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The Influence of Literacy and Numeracy on Problem-Solving Ability in Mathematics Learning

Fitriani[1], Yasir Arafat[2], Susanti Faipri Selegi[3], Golaleh Makroni[4]
[1,2,3,]Education Teacher School Base, Faculty Teaching Knowledge Education, Universitas PGRI Palembang, Indonesia
[4]Department of Education dan Culture, Tampere University, Finlandia
fitriania714@gmail.com, yasirarafat@univpgri-palembang.ac.id, susantifaipriselegi@gmail.com, golaleh.makrooni@tuni.fi

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Abstrak: *Penelitian ini bertujuan untuk mengkaji pengaruh pembelajaran berbasis literasi numerasi terhadap kemampuan pemecahan masalah matematika siswa tingkat sekolah dasar, khususnya pada materi bangun datar di kelas IV SD Negeri 33 Palembang. Urgensi penelitian ini didasarkan pada pentingnya penguatan kompetensi numerasi siswa sebagai bagian dari Gerakan Literasi Nasional yang menekankan kemampuan berpikir analitis dan penalaran logis dalam pembelajaran matematika. Penelitian ini menggunakan pendekatan kuantitatif dengan desain eksperimen True Experimental Design tipe Nonequivalent Control Group Design. Subjek penelitian terdiri atas 40 siswa yang terbagi menjadi dua kelas, yaitu kelas eksperimen IVC dan kelas kontrol IVD. Baik kelas eksperimen maupun kelas kontrol masing-masing berjumlah 20 siswa. Teknik pengumpulan data dilakukan melalui tes pilihan ganda sebanyak 10 soal dan dokumentasi, sedangkan analisis data menggunakan uji Independent Sample t-test. Hasil penelitian menunjukkan adanya pengaruh signifikan pembelajaran literasi numerasi terhadap kemampuan pemecahan masalah matematika siswa, yang berdampak pada peningkatan pemahaman konsep dan keterlibatan kognitif dalam belajar matematika.*
Kata Kunci: Literasi, Numerasi, Matematika

Abstract: This study aims to examine the effect of numeracy-based learning on elementary school students' mathematical problem-solving skills, particularly in the subject of flat shapes in the fourth grade at SD Negeri 33 Palembang. The urgency of this study is based on the importance of strengthening students' numeracy skills as part of the National Literacy Movement, which emphasizes analytical thinking and logical reasoning in mathematics learning. This study used a quantitative approach with a True Experimental Design of the Nonequivalent Control Group Design type. The research subjects consisted of 40 students divided into two classes, namely the IVC experimental class and the IVD control class. Both the experimental and control classes had 20 students each. Data collection techniques were carried out through a multiple-choice test consisting of 10 questions and documentation, while data analysis used the Independent Sample t-test. The results showed a significant effect of numeracy literacy learning on students' mathematical problem-solving abilities, which had an impact on improving conceptual understanding and cognitive engagement in learning mathematics.
Keywords: Literacy, Numeracy, Mathematics

INTRODUCTION

Education plays a crucial role in shaping human life and development. It provides individuals with the foundation to grow intellectually, socially, and emotionally from birth through adulthood (Anggraini, Arafat, & Selegi, 2023). The rapid transformation from a traditional to a globalized era has made education an essential means for individuals to develop their potential and adapt to technological and societal changes (Afandi, Jafar, & Adnan, 2021). One of the essential competencies in the 21st century is numeracy literacy, also known as mathematical literacy, which refers to the ability to apply numerical, data-related, and mathematical reasoning skills to real-life situations (Putri, Utomo, & Zukhrufurrohmah, 2021). Numeracy literacy involves understanding and using numbers, symbols, and data to analyze information, interpret results, and draw logical conclusions (Salsabila & Jaenudin, 2023). These competencies are vital for problem-solving and decision-making in everyday life and form the basis for lifelong learning.

According to (Abdullah & Zaenal, 2023), numeracy literacy contributes to developing high-quality human resources capable of competing in an increasingly complex global society. While literacy is often associated with language, numeracy focuses on reasoning through mathematics; therefore, numeracy literacy represents an integration of both enabling individuals to interpret, analyze, and communicate mathematical information effectively (Ate & Lede, 2022; Silitonga & Ratumanan, 2023).

However, many students still face challenges in mastering mathematical concepts. (Romauli & Must, 2019) highlight that the inability to solve mathematical problems often stems from weak numeracy literacy skills. This deficiency leads to misconceptions and a lack of problem-solving ability, even for non-routine or complex problems. Thus, improving numeracy literacy from an early stage is essential for developing students' logical and analytical thinking skills.

Mathematics, as a subject taught from early childhood through higher education, plays a fundamental role in cognitive development. It not only enhances computational skills but also fosters critical, logical, and systematic thinking (Ratnasari & Setiawan, 2022). Despite its importance, mathematics remains one of the subjects most students find difficult. (Nasution & Mujib, 2022) revealed that low mathematics achievement often results from students' limited conceptual understanding and negative perceptions toward the subject. (Similarly, Perdana, & Suswandari, 2021) found that misconceptions at early learning stages can persist and hinder students' mathematical development in later years.

A preliminary interview conducted with the fourth-grade mathematics teacher at SDN 33 Palembang revealed persistent challenges in mathematics learning. Students' achievement in mathematics remains below the Minimum Mastery Criteria (KKM) of 70. In the control class of 35 students, only 15 met the standard, while in the experimental class of 34 students, only 10 achieved mastery. Teachers still rely heavily on conventional media such as blackboards and textbooks, and numeracy-based learning media have not been optimally utilized. As a result, students show low motivation and engagement during lessons.

Numeracy literacy skills are therefore essential in addressing these issues. Several previous studies have examined numeracy literacy in mathematics education. Amaliah and Zulkarnaen emphasized that numeracy literacy involves the ability to acquire, interpret, use, communicate, and analyze mathematical symbols and data to make logical decisions in everyday contexts (Amaliah & Zulkarnaen, 2021). Ekowati (Ekowati et al, 2019) reported that the application of numeracy literacy-based learning media significantly improved students' mathematical problem-solving abilities. (Similarly, Lastrijanah, & Mawardini, 2017) demonstrated that the use of geoboard media enhanced students' understanding of geometric concepts and improved their learning outcomes.

While these studies provide valuable insights, they primarily focus on higher-grade students or specific mathematical topics such as geometry. Few have examined the impact of numeracy literacy on problem-solving ability among elementary students, particularly at the fourth-grade level. This gap highlights the need for research exploring how numeracy literacy can be effectively integrated into early mathematics learning to improve students' conceptual understanding and performance.

Therefore, this study seeks to fill this gap by investigating the influence of numeracy literacy on students' problem-solving ability in mathematics learning among fourth grade students at SDN 33 Palembang. The novelty of this study lies in its focus on early mathematical development and the implementation of numeracy-based learning approaches at the elementary level. The findings are expected to contribute to improving instructional strategies that enhance students' mathematical reasoning and problem-solving competencies.

METHOD

This study employed a true experimental design, specifically a posttest-only control group design. This design was selected because it allows the researcher to measure the effect of the treatment (numeracy literacy-based learning) on students' problem-solving abilities by comparing the outcomes of two randomly assigned

groups, experimental and control after the intervention. The design helps to control for potential threats to internal validity since participants are randomly assigned and only tested after treatment. The design of the study can be illustrated as follows at table 1:

Table 1. Study Design

	Class	*Treatment* (treatment)	*Posttest*
(R)	Experiment	X	O_1
(R)	Control	-	O_2

(Source : Khotimah, 2019, p. 160)

Information:

R : Randomly assigned group (experimental or control)

$O_1 O_2$: Posttest results measuring problem-solving ability

X : Treatment using numeracy literacy-based learning

The table 1 shows that this study employed a true experimental design with a posttest-only control group approach. This design was chosen because it enables an objective comparison between two randomly assigned groups the experimental and control groups after the intervention, without being influenced by pretest sensitization. The experimental group received numeracy literacy based learning, while the control group was taught through conventional methods. This approach was selected to ensure internal validity, allowing the researcher to attribute any differences in students' learning outcomes to the treatment provided.

The population of the study comprised all fourth-grade students at SD Negeri 33 Palembang, totaling 139 students across four classes: IVA, IVB, IVC, and IVD. The sampling technique used was simple random sampling, as it provides every individual in the population an equal opportunity to be selected. The procedure involved determining the population, deciding the sample size, and randomly assigning classes to the experimental and control groups. Through this process, Class IVA was designated as the experimental group and Class IVB as the control group.

Data were collected using two main techniques, namely testing and documentation. The testing technique was chosen to obtain quantitative data on students' mathematical problem-solving abilities after the learning intervention. The posttest was administered to both groups following the completion of the treatment sessions. Meanwhile, documentation was employed to gather supporting data such as student rosters, school records, and demographic information, providing contextual background for interpreting test results. These methods were selected because they ensure that the collected data are both measurable and verifiable.

The research instrument used was a mathematical problem-solving test consisting of ten open-ended questions. These items were developed based on numeracy literacy indicators and aligned with the fourth grade mathematics curriculum. The test aimed to measure students' abilities to identify mathematical information, select appropriate operations, analyze and interpret data, and communicate their reasoning effectively. Each question required students to explain the steps of their solution, demonstrating not only computational accuracy but also logical reasoning.

Before being administered, the instrument was validated by three experts a mathematics education lecturer, a classroom teacher, and an educational assessment specialist to ensure its content validity, clarity, and alignment with learning objectives. Reliability testing was conducted using Cronbach's Alpha, and the coefficient value exceeding 0.70 indicated that the test had good internal consistency. Item validity was further confirmed through item total correlation analysis, ensuring that each item accurately measured the intended construct.

The data obtained from the posttest were analyzed using both descriptive and inferential statistics. Preliminary analyses included the Kolmogorov Smirnov test for normality and Levene's test for homogeneity of variance. Once the assumptions were met, an independent samples t-test was applied to determine whether there was a significant difference in students' posttest mean scores between the experimental and control groups. The level of significance was set at $\alpha = 0.05$, and all analyses were performed using SPSS software.

Ethical considerations were observed throughout the research process. Permission to conduct the study was obtained from the school administration, and informed consent was secured from teachers and parents. The confidentiality and anonymity of participants were maintained at all stages of the research.

RESULTS AND DISCUSSION

The purpose of this study is to evaluate whether numeracy literacy positively influences the problem solving abilities of fourth grade students in mathematics learning at SD Negeri 33 Palembang. The focus of this research is the topic of flat shapes. This study is experimental research involving two classes with different treatments: an experimental class that uses the numeracy literacy learning method and a control class that receives the material using conventional methods without numeracy literacy. The study was conducted over five meetings, from July 18, 2024 to July 23, 2024.

Results

Data were obtained from students' learning outcomes in the initial test (pretest), using 10 multiple-choice questions aimed at measuring students' ability levels before receiving treatment with numeracy literacy based learning. Based on the study results, the pretest and post-test scores of the control class showed that, out of 20 students, only 4 met the Minimum Mastery Criteria (KKM), while 16 students did not. The following table presents the Minimum Mastery Criteria (KKM) of students in the control class:

Table 2. Description Completeness Results Study on Control Class

Mark Minimum Competency (KKM)	Category	Frequency	Presentation (%)
<70	No Completed	16	80%
≥70	Completed	4	20%
	Total	20	100%

Based on the data presented in the table 2, it was found that among the 20 students in Class VC at SD Negeri 33 Palembang, only 4 students (20%) achieved mastery learning, while 16 students (80%) did not reach the minimum completeness criteria (KKM) in the topic of two dimensional shapes in mathematics. This finding indicates that, from a classical perspective, the overall learning outcomes have not yet met the expected standards of achievement.

From a research standpoint, this result reflects the limitations of conventional learning approaches, which tend to emphasize rote procedures rather than conceptual understanding. The low level of mastery suggests that students may face difficulties in translating abstract mathematical concepts into concrete representations. Such conditions highlight the need for instructional interventions grounded in numeracy literacy, which integrate contextual problem-solving and active learning. By incorporating numeracy literacy based strategies, students are encouraged to connect mathematical ideas with real life contexts, thereby improving comprehension and retention. Therefore, these findings provide a strong rationale for implementing the experimental treatment in this study to address students' learning gaps and enhance overall achievement in mathematics.

Meanwhile, the results of the students' pretest and post-test (final test) after receiving treatment in the experimental class using 10 multiple choice questions, showed that out of 20 students, eighteen achieved the Minimum Mastery Criteria (KKM), while two students did not. The following table presents the Minimum Mastery Criteria (KKM) for each student in the experimental class:

Table 3. Description Completeness Results Study on Class Experiment

Mark Minimum Competency (KKM)	Category	Frequency	Presentation (%)
<70	No Completed	2	10%
≥70	Completed	18	90%
	Total	20	100%

Based on the data presented on table 3, it was found that out of 20 students in class IVC at SD Negeri 33 Palembang, 18 students (90%) achieved mastery learning criteria in the topic of plane figures. This high level of achievement indicates that, from a classical perspective, the students' learning outcomes in mathematics have met the expected competency standards.

From the perspective of this research, these findings demonstrate the effectiveness of numeracy literacy–based learning in enhancing students' conceptual understanding and problem-solving skills. The improvement reflects not only the students' ability to recall formulas or procedures but also their capacity to apply mathematical reasoning in contextual problem-solving situations. This suggests that integrating numeracy literacy into mathematics instruction can foster deeper cognitive engagement, encourage active participation, and bridge abstract mathematical concepts with real-life applications. Consequently, this result supports the theoretical premise that numeracy literacy contributes significantly to students' overall mathematical proficiency and learning independence.

Results of Control and Experiment Classes

Table 4. Data Mark of Control and Experiment Classes

Class	Control	Experiment
Average	50.35	82.00

Based on the descriptive statistical data on table 4, the control class obtained a minimum score of 10 and a maximum score of 80, with an average of 50.35. The minimum passing grade (Kriteria Ketuntasan Minimal/KKM) used in this study was 70. Only 4 students in the control class met the minimum criteria, while 16 students did not achieve it. In contrast, the experimental class obtained a minimum score of 50 and a maximum score of 100, with an average score of 82.00. In this group, 18 students successfully met the minimum passing grade, and only 2 students failed to reach the standard.

These results demonstrate that students who were taught using numeracy literacy based learning showed substantially higher achievement compared to those taught

through conventional methods. This improvement suggests that numeracy literacy activities, which emphasize contextual problem solving and real life numerical reasoning, effectively enhance students' conceptual understanding and engagement in mathematics learning.

The data normality test was conducted to ensure that the dataset met the assumptions for parametric analysis. The normality test, performed using the Shapiro Wilk test in SPSS version 26, confirmed that the data were normally distributed in both the experimental and control groups. This finding supports the validity of subsequent inferential statistical analyses, such as homogeneity testing and the independent sample t-test, to determine the significance of the observed differences. From a research perspective, these statistical results strengthen the conclusion that the implementation of numeracy literacy not only improves mean performance but also increases the overall distribution consistency of students' mathematical achievement.

Table 5. Results of Data Normality Test

		Kolmogorov- Smimov [a]			Shapiro-wilk		
		Statistics	Df	Sig.	Statistics	DF	Sig.
Ability Solve the problem	*Pretest* Experimental Class	,170	20	,133	,951	20	,375
	Posttest Class Experiment	,155	20	,200	,911	20	,068
	Pretest Class Control	,150	20	,200	,957	20	,484
	Posttest Class Control	,244	20	,003	,924	20	,118

(Source : Results exercise data primary, 2024)

Based on the results of the data normality test on table 5, the significance value of the pretest in the experimental class was 0.375, and the posttest in the experimental class was 0.068. In the control class, the pretest significance value was 0.484, and the posttest significance value was 0.118. Since all obtained significance values exceeded the threshold of $\alpha = 0.05$, it can be concluded that the pretest and posttest data for both the experimental and control groups were normally distributed. This finding satisfies one of the key assumptions required for parametric testing, specifically the independent sample t-test, which assumes data normality as a prerequisite for valid statistical inference.

From the perspective of this study, confirming data normality is crucial because it ensures that the observed differences in mathematical problem-solving abilities between the experimental and control groups are due to the implementation of numeracy literacy learning, rather than irregularities in data distribution. The results also demonstrate that students' learning outcomes varied systematically according to the treatment,

supporting the reliability of the subsequent hypothesis testing.

Furthermore, a homogeneity test was conducted to determine whether the variances between the two groups were equal. Meeting the assumption of homogeneity is essential to ensure that both groups experimental and control had comparable initial conditions prior to the intervention. The results of this test (presented in the following table) confirmed that the data were homogeneous, thereby validating the use of parametric statistical analysis. These results reinforce the methodological rigor of the study and strengthen the conclusion that any observed differences in performance stem from the applied instructional treatment rather than sampling bias or unequal group variability.

Table 6. Results of Data Homogeneity Test

Levene Statistics	df1	df2	Sig.
,563	3	76	,641

(Source : Results exercise data primary, 2024)

Based on the data results in the homogeneity test table 6, the significant class value is obtained experiment And class control that is 0.641 with $\alpha = 0.05$ so mark significant 0.641 > 0.05, according to the homogeneity test requirements of the data test, it can be seen that the data analyzed is homogeneous. The hypothesis test given in this research is whether there is an influence in numeracy literacy learning on problem-solving abilities in mathematics learning for class IV students at SD Negeri 33 Palembang. During the implementation of the experiment assumption this uses test *independent sample t-test* helped SPSS 26, from results calculation get results as following:

Tabel 7. Hypothesis Test Results

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Results_ Learning	,783	,382	-7,152	40	,000	-35,000	4,894	44,907	-25,093
Equal variances assumed									

(Source : Results exercise data primary, 2024)

The results of the hypothesis testing using an independent sample t-test showed a significant difference between the experimental and control groups. The obtained p

value was 0.000 < 0.05, and the t-value was 7.152 > 1.683, indicating that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. Thus, it can be concluded that numeracy literacy learning had a significant effect on students' problem-solving abilities in mathematics at SD Negeri 33 Palembang.

To further assess the strength of this effect, an effect size analysis using Cohen's d was conducted. Based on the mean difference and pooled standard deviation, the value of Cohen's d = 1.42, which falls within the large effect size category (Cohen, 1988). This indicates that the implementation of numeracy literacy learning had a strong and practically meaningful impact on improving students' mathematical problem-solving performance. Therefore, the findings confirm that the application of numeracy literacy strategies not only produces statistically significant differences but also contributes substantially to enhancing students' learning outcomes.

Discussion

The findings of this study indicate that numeracy literacy based learning has a significant and positive effect on students' mathematical problem solving abilities, particularly on the topic of flat shapes among fourth grade students at SD Negeri 33 Palembang. Students in the experimental group not only achieved higher posttest scores but also showed improved engagement, reasoning, and participation compared to the control group. This improvement suggests that numeracy literacy fosters both cognitive and behavioral gains, making learning experiences more meaningful and contextualized.

These findings are consistent with recent studies emphasizing the importance of integrating literacy into mathematics learning. (Ekowati & Rachmawati, 2022) reported that numeracy literacy contributes to students' mathematical reasoning and conceptual understanding through contextual problem-solving. (Similarly, Sari, & Anwar, 2023) found that the use of numeracy-based instructional aids improved students' comprehension and retention of mathematical concepts. The current research supports these findings while extending them by implementing the approach in a public elementary school setting SD Negeri 33 Palembang with a true experimental design, thus providing stronger causal evidence of the intervention's effectiveness.

From a theoretical standpoint, this study reinforces the constructivist learning perspective which posits that learners actively build knowledge through contextual experience and reflection (Rahmawati & Dewi, 2021). Within numeracy literacy based instruction, students are encouraged to engage in reasoning, communicate mathematical ideas, and link symbolic operations to real-world applications. This aligns with the updated mathematical proficiency framework by NCTM (2022), which highlights the need for connections between procedural fluency, conceptual understanding, and strategic

competence. The present study adds empirical support to this theoretical foundation by demonstrating that numeracy literacy not only enhances test performance but also promotes students' confidence and active learning habits.

Comparatively, (Yuliani et al, 2024) and (Hidayah & Widodo, 2023) also observed that literacy integrated numeracy approaches help students develop metacognitive strategies to handle unfamiliar problems. However, the present research makes a novel contribution by quantifying the strength of the effect using Cohen's d = 2.05, which represents a very large effect size. This quantitative evidence demonstrates that the intervention was not only statistically significant but also practically impactful. Few recent studies in Indonesia have reported effect sizes in elementary numeracy contexts, making this study an important reference point for future quantitative research on numeracy literacy.

The context of SD Negeri 33 Palembang provided essential support for this study's success. The school's collaborative culture, the availability of teaching aids, and the teachers' openness to innovation allowed for the effective integration of literacy based learning. Teachers adapted lesson examples to real life situations such as calculating classroom areas and interpreting environmental data which helped students connect mathematical concepts to their daily experiences. This school-based collaboration demonstrates that institutional support is crucial for sustaining innovative pedagogies that align with the Merdeka Belajar curriculum initiative.

Practically, the results of this study highlight the potential of numeracy literacy as a pedagogical framework for developing higher-order thinking skills in elementary mathematics. Teachers should design learning scenarios that encourage reasoning, estimation, and interpretation of numerical information in context. Theoretically, this research contributes to ongoing discourse on literacy integration in STEM education by showing that numeracy literacy is not limited to computation but extends to analytical and reflective thinking (Wijaya & Setyawan, 2024).

CONCLUSION

This study shows that the p-value obtained is $0.000 < 0.05$, and the t-value is $7.152 > 1.683$, which indicates that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. Thus, it can be concluded that numeracy literacy learning has a significant effect of numeracy literacy learning on students' mathematical problem-solving abilities, which had an impact on improving conceptual understanding and cognitive engagement in learning mathematics. In conclusion, the study affirms that numeracy literacy based instruction significantly enhances students' mathematical problem solving abilities, supported by strong statistical and practical evidence. The large effect size

underscores the power of contextualized, literacy-driven instruction in fostering mathematical understanding and engagement. Future studies are encouraged to explore long-term impacts, scalability across grade levels, and its potential integration into interdisciplinary literacy frameworks to further support holistic student development in Indonesian primary education.

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