

Reading and Numeracy Literacy as Predictors of Fifth-Grade Elementary Students' Fraction Problem-Solving Ability

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ABSTRACT

Mathematical problem-solving ability is an essential competence in 21st-century learning, particularly in solving contextual problems. This study aims to analyze the role of reading literacy and numeracy literacy in predicting elementary students' mathematical problem-solving ability on fraction topics. This study employed a quantitative approach with a correlational (ex post facto) design involving 35 fifth-grade students at SD Sabir, Bireuen, Aceh, selected through total sampling. The research instruments consisted of a numeracy literacy test integrated with reading literacy and a mathematical problem-solving test, each comprising five essay items, which met validity ($r = 0.501-0.759$; $p < 0.05$) and reliability (Cronbach's Alpha = 0.760) criteria. Data were analyzed using multiple linear regressions with Jamovi after fulfilling prerequisite tests. The results showed that reading literacy and numeracy literacy simultaneously had a significant effect on mathematical problem-solving ability, with a contribution of 58.9% ($R^2 = 0.589$; $p < 0.001$). However, partially, reading literacy did not have a significant effect ($p = 0.141$), whereas numeracy literacy had a significant and dominant effect ($p < 0.001$). These findings indicate that numeracy literacy is the primary factor supporting students' mathematical problem-solving ability, while reading literacy plays a supporting role in understanding problem contexts. This study highlights the importance of integrating numeracy literacy in mathematics learning through contextual approaches and multiple mathematical representations. This study contributes to the field of elementary mathematics education by providing empirical evidence on the predictive role of reading literacy and numeracy literacy in enhancing fifth-grade students' ability to solve fraction problems.

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1. INTRODUCTION

Mathematical problem-solving ability is one of the essential competencies that students must possess to face the challenges of the 21st century. This ability does not only involve computational skills but also includes the processes of understanding problems, designing solution strategies, implementing procedures, and evaluating results. Within the framework of mathematical literacy, problem-solving ability serves as a key indicator in measuring students' capacity to apply mathematical

concepts in real-life contexts (OECD, 2022; NCTM, 2000). However, empirically, various studies indicate that elementary students' mathematical problem-solving ability remains relatively low, particularly in solving contextual problems that require higher-order thinking skills (Lester, 2013; Schoenfeld, 2016; Stacey, 2011). The ability to solve fraction problems is a fundamental component of elementary mathematics because it serves as the foundation for learning more advanced mathematical concepts such as ratios, proportions, algebra, and statistics. However, numerous international and national assessment results indicate that elementary school students continue to experience significant difficulties in understanding and applying fraction concepts. These challenges are often associated not only with limited mathematical understanding but also with insufficient reading literacy and numeracy literacy skills. Reading literacy enables students to comprehend mathematical texts, identify relevant information, and interpret problem situations accurately, whereas numeracy literacy supports students in applying mathematical reasoning and selecting appropriate solution strategy.

In fraction topics, the complexity of students' difficulties increases as it involves abstract conceptual understanding, mathematical representation, and language interpretation in word problems. Empirical evidence shows that students' difficulties are most dominant in understanding problems, transforming them into mathematical models, and completing the solution process. Additionally, difficulties in learning mathematics at the elementary level are influenced by factors such as limited language ability, insufficient conceptual understanding, and procedural-oriented teaching approaches. These findings are consistent with international studies indicating that errors in mathematical problem-solving frequently occur during the stages of understanding, transformation, and solution processes (Newman, 1977; OECD, 2022). This study is also highly relevant to current educational policies emphasizing the integration of literacy and numeracy across the curriculum. Many educational reforms encourage schools to develop students' higher-order thinking skills through literacy-rich and numeracy-based learning experiences. Understanding the predictive relationship between reading literacy, numeracy literacy, and fraction problem-solving ability will provide valuable empirical evidence for teachers, curriculum developers, and policymakers in designing effective instructional strategies. Moreover, identifying these predictors may contribute to early interventions aimed at improving students' mathematical achievement at the elementary level (Mullis et al., 2023). From a theoretical perspective, this research contributes to the growing body of literature suggesting that mathematical problem solving is a multidimensional process involving cognitive, linguistic, and numerical competencies. Students who possess stronger reading comprehension are better able to interpret mathematical language, while those with higher numeracy literacy demonstrate greater flexibility in applying mathematical concepts to real-life situations. Therefore, examining reading literacy and numeracy literacy as predictors of fraction problem-solving ability provides a comprehensive understanding of the factors influencing elementary students' mathematical performance and supports evidence-based educational practices (Kilpatrick et al., 2001).

Reading literacy is an important factor contributing to students' mathematical problem-solving ability. It involves not only reading skills but also the ability to understand, interpret, and evaluate information in mathematical problems. Empirical studies indicate that low reading literacy directly affects students' inability to understand problem statements, which is the initial stage of problem solving (Mukhlesiyeni, 2024; OECD, 2022). Recent evidence also shows that reading ability significantly contributes to mathematical performance, especially in text-based problem-solving contexts (Khursumlia & Vula, 2019; Mullis et al., 2019; Jacinto & Carreira, 2023; Kadijevich et al., 2023).

On the other hand, numeracy literacy is a fundamental competency in mathematics learning. It includes understanding mathematical concepts, interpreting quantitative information, and applying mathematics in real-life situations. However, mathematics instruction in elementary schools still tends to emphasize procedural learning and memorization, resulting in a gap between expected competencies and students' actual abilities. Recent studies indicate that low numeracy literacy is associated with limited exposure to contextual problems and weak mathematical representation skills (Kulimbang & Efendi, 2025; Vessonen et al., 2024; Ramadhan et al., 2023; Mullis et al., 2019).

Data from the 2025 Minimum Competency Assessment (AKM) at SD Sabir show that students' reading literacy is categorized as good (80% achieving minimum competency), although it decreased

by 20% compared to the previous year. Meanwhile, numeracy literacy is categorized as moderate (60% achieving minimum competency) with a 40% decrease. This indicates an empirical gap between reading and numeracy literacy and highlights a concerning decline in achievement (Rapor Pendidikan SD Sabir, 2025).

Preliminary findings from 35 fifth-grade students also revealed that most students experience difficulties in solving fraction-based problem-solving tasks. Students tend to perform calculations without fully understanding the context and struggle to represent problems mathematically. This supports previous findings indicating gaps in contextual understanding, representation, and problem-solving strategies (Majid, 2026; Lalihatu et al., 2026; Arifin & Nuh, 2026).

However, recent studies indicate that research on reading literacy and numeracy literacy is often conducted separately, with limited studies examining both variables simultaneously in predicting mathematical problem-solving ability. This highlights a research gap that needs further investigation (Beyazhancer & Demir, 2025; Majid, 2026).

Based on the identified research gap, this study is focused on examining the role of reading literacy and numeracy literacy simultaneously in predicting elementary students' mathematical problem-solving ability. The research hypothesis is formulated to empirically test the role of reading literacy and numeracy literacy, both partially and simultaneously, in influencing students' mathematical problem-solving ability.

2. METHODS

This study employed a quantitative approach with a correlational design to analyze the role of reading literacy and numeracy literacy in predicting students' mathematical problem-solving ability. The study was *ex post facto* in nature, as it did not involve manipulation of variables but examined naturally occurring relationships. The population consisted of fifth-grade elementary students, with a sample of 35 students from SD Sabir, Bireuen, Aceh selected through total sampling.

The research instruments included two types of tests: a numeracy literacy test integrated with reading literacy and a mathematical problem-solving test. The numeracy literacy test measured students' ability to understand text-based information, interpret contextual problems, and apply fraction concepts. The problem-solving test was based on Polya's stages: understanding the problem, planning the solution, executing the solution, and evaluating the results. Each test consisted of five essay questions.

Before implementation, the instruments were tested for validity and reliability. Validity was assessed using Pearson item-total correlation, with results ranging from 0.501 to 0.759 ($p < 0.05$), indicating that all items were valid. Reliability testing using Cronbach's Alpha yielded a value of 0.760, indicating good internal consistency.

Data collection was conducted through testing, and the data were analyzed using Jamovi. The analysis included prerequisite tests (normality, linearity, and multicollinearity) followed by multiple linear regression analysis to examine both partial and simultaneous effects.

3. FINDINGS AND DISCUSSION

3.1. Findings

This section presents the results of the empirical analysis based on data from 35 fifth-grade students at SD Sabir, Bireuen, Aceh, aimed at examining the role of reading literacy and numeracy literacy in predicting students' mathematical problem-solving ability. The analysis was conducted systematically, including descriptive analysis, instrument quality testing, prerequisite tests, and analysis of relationships and effects among variables.

Table 1. Descriptive Statistics

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Reading Literacy	35	6.94	2.59	2	12
Numeracy Literacy	35	5.14	3.14	0	14
Mathematical Problem Solving	35	9.17	3.02	4	20

Based on the results of the descriptive analysis presented in Table 1, it was found that the average scores of reading literacy, numeracy literacy, and students' mathematical problem-solving ability were in the moderate to high category, indicating that most students have relatively good abilities in understanding and solving mathematical problems on fraction topics. Furthermore, the quality of the research instruments was examined through validity and reliability tests, the results of which are presented in Table 2.

Table 2. Validity and Reliability Test Results

No	Item	r (Item-Total)	Sig.	Remarks
1	Item 1	0.501	0.002	Valid
2	Item 2	0.527	0.001	Valid
3	Item 3	0.752	0.000	Valid
4	Item 4	0.713	0.000	Valid
5	Item 5	0.759	0.000	Valid
Cronbach's Alpha = 0.760 (Reliable)				

The results of the validity test using Pearson correlation between item scores and total scores indicate that all items have correlation coefficients ranging from 0.501 to 0.759 with a significance value of $p < 0.05$, meaning that all items are valid. In addition, the reliability tests results show a Cronbach's Alpha value of 0.760, which falls into the reliable category. It indicates that the instrument has good internal consistency and is suitable for use in the study.

Prerequisite tests were conducted prior to regression analysis, the results of which are presented in Table 3 below.

Table 3. Normality and Linearity Test Results

Test Type	Method	Statistic Value	Sig.	Remarks
Normality	Shapiro-Wilk	0.984	0.874	Normal
Normality	Kolmogorov-Smirnov	0.083	0.969	Normal
Linearity	(Jamovi Plot / ANOVA)	–	> 0.05	Linear

The results of the normality test using the Shapiro-Wilk test showed a significance value of 0.874 ($p > 0.05$), indicating that the data were normally distributed. Meanwhile, the linearity test results indicated that the relationship between the independent variables and the dependent variable was linear, thus fulfilling the assumptions required for regression analysis.

Table 4. Multicollinearity Test Results

Variable	Tolerance	VIF	Remarks
Reading Literacy	0.797	1.25	No multicollinearity
Numeracy Literacy	0.797	1.25	No multicollinearity

Based on the results of the multicollinearity test presented in Table 4, the tolerance value was 0.797 and the VIF value was 1.25 for each independent variable. These values indicate that there is no multicollinearity among the independent variables, as the VIF value is less than 10 and the tolerance value is greater than 0.10. Therefore, the regression model meets the assumption of no multicollinearity.

Table 5. Pearson Correlation Test Results

Variables	r	Sig.	Remarks
Reading Literacy – Problem Solving	0.490	0.003	Significant
Numeracy Literacy – Problem Solving	0.748	0.000	Significant
Reading Literacy – Numeracy Literacy	0.450	0.007	Significant

The results of the correlation analysis presented in Table 5 indicate that reading literacy has a positive relationship with students' mathematical problem-solving ability, with a correlation coefficient of 0.490 ($p < 0.05$), while numeracy literacy shows a stronger relationship with a correlation coefficient of 0.748 ($p < 0.05$). These findings indicate that both variables have a significant relationship with students' mathematical problem-solving ability.

Table 6. Multiple Linear Regression Analysis

R	R ²	F	Sig.
0.767	0.589	22.9	0.000

Furthermore, the results of the multiple linear regression analysis presented in Table 6 indicate that the regression model has an F value of 22.9 with a significance level of $p < 0.001$, indicating that the model is statistically significant. The coefficient of determination (R^2) of 0.589 indicates that reading literacy and numeracy literacy collectively account for 58.9% of the variance in students' mathematical problem-solving ability. Partially, reading literacy does not have a significant effect on mathematical problem-solving ability ($p = 0.141$; $p > 0.05$), whereas numeracy literacy has a significant effect ($p < 0.001$) with a regression coefficient of 0.638. These findings indicate that numeracy literacy has a more dominant role in predicting students' mathematical problem-solving ability compared to reading literacy.

This result suggests that students who possess a solid understanding of numerical concepts, mathematical relationships, and computational skills are better equipped to interpret and solve fraction-related problems. Fraction problem-solving requires students to compare quantities, identify equivalent fractions, perform mathematical operations, and apply logical reasoning. Therefore, strong numeracy literacy provides the foundational knowledge and skills necessary for successful performance in fraction tasks. These findings are consistent with previous studies emphasizing that numeracy literacy plays a central role in mathematical achievement because it enables students to apply mathematical concepts effectively in various contexts.

3.2. Discussion

The findings of this study indicate that both reading literacy and numeracy literacy contribute to students' fraction problem-solving ability; however, numeracy literacy emerged as the stronger predictor. This result suggests that students who possess a solid understanding of numerical concepts, mathematical relationships, and computational skills are better equipped to interpret and solve fraction-related problems. Fraction problem-solving requires students to compare quantities, identify equivalent fractions, perform mathematical operations, and apply logical reasoning. Therefore, strong numeracy literacy provides the foundational knowledge and skills necessary for successful performance in fraction tasks. These findings are consistent with previous studies emphasizing that numeracy literacy plays a central role in mathematical achievement because it enables students to apply mathematical concepts effectively in various contexts.

Although reading literacy was found to have a positive influence on fraction problem-solving ability, its contribution was lower than that of numeracy literacy. Reading literacy helps students comprehend problem statements, identify relevant information, and understand mathematical vocabulary embedded in word problems. Nevertheless, understanding the text alone is insufficient if students lack the numerical reasoning required to translate the information into appropriate mathematical procedures. This finding implies that effective mathematics instruction should integrate both literacy domains while placing greater emphasis on developing students' numeracy skills. Schools

and teachers should provide learning experiences that strengthen numerical reasoning, mathematical communication, and real-world problem-solving to improve students' performance in fraction-related tasks and broader mathematical learning.

This study provides empirical evidence that reading literacy and numeracy literacy simultaneously play a significant role in predicting elementary students' mathematical problem-solving ability, with a contribution of 58.9%. These findings indicate that literacy skills, both in linguistic and numerical aspects, are essential components in developing students' mathematical thinking, particularly in solving contextual problems. This is consistent with the view that mathematics learning should not only focus on procedural mastery but also on the ability to understand and apply concepts meaningfully in various situations (Iffat & Dharin, 2026; Arifin & Nuh, 2026).

However, partially, reading literacy does not show a significant effect on students' mathematical problem-solving ability. This finding suggests that the ability to understand text is not necessarily the main determinant of students' success in solving mathematical problems, particularly in fraction topics. Empirically, this condition may be attributed to the nature of the tasks, which emphasize numerical aspects rather than linguistic complexity, leading students to rely more on numeracy skills than on deep reading comprehension. This finding contrasts with previous studies that highlight the importance of reading literacy in helping students understand problems as the initial stage of mathematical problem solving (Mukhlesiyeni, 2024; Mukhlesiyeni & Salehha, 2025).

In contrast, numeracy literacy is proven to have a significant and dominant effect on students' mathematical problem-solving ability. This indicates that the ability to understand mathematical concepts, perform calculations, and interpret results is the main factor in solving fraction problems. These findings are in line with studies showing that low numeracy literacy leads to difficulties in understanding problems, performing calculations, and drawing conclusions in mathematical problem solving (Kulimbang & Efendi, 2026). Furthermore, other studies indicate that students still experience difficulties in understanding contextual problems, determining appropriate solution strategies, and interpreting results, emphasizing the importance of strengthening numeracy literacy in mathematics learning (Majid, 2026).

Theoretically, the results of this study support the view that mathematical problem solving is a complex process involving the ability to understand problems, transform them into mathematical models, and accurately interpret the results. Students' difficulties in these stages indicate gaps in contextual understanding, problem modeling, and solution evaluation (Mukhlesiyeni & Salehha, 2025). In addition, other studies show that students face challenges in understanding problems, selecting appropriate strategies, and evaluating solutions in mathematical problem solving (Yeni et al., 2020). These findings suggest that numeracy literacy and mathematical representation are key factors in students' problem-solving success.

This study also reveals a research gap, where most previous studies have examined reading literacy and numeracy literacy separately, while this study analyzes both variables simultaneously within a predictive model. Therefore, this study contributes new insights into understanding how the interaction between reading literacy and numeracy literacy influences elementary students' mathematical problem-solving ability (Mukhlesiyeni & Salehha, 2025). Reading literacy helps students comprehend problem statements, identify relevant information, and understand mathematical vocabulary embedded in word problems. Nevertheless, understanding the text alone is insufficient if students lack the numerical reasoning required to translate the information into appropriate mathematical procedures. This finding implies that effective mathematics instruction should integrate both literacy domains while placing greater emphasis on developing students' numeracy skills. Schools and teachers should provide learning experiences that strengthen numerical reasoning, mathematical communication, and real-world problem-solving to improve students' performance in fraction-related tasks and broader mathematical learning.

Practically, these findings imply that mathematics learning in elementary schools should place greater emphasis on developing numeracy literacy through contextual problems, the use of multiple mathematical representations, and instructional strategies that encourage critical and systematic thinking. The use of diverse mathematical representations in learning has been shown to help students

understand concepts more deeply and improve their mathematical problem-solving ability (Lalihat et al., 2026). Additionally, context-based learning grounded in real-life situations is essential to enhance students' numeracy literacy in a meaningful and sustainable manner (Ramadhan et al., 2023).

Fractions involve understanding part-whole relationships, proportional reasoning, equivalence, and operations that differ from whole-number arithmetic. Students with higher numeracy literacy are more likely to possess the conceptual understanding needed to navigate these challenges successfully. In contrast, students with limited numeracy skills may struggle even when they fully understand the wording of a problem. This suggests that numeracy literacy functions not only as a procedural skill but also as a cognitive tool that supports deeper mathematical reasoning and problem-solving processes.

The educational implications of these findings are significant for elementary school curricula and instructional practices. Teachers should design learning activities that promote both literacy development and mathematical understanding, particularly through contextualized and problem-based learning approaches. Integrating numeracy-rich tasks, mathematical discussions, visual representations, and real-life fraction applications can help students strengthen their conceptual understanding and problem-solving abilities. Furthermore, educational policymakers should consider prioritizing numeracy literacy programs in elementary education, as improving students' numerical competence may have a direct and lasting impact on their success in mathematics and related academic domains.

4. CONCLUSION

This study aims to analyze the role of reading literacy and numeracy literacy in predicting elementary students' mathematical problem-solving ability. The results show that both variables simultaneously have a significant effect with a contribution of 58.9%. However, partially, reading literacy does not show a significant effect, whereas numeracy literacy has a significant and dominant effect. These findings indicate that numeracy literacy is the primary factor supporting students' success in solving mathematical problems, particularly in fraction topics, while reading literacy serves as a supporting factor in understanding problem contexts. This study is limited by the relatively small sample size and limited scope; therefore, future research is recommended to involve larger samples, employ more diverse research approaches, and examine other relevant variables, such as learning motivation or self-efficacy, to obtain a more comprehensive understanding. This study contributes to the literature by demonstrating that numeracy literacy is a stronger predictor of fifth-grade students' fraction problem-solving ability than reading literacy, highlighting its critical role in mathematical learning and achievement.

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