

The Influence of the Read Answer Discuss Explain Create (RADEC) Learning Model on Elementary School Students' Numeracy Skills

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Abstract. Based on the current international and national data, Indonesia has a low numeracy proficiency. This study aims to identify the potential of the (RADEC) Learning Model in efforts to enhance elementary school students' numeracy skills. Utilizing a pre-experimental approach, this research focuses on the implementation of RADEC within the context of Non-Standard Unit materials. The chosen methodology is the One-Group Pretest-Posttest design, applied to a sample of 18 elementary school students. Data analysis was conducted using inferential statistical methods, with the t-test as the primary tool to measure the increase in numeracy skills following the RADEC implementation. The results show a significant improvement, indicated by a t-value of 4.099, which is less than the t-table value of 2.110 at a 0.05 significance level. This conclusion leads to the rejection of H₀ and acceptance of H₁, significantly indicating that RADEC has a positive impact on improving students' numeracy skills.

Keywords: Learning Model; RADEC; Numeracy; Elementary School

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INTRODUCTION

PISA initiated by the Organisation for Economic Co-operation and Development (OECD), is an international study providing in-depth evaluation of education systems in various countries (KEMENDIKBUD, 2019). Primary goal of fostering learning exchange among member countries, PISA seeks to create school systems that are not only effective but also inclusive (KEMENDIKBUD, 2019). The importance of PISA lies in its ability to provide accurate data on educational progress, enabling countries, including Indonesia, to compare and assess their students' competencies against international standards and monitor educational progress over time. This study reveals trends in score changes over time and highlights areas needing improvement. For instance, in 2018, PISA ranked Indonesia 72nd out of 78 countries in mathematical competency (OECD, 2019), with 71% of students below the minimum competency level (KEMENDIKBUD, 2019). However, in 2022, Indonesia's have ranking in Mathematical Literacy by five positions compared to PISA 2018, placing it at 70th out of 81 countries (OECD, 2022). This finding certainly serves as motivation for Indonesia to strategize more effective and strategic educational initiatives through the National Assessment.

The Indonesian Ministry of Education, Culture, Research, and Technology took an innovative step by implementing the Minimum Competency Assessment (AKM) (KEMENDIKBUD, 2020). AKM as an integral part of the National Assessment, is intended to measure students' literacy and numeracy. Literacy and numeracy are two cognitive aspects considered essential foundations in modern education. The demand for numeracy skills has grown alongside literacy, reflected in daily news filled with statistics, graphs, data, and percentages. Numeracy

refers to mathematics and statistics skills that are immediately useful in everyday life, such as comparing loans, calculating risk, estimating unit prices, understanding scale drawings, and recognizing the effects of inflation rates (Steen, 1990). Numeracy proficiency enhances confidence in making daily decisions, regardless of a person's occupation or standard of living.

Numeracy as a significant aspect of the competencies measured by AKM, encompasses systematic-logical thinking skills and reasoning abilities using mathematical concepts and knowledge (Yunarti & Amanda, 2022). Students are tested on their ability to apply mathematics in relevant real-life contexts, preparing them to become effective and reflective citizens in a complex global environment (Sellars, 2018). True numeracy goes beyond basic understanding of measurement, numbers, geometry, algebra, and data, requiring students to possess complex and adaptable reasoning skills to handle a variety of real-life situations (KEMENDIKBUD, 2020).

The goal of AKM numeracy is to gain an in-depth understanding of students' abilities to apply mathematics in real life, helping policymakers and educators to understand and address learning gaps (Susanto, dkk. 2021). To achieve substantial improvement in numeracy, several minor but essential changes are required: (Steen, 1990)

1. Education should not only teach arithmetic; numeracy, rich in statistics, geometry, and arithmetic, should also be reinforced with careful reasoning and common sense.
2. Students achieve optimal learning when engaged in active environments that include discussion, writing, debating, investigating, and collaborating, as opposed to working on individual worksheets in isolation.
3. Calculators should be a part of school mathematics learning, as they reflect the real world around us. It is also essential not to rely solely on schools, as children are also influenced by the entertainment and sports industries, which can contribute to promoting literacy and numeracy.
4. Tests that only require short answers are not sufficient; it is essential for tests to reveal students' thinking, not just what they know.
5. Effective numeracy should be taught not only in the context of mathematics but also in everyday life, at school, at home, in entertainment, and sports.

AKM at the Elementary School level requires students to apply various thinking skills to handle the given questions. According to (KEMENDIKBUD, 2020), numeracy skills in this assessment are divided into three cognitive levels:

1. Knowing Level – Questions assess students' knowledge regarding facts, processes, concepts, and procedures, including activities such as remembering, identifying, classifying, calculating, obtaining information, and measuring.

2. Applying Level – This level assesses how effectively students can apply their knowledge and understanding of mathematical facts, relationships, processes, concepts, and procedures to solve problems or respond to questions in real-world situations. This stage involves choosing appropriate strategies, formulating or developing models, and applying or performing relevant mathematical strategies or operations.
3. Reasoning Level – This level assesses students' ability to analyze data and information, draw inferences, and apply concepts and procedures in new situations, often involving multiple approaches or strategies. This includes activities such as analyzing, synthesizing, evaluating, concluding, and making justifications. Questions at this level require deeper understanding and complex reasoning skills.

The primary content areas of the AKM Numeracy assessment encompass four specific fields: Numbers, Geometry and Measurement, Algebra, and Data and Probability. Numbers, taught from grades 2 to 6, includes subdomains such as Representation, Ordering Properties, and Operations, focusing on understanding number representation, comparisons, and basic to advanced operations like integers, decimals, and percentages. Geometry and Measurement, covered in all grades from 2 to 10, assesses students' competencies in geometry and measurement, including volume and surface area, as well as measurements using both standard and non-standard units. Algebra, covering equations, inequalities, relations, functions, number patterns, ratios, and proportions, is taught from elementary to higher levels, with an emphasis on ratios and proportions in middle grades. (KEMENDIKBUD, 2020)

One essential component within AKM is the measurement topic, divided into two main categories: the use of standard units and non-standard units. Within the elementary math curriculum, Non-Standard Units play a crucial role. This topic not only provides students with a foundation for understanding basic measurement and estimation concepts often encountered in daily life but also promotes the development of critical and analytical thinking, particularly in the context of measuring objects or distances without using standard measurement tools (Skoumpourdi, 2020). Understanding Non-Standard Units is highly beneficial for measuring objects or distances without relying on standard tools, enriching students' skills in applying mathematics in practical and contextual ways.

Measuring with non-standard tools is considered valuable in learning about measurement, as it allows students to directly engage with understanding the basic concepts of measurement. Using these tools helps students grasp the process of measurement practically before introducing them to standard units. This involves activities like measuring objects with non-standard units, such as body parts or everyday objects, which help develop an intuitive

understanding of measurement and estimation (Montoro et al., 2021). Through activities involving body parts (e.g., footsteps, arm span, or hand length) or everyday items (e.g., pencils, books, or bottles), students can build an intuitive understanding of size and scale. Therefore, integrating Non-Standard Units in elementary mathematics learning not only aids students in mastering practical skills but also develops a deeper conceptual understanding of measurement and proportion in real-life contexts.

In addressing the complexities of today's education, learning approaches that stimulate students' activeness, collaboration, and creativity are crucial. The RADEC learning model, as outlined by (Maspiroh & Eddy Sartono, 2022), emerges as an effective strategy that encourages active student engagement. RADEC not only trains students' creativity in using knowledge to explore ideas and solve everyday problems but also activates the learning process by enabling students to not only receive information but actively participate in collaboratively constructing their own knowledge.

The RADEC learning process consists of several stages. First is the 'Read' stage, where students independently gather information from various sources, like books or internet, the classroom outside learning. Second, the 'Answer' stage, where students answer pre-learning questions based on acquired knowledge, often in worksheet form. Third is 'Discuss,' where students discuss the answers to questions they have worked on independently. Fourth, 'Explain,' is when students present their understanding in a classical setting, covering all cognitive indicators of learning. Fifth, 'Create,' where the teacher inspires students to use knowledge they have mastered to generate creative ideas or thoughts. (Sopandi, et al., 2021)

Through the stages of Read, Answer, Discuss, Explain, and Create, RADEC helps students internalize and apply mathematical concepts, sharpen critical thinking skills, and foster creativity in finding practical solutions. This model not only strengthens mathematical understanding but also encourages students to think independently, collaborate with peers, and respond to challenges innovatively (Sopandi, et al., 2021). Therefore, implementing the RADEC learning model can be a strategic step in improving numeracy skills among elementary students in Indonesia, equipping them to contribute as engaged and constructive citizens in the 21st century.

A review of two articles related to elementary mathematics education provides valuable insights into how specific learning models can improve students' math skills. The first article, by (Predi et al., 2022) explain about RADEC (Read, Answer, Discuss, Explain, Create) learning model alongside student IQ on the numerical ability of 11th-grade students in Tulang Bawang Barat Regency. This study uses a quasi-experimental design with a posttest-only control design and involves 57 students, divided into 31 in the experimental group and 26 in the control

group. The results indicate that both the RADEC learning model and students' IQ significantly influence numerical ability, without interaction between the two factors. (Predi et al., 2022)

Second article, by (Yuliany et al., 2023) discusses the influence of the RADEC learning model on 8th-grade students at SMP Negeri 24 Bulukumba. This study uses an experimental approach to evaluate how RADEC affects mathematical critical thinking skills. The results confirm that RADEC significantly improves mathematical critical thinking skills, with higher improvement in the experimental group compared to the control group (Yuliany et al., 2023).

From these two articles, this study, as the next innovative step, aims to explore the impact of implementing the RADEC learning model in enhancing numeracy skills among elementary school students at a public elementary school in Bandung. This study also seeks to develop a deeper understanding of mathematical teaching practices in Indonesian elementary schools. The primary focus is on applying a model that not only expands mathematical understanding but also effectively supports the comprehensive development of students' numeracy skills. The expected outcome is a significant contribution to mathematics education, demonstrating the effectiveness of the RADEC learning model in significantly improving students' understanding and numeracy skills.

METHODOLOGY

The research method applied is pre-experimental with a One-Group Pretest-Posttest design. The study was conducted at an elementary school in Bandung City grade-fourth A sample of 18 fourth-grade students was selected through simple random sampling. Data collection was carried out using tests to obtain measurements before and after the intervention. Data analysis was conducted using statistical methods to see difference between pre-test and post-test performance, thus assessing the effectiveness of the intervention. Here's the table for Cognitive levels of AKM for numeracy indicators: (KEMENDIKBUD, 2021).

Table 1. Indicators

Level	Indicator	Sub-Indicator
Knowing	Understanding basic mathematical facts, concepts, and procedures	1. Students can calculate the number of papers required to cover the surface of the table.
Applying	Applying mathematical concepts or procedures to solve real world problems	1. Students can explain the method or steps to calculate the number of papers.

Level	Indicator	Sub-Indicator
		2. Students can list other objects that can be used to cover the surface of the table.
Reasoning	Connecting different mathematical elements of solve problems	1. Students can provide logical reasons for selecting a specific object to cover the table surface. 2. Students can analyze the feasibility of using two objects (from their answer in question 3) to cover the table and explain their reasoning.

The One-Group Pretest-Posttest Design, a type of pre-experimental design, involves three primary steps (Gall et al., 2003)

1. Administration of a pretest measuring the dependent variable: The first step involves conducting a pretest on participants before the intervention. This pretest aims to measure the dependent variable—the variable that is the focus of the study and expected to be influenced by the experimental treatment.
2. Implementation of the experimental treatment (in-dependent variable) for participants: The second step is the application of the experimental treatment to the participants. This treatment is the independent variable—the factor altered or manipulated by the researcher to observe its effect on the dependent variable.
3. Administration of a posttest that measures the dependent variable gain: The third step is conducting a posttest after the experimental treatment has been applied. This posttest, similar to the pretest, aims to re-measure the dependent variable but after the treatment. This measurement provides data on the effect of the treatment.

Table 2. Posttest-Only Control Group Design

Pretest	Treatment	Posttest
O ₁	X	O ₂

The impact of the experimental treatment is assessed by analyzing the pretest and posttest scores to identify any significant changes in the dependent variable as a result of the treatment. If a significant difference exists between pretest and posttest scores, it could indicate that the treatment has the desired effect. The t-test criteria are:

If the calculated t-value is positive:

1. $t_{\text{calculated}} > t_{\text{table}}$, it means H₀ is rejected, and H₁ is accepted (independent variable X significantly affects dependent variable Y).

2. $t_{\text{calculated}} < t_{\text{table}}$, it means H_0 is accepted, and H_1 is rejected (independent variable X does not significantly affect dependent variable Y). In this study, the error level used is 0.05 (5%) at a 95% significance level.

The hypotheses are formulated in statistical format as follows:

1. Null Hypothesis (H_0): ($\mu_1 = \mu_2$), indicating no significant difference in the average numeracy scores of elementary students before and after the implementation.
2. Alternative Hypothesis (H_1): ($\mu_1 \neq \mu_2$), indicating a significant difference in the average numeracy scores of elementary students before and after the RADEC Learning Model implementation.

Table 3. Cohens Effect Size Classification (Cohen et al., 2007)

Effect Size (d)	Interpretation
$d \geq 0,8$	Large
$0,5 \leq d < 0,8$	Medium
$d < 0,5$	Small

The final test is the N-gain test, which provides a deeper perspective on the extent to which the learning model intervention has improved students' numeracy, taking into account their initial understanding level: (Hake, 1999)

$$N - Gain = \frac{\text{Skor Posttest} - \text{skor pretest}}{\text{Skor Ideal} - \text{Skor Pretest}}$$

After obtaining the N-Gain results, they are immediately categorized. According to (Hake, 1999), the N-Gain criteria are based on the following values:

Table 5. N-Gain Criteria

Score	Criteria
Low	$n\text{-gain} \leq 0,3$
Medium	$0,3 < n\text{-gain} \leq 0,7$
High	$n\text{-gain} > 0,7$

RESULTS AND DISCUSSION

Following table presents Paired Sample Statistics from pre-test and post-test scores, providing an initial overview of student performance before and after learning intervention.

Table 6. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PostTest	78.33	18	18.231	4.297
	PreTest	57.78	18	22.111	5.212

Pre-test score average was 57.78 with a standard deviation of 22.111, indicating a fairly wide variation in initial student performance. The average post-test score increased to 78.33 with a lower standard deviation of 18.231, showing overall improvement in student performance after the intervention. The table below shows the statistical test results to see difference between pre-test and post-test scores:

Table 7. Paired Samples Test

	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
				Lower	Upper				
Pair 1 PostTest - PreTest	20.556	21.275	5.015	9.976	31.135	4.099	17	<,001	<,001

A study conducted to test the effect of the RADEC learning model on elementary students' arithmetic skills produced data showing a positive change. The paired sample t-test indicated an average increase of 20.556 points in arithmetic scores from the pre-test to the post-test. The calculated t-value obtained was 4.099, rather, the test is left-sided and falls within the H0 rejection area with a negative t-value because the average learning score in the pre-test was lower than in the post-test. In this context, a negative t-value can indicate a positive effect. The degrees of freedom, which is 17, suggest that difference between pre-test and post-test is statistically significant, with a p-value of less than 0.001 for both one-sided and two-sided tests.

Table 8. Paired Samples Effect Sizes

	Standardizer ^a	Point Estimate	95% Confidence Interval	
			Lower	Upper
Pair 1 PostTest - PreTest	Cohen's d	21.275	.966	.393 1.520
	Hedges' correction	22.275	.923	.376 1.452

The effect size analysis was conducted using Cohen's *d* and Hedges' correction, two standard statistical methodologies for evaluating the magnitude of an intervention's effect. The estimated difference between post-test and pre-test scores was 21.275. Using Cohen's *d*, the calculated effect size was 0.966. falls within the 'Large' category, indicating that the intervention had a significant impact on the measured variable.

Hedges' correction, which includes a correction factor in the average difference standard deviation, resulted in an effect size of 0.923. falls within the high effect category. This suggests that the intervention in this study had a high effect on the measured variable. Although this value is slightly lower than Cohen's *d*, it still demonstrates a significant and relevant effect of the intervention. Both methods provide strong evidence that the intervention significantly impacted participants' scores, confirming its effectiveness. The N-gain results, which illustrate the significant difference between pre-test and post-test scores, are presented in the following table:

Table 9. Average N-Gain Results

Class	Score		Average N-Gain
	Pre-test	Post-test	
Experiment	57.78	78.33	0,451

An average N-Gain of 0.451 (Medium category) in the experimental class indicates a significant improvement in students' understanding as a result of the learning intervention. While this value does not reflect the maximum possible improvement, the figure of 0.451 still represents substantial progress. This finding confirms that the teaching model positively impacted the improvement of students' numeracy skills, though there remains room for further improvement. The N-Gain value objectively demonstrates how much the intervention enhanced student learning quality, measuring its effectiveness in improving students' understanding of the taught material.

Statistical analysis results show that each component of the RADEC learning model plays a significant role in improving students' learning outcomes, particularly in the context of non-standard unit material. These findings align with (Mentari Fitri, 2023) research, which concluded that the RADEC learning model can be an effective solution for teachers to enhance students' mathematical abilities. This model is specifically designed to address the challenges faced in Indonesia's education system. Additionally (Ramadhani et al., 2023) supports these findings by stating that the application of the RADEC learning model has been proven to significantly improve students' mathematics learning outcomes.

The 'Read' phase in this model allows students to interact with non-standard unit learning materials, which not only builds a foundation of initial knowledge but also stimulates

their curiosity and engagement (Sopandi et al., 2019). Initially, many students displayed a limited understanding of this concept. However, through the 'Answer' process, students became more active in learning by gradually responding to questions. This helps reinforce their understanding of non-standard units.

In the 'Discuss' phase of the RADEC model, students are given the opportunity to collaborate and discuss with their peers, a process that Vygotsky deems essential in learning. Vygotsky emphasizes that an individual's intellectual development is highly influenced by experiences in collaborative thinking, communication, and problem-solving. His theory posits that collaboration among individuals with diverse backgrounds within a group can lead to innovative solutions to challenges (Vygotsky, 1978). In practice, particularly during the 'Answer' phase, it was observed that some students struggled with the questions. Therefore, the 'Discuss' stage in the RADEC model is crucial, as it fosters a synergistic process where students who understand the material can support those who do not. This interaction strengthens individual understanding and supports collective learning and group-level comprehension.

The 'Explain' phase further enhances students' understanding through the process of verbalizing and articulating concepts (Sopandi et al., 2019), aligning with Piaget's concrete operational stages (Piaget, 1954), where students begin to internalize and apply knowledge, forming a deeper understanding. In this stage, students actively explain what they understand about non-standard unit materials. Finally, the 'Create' component allows students to apply the knowledge and skills they have developed to new situations or problems, reinforcing their understanding and numeracy skills in the context of non-standard units. The combination of these five components in the RADEC model provides a holistic approach to mathematics learning, not only improving students' numeracy skills but also supporting their cognitive development in line with Piaget and Vygotsky's theories. This contributes significantly to stimulating students' activeness and curiosity while forming a more structured and comprehensive understanding of non-standard units.

CONCLUSION

This research examines of the RADEC learning model impact on elementary students' arithmetic skills within the context of the global education environment, as evaluated based on PISA studies and the need to meet international standards. From statistical analysis, the calculated t-value < t-table, with a calculated t-value of 4.099 and a t-table value of 2.110, Resulting in the null hypothesis (H0) being rejected and the alternative hypothesis (H1) being accepted. The significance (p-Value) for both one-sided and two-sided tests is below 0.001. Since the p-value < 0.05, the difference between PreTest and PostTest scores is statistically

significant. Thus, there is strong evidence that the implemented learning or intervention positively impacted the score improvement from PreTest to PostTest.

RADEC model significantly enhances students' arithmetic skills, as indicated by score average between pre-test and post-test. This improvement demonstrates the success of the RADEC model in helping students not only understand mathematical concepts but also apply them in everyday situations. Therefore, the RADEC model is an effective learning model and should be integrated into Indonesia's educational strategies to improve the quality of mathematics learning.

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