self-efficacy demonstrated the strongest performance, followed by those with Medium self-efficacy, whereas students with Low self-efficacy obtained the lowest scores. This pattern suggests that students' beliefs in their own capabilities may be closely related to how effectively they engage with and solve numeracy literacy tasks, particularly those involving algebraic reasoning, contextual interpretation, and problem-solving.

These differences can be further interpreted through the three dimensions of self-efficacy proposed by Bandura (1995), namely magnitude, strength, and generality. Magnitude refers to students' beliefs about their ability to handle tasks of varying levels of difficulty. Numeracy literacy in algebraic expressions requires higher-order thinking skills, including interpreting contextual problems, identifying relevant information, and translating situations into mathematical representations. Students with High self-efficacy are more likely to believe that they can solve complex algebraic problems, whereas students with Low self-efficacy may perceive such tasks as exceeding their capabilities and may therefore be less persistent in attempting them. Strength reflects the degree of confidence and resilience students maintain when facing difficulty. Students with stronger self-efficacy tend to persist in constructing and revising algebraic models even when their initial solutions are incorrect. In contrast, students with lower self-efficacy may be more vulnerable to mathematics anxiety, which can interfere with working memory and reduce performance during mathematical problem-solving and

assessment (Demedts et al., 2022). Finally, generality refers to the extent to which students can transfer confidence and problem-solving competence across different contexts. Students with High self-efficacy are generally better able to apply logical reasoning developed in familiar everyday situations to more abstract algebraic representations, thereby supporting stronger numeracy literacy performance.

From a critical perspective, the dominance of this effect size raises an important question for future research: Does PBL integrated with the TaRL approach improve numeracy literacy directly, or does part of its effectiveness operate indirectly by fostering students' self-confidence and persistence? Since this quasi-experimental study did not measure changes in self-efficacy before and after the intervention (i.e., no self-efficacy pre-test and post-test were administered), the researchers cannot claim a definitive causal relationship regarding these affective processes. Nevertheless, based on classroom observations, the integration of PBL with the TaRL approach appears to provide a form of psychological scaffolding. When students in the lower readiness groups were presented with algebraic problems that matched their actual competence levels (right level), their anxiety appeared to decrease, thereby promoting mastery experiences (Bandura, 1995) and strengthening their persistence in solving mathematical problems (Hutajulu & Minarti, 2024). This reciprocal relationship between adaptive instructional practices and the enhancement of students' affective characteristics represents an important avenue for future investigation.

Critical Analysis of the Absence of the Interaction Effect (Class $\times$ Self-Efficacy)

Based on the inferential analysis using a Two-Way ANOVA, the interaction significance value of 0.564 ($p > 0.05$), with a very small partial eta squared value ($\eta^2 = 0.013$), indicates that there was no statistically significant interaction between the learning model and self-efficacy level on students' Numeracy Literacy. This finding is visually supported by the Estimated Marginal Means plot presented in Figure 1, in which the trend lines for the experimental and control classes are parallel and do not intersect (non-crossing) across all levels of self-efficacy. This visual pattern demonstrates that both variables operate independently (Mellyzar et al., 2021).

Although the statistical analysis showed no significant interaction between the instructional treatment and students' self-efficacy levels, this finding should not be interpreted as evidence that the PBL–TaRL approach produces universally superior outcomes or that self-efficacy has no role in shaping learning outcomes. A non-significant interaction indicates that the effect of the instructional treatment did not differ significantly across the High, Medium, and Low self-efficacy groups. Its interpretation, however, should not depend solely on the p -value; statistical power, confidence intervals, sample size, analytical decisions, and the context of implementation should also be considered (Amrhein & Greenland, 2022; Kiernan & Baiocchi, 2022). In this study, the absence of a significant interaction suggests that the advantage of PBL integrated with the Teaching at the Right Level (TaRL) approach was relatively consistent across different self-efficacy levels. In other words, students with High, Medium, and Low self-efficacy appeared to benefit from the problem-solving structure of PBL and the adaptive grouping and differentiated support embedded in the TaRL approach, although the magnitude of these benefits should be interpreted cautiously (Putri et al., 2025; Yang et al., 2024).

Several methodological considerations may help explain why the interaction effect was not statistically significant. First, the Two-Way ANOVA employed a 2×3 factorial design with a total sample of 92 students distributed across six cells, resulting in a relatively limited number of participants in each subgroup. Such cell sizes may reduce statistical power and make small interaction effects more difficult to detect (Kiernan & Baiocchi, 2022). Second, self-efficacy was categorized into High, Medium, and Low levels. Although this categorization facilitates interpretation, converting a continuous variable into categories can reduce variability and statistical sensitivity, thereby limiting the ability to identify more subtle interaction patterns

(Altman & Royston, 2006). Third, the intervention was implemented within the Algebraic Expressions unit over a limited instructional period. This duration may not have been sufficient for the interaction between instructional treatment and students' psychological characteristics to become fully observable. Meta-analytic evidence indicates that implementation characteristics, including intervention duration and intensity, can influence the magnitude of instructional effects (Cochon et al., 2023). Therefore, the non-significant interaction found in this study is better interpreted as an indication of relatively comparable treatment effects across self-efficacy levels, rather than definitive evidence that the relationship between instructional treatment and self-efficacy is absent.

Although the learning model and self-efficacy operated independently without a statistically significant interaction, the descriptive empirical data revealed an interesting pattern when the post-test scores were examined in greater detail. The largest differences in achievement were observed among students with medium self-efficacy (10.46-point difference) and low self-efficacy (11.67-point difference). By nature, students in the medium and low self-efficacy categories require greater external support through a structured and supportive learning environment (Salsabilah & Kurniasih, 2022).

PBL integrated with the TaRL approach effectively addresses these needs. The TaRL approach provides appropriately differentiated learning tasks that foster mastery experiences (Bandura, 1995), while PBL promotes active engagement through authentic real-world problems (Hutajulu & Minarti, 2024). These complementary characteristics likely contributed to the substantial improvement in Numeracy Literacy among students in these more vulnerable groups compared with those who experienced conventional learning (Riandhany & Puadi, 2023).

In contrast, the achievement gap between the two classes was considerably smaller among students with high self-efficacy, with a difference of only 5.20 points. This finding suggests that students with high self-efficacy are primarily supported by internal factors, including well-developed self-regulation, learning resilience, and independence in overcoming cognitive challenges (Nisa & Arliani, 2023; Zulfayani et al., 2023). Consequently, these students consistently demonstrated stable academic performance and were less dependent on variations in instructional models or learning environments (Bandura, 1995; Yang et al., 2024). Overall, PBL integrated with the TaRL approach proved to be a reliable and inclusive instructional strategy (Colle et al., 2023; Mustafa et al., 2024).

Overall, the findings of this study indicate that improvements in Numeracy Literacy depend not only on the implementation of innovative learning models but also on students' psychological readiness to face mathematical learning challenges. PBL integrated with the TaRL approach creates an adaptive learning environment for students with diverse levels of ability, while self-efficacy serves as an internal factor that strengthens persistence, problem-solving strategies, and learning success. Therefore, the development of mathematics instruction at the secondary school level should be directed not only toward improving cognitive outcomes but also toward strengthening students' self-efficacy through meaningful, gradual, and readiness-based learning experiences.

Research Limitations

The researchers acknowledge that this quasi-experimental study has several limitations that should be considered when interpreting and generalizing the findings. First, the study involved a relatively limited sample of 92 students from only two junior secondary schools, namely SMP Negeri 1 Sarjo and SMP Negeri 2 Sarjo. Consequently, the findings should be generalized cautiously to broader populations and educational contexts. Second, students' Numeracy Literacy in the Algebraic Expressions topic was assessed using only three essay items. Although the instrument satisfied the established validity and reliability criteria, the limited number of items may not have fully captured the multidimensional nature of students' Numeracy Literacy. Third, although the experimental and control groups were taught by the

same mathematics teacher to minimize instructional bias, potential variations in teaching style, classroom management, instructional consistency, and teacher commitment could not be entirely controlled, which represents an inherent limitation of the quasi-experimental design. Fourth, the instructional intervention was implemented only during the Algebraic Expressions unit within a relatively short instructional period; therefore, the long-term effects and sustainability of PBL integrated with the TaRL approach on students' Numeracy Literacy could not be comprehensively examined. In addition, this study did not investigate changes in students' self-efficacy through a longitudinal pre-test–post-test design. Future research is therefore encouraged to employ larger and more diverse samples, extend the duration of the intervention, use more comprehensive measures of Numeracy Literacy, and incorporate longitudinal or mediation analyses to provide a deeper understanding of the relationships among PBL integrated with the TaRL approach, self-efficacy, and students' Numeracy Literacy.

CONCLUSION

Based on the results of the data analysis and discussion, this study provides empirical evidence of the positive effect of Problem-Based Learning (PBL) integrated with the Teaching at the Right Level (TaRL) approach on students' Numeracy Literacy in the Algebraic Expressions topic within the scope of this study. The treatment effect size was in the medium category, indicating that a contextual problem-based instructional intervention adapted to students' levels of learning readiness has the potential to support the development of their Numeracy Literacy more adaptively.

Furthermore, the findings revealed a significant main effect of Self-Efficacy on students' Numeracy Literacy, with a larger effect size than that of the learning model. This finding indicates that the psychological factor of self-efficacy plays an important role in explaining variations in students' Numeracy Literacy within the context of this study. Meanwhile, the absence of a significant interaction effect between the learning model and self-efficacy level indicates that this study found no evidence of differential effects of the learning model on students' Numeracy Literacy across different levels of self-efficacy.

Nevertheless, the findings of this study have limitations regarding the broader generalizability of the results. The pattern of descriptive improvement demonstrated by PBL integrated with the TaRL approach is limited to the characteristics of the sample, the duration of the intervention, and the specific instructional content examined. Therefore, it cannot be claimed as a universally superior or unequivocally effective instructional approach across all educational contexts.

In addition, the use of a quasi-experimental design involving intact classes also limits causal inference and the generalizability of the findings. Therefore, the results of this study should be interpreted with caution while taking into account the methodological limitations inherent in the research design.

RECOMMENDATION

For mathematics teachers, it is recommended that diagnostic assessment be administered at the beginning of each instructional unit to identify students' learning readiness and potential learning obstacles before introducing abstract mathematical concepts such as Algebraic Expressions. The implementation of PBL integrated with the TaRL approach can be strengthened through flexible grouping strategies and differentiated instructional support, in which problem cards, learning tasks, and scaffolding are systematically adjusted to students' levels of readiness. In addition, considering the important role of self-efficacy in students' numeracy literacy achievement, teachers should not focus exclusively on cognitive content. They are also encouraged to create a supportive learning environment that reduces mathematics anxiety, provides constructive feedback, and promotes mastery experiences, particularly for students with lower levels of self-efficacy or academic readiness.

For future researchers, several methodological improvements are recommended to strengthen the validity and generalizability of subsequent findings. Future studies should involve larger and more diverse samples representing a wider range of school characteristics and educational contexts rather than being limited to only two schools. Where feasible, researchers may employ a Randomized Controlled Trial (RCT) design to minimize selection bias and reduce the influence of uncontrolled extraneous variables. Longitudinal research designs with repeated pre-test and post-test measurements are also recommended to examine changes in self-efficacy and numeracy literacy over time and to better understand the dynamic relationship between affective and cognitive learning outcomes. Furthermore, future studies should develop more comprehensive numeracy literacy assessment instruments with a more proportional number of test items and broader indicators of mathematical proficiency so that students' competencies can be measured more accurately and comprehensively.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to their academic supervisors for their invaluable guidance and methodological insights, as well as to the thesis examiners for their constructive suggestions and critical feedback throughout the preparation and refinement of this research. The authors also thank the principals and mathematics teachers of SMP Negeri 1 Sarjo and SMP Negeri 2 Sarjo for their cooperation, institutional support, and technical assistance during the data collection process.

FUNDING INFORMATION

This research received no external funding. The APC was funded by the authors.

AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Mardiani Sukri	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	
Sutji Rochaminah	✓	✓		✓	✓		✓			✓		✓		
Sukayasa	✓	✓		✓	✓		✓			✓		✓		
Rita Lefrida		✓		✓			✓			✓		✓		
Dasa Ismailmuza		✓		✓			✓			✓		✓		

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

This study was conducted in accordance with the ethical principles governing educational research involving human participants, particularly junior secondary school students. The study complied with relevant institutional and national ethical guidelines. The procedures implemented to protect participants' rights and ensure institutional approval were as follows:

1. The study received official permission from the relevant educational authorities and the principals of SMP Negeri 1 Sarjo and SMP Negeri 2 Sarjo. The research activities were conducted without disrupting the regular teaching and learning process.
2. The researchers provided participants and their parents or legal guardians with clear information regarding the objectives of the study and the administration of the research instruments. Participation was entirely voluntary.
3. Students' identities were replaced with numerical codes to protect their privacy. All research data were stored securely and used only for academic research purposes. No personally identifiable information was disclosed in this study.

DATA AVAILABILITY

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

REFERENCES

- Afandi, R. A., Ningtyas, N. S., Susiyawati, E., & Pratiwi, P. (2024). The effectiveness of differentiated learning using the TaRL (Teaching at the Right Level) approach for improving learning interest and learning outcome. *Jurnal Pijar MIPA*, 19(4), 657–662. <https://doi.org/10.29303/jpm.v19i4.6860>

- Altman, D. G., & Royston, P. (2006). The cost of dichotomising continuous variables. In *British Medical Journal* (Vol. 332, Issue 7549, p. 1080). <https://doi.org/10.1136/bmj.332.7549.1080>
- Amrhein, V., & Greenland, S. (2022). Discuss practical importance of results based on interval estimates and p-value functions, not only on point estimates and null p-values. *Journal of Information Technology*, 37(3), 316–320. <https://doi.org/10.1177/02683962221105904>
- Andini, F., & Siregar, M. A. P. (2024). The effect of problem based learning on Students' mathematical literacy ability. *Desimal: Jurnal Matematika*, 7(1), 113–122. <https://doi.org/10.24042/djm.v7i1.22211>
- Arikunto, S. (2018). *Dasar-dasar evaluasi pendidikan* (R. Damayanti (ed.); 3rd ed.). PT Bumi Aksara.
- Asrini, N. M. N. A., Juwana, I. D. P., & Wirasti, N. K. (2024). Penerapan pendekatan Teaching At The Right Level (TaRL) untuk meningkatkan hasil belajar matematika Siswa. *Widyadari*, 25(2), 240–249. <https://doi.org/10.59672/widyadari.v25i2.4125>
- Bandura, A. (1995). *Self-efficacy in Changing Societies*. in the United States of America. <https://www.researchgate.net/publication/247480203>
- Barrows, H. S., Robyn, M., & Tamblyn, N. (1980). *Problem-based learning an approach to medical education*. Springer Publishing Company. <https://app.nova.edu/toolbox/instructionalproducts/edd8124/fall11/1980-BarrowsTamblyn-PBL.pdf>
- Boye, E. S., & Agyei, D. D. (2023). Effectiveness of problem-based learning strategy in improving teaching and learning of mathematics for pre-service teachers in Ghana. *Social Sciences and Humanities Open*, 7(1). <https://doi.org/10.1016/j.ssaho.2023.100453>
- Cochon, D. O., Lentillon-Kaestner, V., & Margas, N. (2023). Effects of the Jigsaw method on student educational outcomes: systematic review and meta-analyses. In *Frontiers in Psychology* (Vol. 14). Frontiers Media SA. <https://doi.org/10.3389/fpsyg.2023.1216437>
- Colle, T. L. A., Nurnia, & Rabiah. (2023). Improving the Students' writing skills by integrating Problem-Based Learning (PBL) with Teaching at the Right Level (TaRL) approach in Class 7. C of SMP-TQ Mu'adz bin Jabal 1). *Journal of English Language Learning (JELL)*, 7(1), 325–333. <https://doi.org/10.31949/jell.v7i1.5624>
- Demedts, F., Reynvoet, B., Sasanguie, D., & Depaepe, F. (2022). Unraveling the role of math anxiety in students' math performance. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.979113>
- Fambolan, S., Garak, S. ., Jais, A., & Fuadi, M. (2025). Implementation of teaching at the right level through differentiated learning on Senior High School Students' learning outcomes. *Journal of Insan Mulia Education*, 3(2), 59–68. <https://doi.org/10.59923/joinme.v3i2.651>
- Fatwana, H., Dasari, D., Juandi, D., Elsayed, S. A. M., & Azhari, B. (2023). The relationship between self-efficacy and students' mathematical literacy. In *Research Article JOMES* (Vol. 1, Issue 1). <https://iesjournal.com/index.php/jomes>
- Hutajulu, M., & Minarti, E. D. (2024). Increasing mathematical literacy and numeracy abilities with problem-based learning model through technological pedagogical content knowledge. *Hexagon: Jurnal Ilmu Dan Pendidikan Matematika*, 2(1), 55–63. <https://doi.org/10.33830/hexagon.v2i1.6163>
- Imala, Z., Sunaengsih, C., & Syahid, A. A. (2024). The effect of the problem-based learning model on the numerical literacy ability of Elementary School Students. *Jurnal Cakrawala Pendas*, 10(3), 512–522. <https://doi.org/10.31949/jcp.v10i3.9640>
- Kemendikbud. (2024). *Panduan Pembelajaran dan Asesmen Pendidikan Anak Usia Dini, Pendidikan Dasar, dan Pendidikan Menengah* (Edisi Revi). Badan Standar, Kurikulum, dan Asesmen Pendidikan (BSKAP) Kementerian Pendidikan, Kebudayaan, Riset, dan

- Teknologi. https://kurikulum.kemdikbud.go.id/file/1720050633_manage_file.pdf
- Kiernan, M., & Baiocchi, M. T. (2022). Casting new light on statistical power: An illuminating analogy and strategies to avoid underpowered trials. *American Journal of Epidemiology*, 191(8), 1500–1507. <https://doi.org/10.1093/aje/kwac019>
- Koponen, T., Aro, T., Peura, P., Leskinen, M., Viholainen, H., & Aro, M. (2021). Benefits of integrating an explicit self-efficacy intervention with calculation strategy training for low-performing elementary students. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.714379>
- Mellyzar, Unaida, R., Muliani, & Novita, N. (2021). Hubungan self-efficacy dan kemampuan literasi numerasi siswa: ditinjau berdasarkan gender. *Lantanida Journal*, 9(2), 93–182. <https://doi.org/10.22373/lj.v9i2.11176>
- Muhazir, A., Hidayati, K., & Retnawati, H. (2020). Literasi matematis dan self-efficacy siswa ditinjau dari perbedaan kebijakan sistem zonasi. *Pythagoras: Jurnal Pendidikan Matematika*, 15(2), 227–245. <https://doi.org/10.21831/pg.v15i2.36255>
- Mustafa, S., Ilmi, N., & Suliati. (2024). Innovative strategies in math education: The impact of PBL and TaRL on concept mastery and classroom dynamics. *Jurnal Varidika*, 36(1), 50–63. <https://doi.org/10.23917/varidika.v36i1.5150>
- Nasution, S. H., Muchsin, S. B., Wicaksono, A., Pratama, E. Y., & Baist, A. (2024). *Numerasi : urgensi, hambatan, dan upaya meningkatkannya* (T. Herman (ed.)). Baskara Media.
- Nisa, F. K., & Arliani, E. (2023). Junior High School Students' mathematical literacy in terms of mathematical self-efficacy. *Jurnal Elemen*, 9(1), 283–297. <https://doi.org/10.29408/jel.v9i1.7140>
- OECD. (2023). *PISA 2022 Results :The State of Learning and Equity in Education: Vol. I*. OECD. <https://doi.org/10.1787/53f23881-en>
- Pertiwi, M., Suhendra, & Juandi, D. (2022). Mathematical literacy ability of Junior High School Students in terms of self-efficacy. *SJME (Supremum Journal of Mathematics Education)*, 6(2), 171–180. <https://doi.org/10.35706/sjme.v6i2.6547>
- Putri, I. S., Subekti, F. E., & Kusuma, J. W. (2025). Analisis kemampuan berpikir kritis matematis Siswa ditinjau dari self-efficacy. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, 6(1), 201–213. <https://doi.org/10.46306/lb>
- Ramayani, F., & Lubis, N. A. (2025). The Effect of Problem-Based Adaptive Learning on Students' Mathematical Concept Understanding Ability. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 13(1), 94–106. <https://doi.org/10.33394/j-ps.v13i1.14396>
- Riandhany, D. N., & Puadi, E. F. W. (2023). Efektivitas penerapan model pembelajaran Problem Based Learning (PBL) terhadap kemampuan numerasi Siswa. *Indo-MathEdu Intellectuals Journal*, 4(2), 223–234. <https://doi.org/10.54373/imeij.v4i2.160>
- Rigusti, W., Pujiastuti, H., & Mutaqin, A. (2020). The effect of PBL model and learning styles on mathematical problem-solving and self esteem abilities. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 8(1), 12–24. <https://doi.org/10.33394/j-ps.v8i1.2683>
- Rinaldi, A., Novalia, & Syazali, M. (2020). *Statistika inferensial untuk ilmu sosial dan pendidikan* (1st ed.). PT Penerbit IPB Press. <https://perpustakaan.iaiskjmalang.ac.id/wp-content/uploads/2024/02/8.-Statiska-Inferensial.pdf>
- Romadhon, N. I., Amir, M. F., & Wardana, M. D. K. (2024). Assessing students' mathematical reasoning in problem-based learning: a gender perspective. *International Journal of Evaluation and Research in Education*, 13(6), 3763–3774. <https://doi.org/10.11591/ijere.v13i6.29580>
- Salsabilah, A. P., & Kurniasih, M. D. (2022). Analisis kemampuan literasi numerasi ditinjau dari efikasi diri pada Peserta Didik SMP. *Edumatica: Jurnal Pendidikan Matematika*, 12(2). <https://doi.org/10.22437/edumatica.v12i02.18429>

- Schunk, D. H., & Dibenedetto, M. K. (2021). *Self-regulation, self-efficacy, and learning disabilities*. <https://doi.org/10.5772/intechopen.99570>
- Street, K. E. S., Malmberg, L. E., & Schukajlow, S. (2024). Students' mathematics self-efficacy: a scoping review. *ZDM - Mathematics Education*, 56(2), 265–280. <https://doi.org/10.1007/s11858-024-01548-0>
- Sugiyono. (2013). *Metode penelitian kuantitatif kualitatif dan R&D* (Cetakan Ke19). Alfabeta. <https://dokumen.pub/metode-penelitian-kuantitatif-kualitatif-dan-rampd-2013nbsped-9798433640.html>
- Suhirman, & Yusuf. (2020). The effect of problem-based learning with character emphasis toward Students' higher-order thinking skills and characters. *International Journal of Emerging Technologies in Learning*, 15(6), 183–191. <https://doi.org/10.3991/IJET.V15I06.12061>
- Sukmawati, D., Ayu, & Hayati, L. (2025). Integrating teaching at the right level with problem-based learning to enhance mathematics learning outcomes. *AlphaMath: Journal of Mathematics Education*. <https://doi.org/10.30595/alphamath.v11i1.25251>
- Tabun, H. M., Taneo, P. N. L., & Daniel, F. (2020). The ability of Student math literacy on model Problem Based Learning (PBL). *Eduma: Mathematics Education Learning and Teaching*, 9(1), 43–48. <https://doi.org/10.24235/eduma.v9i1.6036>
- Tembang, Y., Rahayu, D. P., Lieung, K. W., Hurit, A. A., Sulistyowati, R. W., Mariyanto, W., & Nurwidiyanto, A. (2024). Pendekatan TaRL berbantuan media augmented reality meningkatkan literasi dan numerasi Siswa SD Negeri 2 Merauke. *Jurnal Pendidikan Dasar Perkhasa*, 10(1), 230–241. <https://doi.org/10.31932/jpdp.v10i1.3096>
- Tim Gerakan Literasi Numerasi. (2017). *Materi Pendukung Literasi Numerasi*. Badan Standar, Kurikulum, dan Asesmen Pendidikan (BSKAP) Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. [chrome-extension://ehhttps://repositori.kemendikdasmen.go.id/11628/1/materi-pendukung-literasi-numerasi-rev.pdf](https://repositori.kemendikdasmen.go.id/11628/1/materi-pendukung-literasi-numerasi-rev.pdf)
- Utama, F., Zaenuri, & Pranoto, Y. K. S. (2023). Students numerical literacy ability in problem based learning with ethnomatematics nuances. *Prima: Jurnal Pendidikan Matematika*, 7(2), 98–108. <https://doi.org/http://dx.doi.org/10.31000/prima.v7i2.8387>
- Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self-efficacy and mathematics achievement: multilevel analysis with NAEP 2019. *Large-Scale Assessments in Education*, 12(1), 1–29. <https://doi.org/10.1186/s40536-024-00204-z>
- Yusuf, F. B., Firdaus, F. M., & Kadir. (2024). Enhancing problem-solving skills and spirit of mutual cooperation in mathematics learning through Teaching at the Right Level (TaRL) approach. *Jurnal Ilmiah Sekolah Dasar*, 8(1), 90–100. <https://doi.org/10.23887/jisd.v8i1.68232>
- Živković, M., Pellizzoni, S., Doz, E., Cuder, A., Mammarella, I., & Chiara, P. M. (2023). Math self-efficacy or anxiety? The role of emotional and motivational contribution in math performance. *Social Psychology of Education*, 26(3), 579–601. <https://doi.org/10.1007/s11218-023-09760-8>
- Zulfayani, Ariawan, R., Nufus, H., & Kafrina. (2023). Profile of Students' numeracy literacy ability and self efficacy in mathematics learning. *Mathematics Research and Education Journal*, 7(2), 25–35. [https://doi.org/10.25299/mrej.2023.vol7\(2\).14381](https://doi.org/10.25299/mrej.2023.vol7(2).14381)