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Comparative study of elementary students' numeracy literacy in solving word problems in Indonesia and Malaysia

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ABSTRACT

Numeracy literacy is a fundamental skill in elementary education, particularly for solving mathematical word problems that reflect real-life situations. Contextual Teaching and Learning (CTL) has emerged as a promising approach to strengthen students' understanding and application of mathematical concepts, yet comparative evidence across national education systems remains limited. This study examines the numeracy literacy of elementary students in Indonesia and Malaysia who were taught using CTL-based methods. A mixed-methods design was used, combining quantitative data from numeracy tests administered to 60 students (30 from each country) with qualitative insights from teacher interviews, classroom observations, and analysis of students' written responses. The qualitative analysis focused on how students interpreted contextual information, formed mathematical representations, and used reasoning to solve word problems. The findings show that Malaysian students demonstrated stronger contextual problem-solving skills, while Indonesian students showed greater flexibility across different problem types, reflecting differences in curriculum structures and instructional practices. Overall, the study confirms the potential of CTL to enhance numeracy literacy, although its effectiveness depends on implementation quality, including teacher preparedness, curriculum integration, and contextual relevance. The study recommends improved teacher training and curriculum development, and calls for future research on the long-term effects of CTL and innovative approaches to contextual learning in varied educational settings.

1. Introduction

Numeracy literacy is a foundational competency that enables individuals to comprehend and solve problems involving numbers, patterns, and quantitative relationships in daily life. It goes beyond arithmetic skills to include interpreting data, evaluating quantitative claims, and making informed decisions in personal and societal contexts (Sullivan et al., 2021). According to the National Council of Teachers of Mathematics, numeracy literacy involves more than procedural computation; it encompasses mathematical reasoning, problem-solving, and communication. Its importance is especially evident in elementary education, where it lays the groundwork for advanced mathematical understanding and cross-disciplinary learning (Griffin et al., 2012; Vessonen et al., 2025).

Despite its recognized importance, global assessments reveal persistent gaps in students' numeracy literacy. UNESCO (2022) reported that in many developing countries, including those in Southeast Asia, fewer than 60% of elementary students achieve basic proficiency. The COVID-19 pandemic further exacerbated these disparities by reducing instructional time, especially for students in under-resourced contexts (Blömeke et al., 2022). These challenges highlight the urgent need to re-examine how foundational mathematics is taught and how learning can be made more meaningful and contextually relevant. In Indonesia and Malaysia, poor performance in the Program for International Student Assessment (PISA) has intensified scrutiny over mathematics instruction. Research shows that

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while students can perform algorithmic operations, they struggle to transfer knowledge to unfamiliar word problems by demonstrating a disconnect between instruction and application (Suseelan et al., 2023a; 2023b). Word problems remain a major obstacle as they require both mathematical and linguistic proficiency. Students often face difficulties with complex syntax and vocabulary, especially in multilingual classrooms such as those in Malaysia (Suseelan et al., 2023a; 2023b). In Indonesia, the challenge stems more from limited contextualization and insufficient exposure to real-life problem settings.

To address these issues, scholars and policymakers have turned to Contextual Teaching and Learning (CTL), a pedagogical model that emphasizes real-world relevance and student engagement. CTL encourages active learning by connecting mathematical content to students' lived experiences and societal realities (Xu et al., 2020). Rooted in constructivist theory, CTL views learning as a process of knowledge construction through interaction, reflection, and social negotiation (Vygotsky, 1978; Tsai et al., 2023). Studies affirm that CTL fosters deeper understanding by linking abstract concepts to concrete examples such as budgeting, shopping, and community planning (Hadebe et al., 2024).

CTL also supports metacognitive development, enabling students to regulate their thinking and adapt strategies during problem-solving (Wu and Molnár, 2021). In culturally diverse contexts like Malaysia and Indonesia, CTL's adaptable framework allows lessons to be tailored to students' cultural and linguistic backgrounds, thereby enhancing inclusivity and engagement (Roza et al., 2023).

Nevertheless, challenges in implementation persist. In Indonesia, rigid curricular structures and an emphasis on standardized testing often restrict the adoption of flexible approaches such as CTL (Diarsini et al., 2022). In Malaysia, although CTL has been integrated into national policy, inconsistencies in teacher training and limited resources constrain its classroom effectiveness (Suseelan et al., 2023a; 2023b). These disparities underscore the need for targeted professional development and systemic reform, with teacher readiness particularly in designing contextual tasks and facilitating inquiry—remaining a key determinant of success (Nouri, 2025). Emerging strategies to overcome these barriers include blended learning modules and digital platforms that support CTL-based instruction. Such innovations have shown promise in improving engagement and conceptual understanding, especially in remote or under-resourced schools (Blömeke et al., 2022). However, access to technology and digital literacy remains a limiting factor, particularly in rural areas. This suggests that infrastructure development must accompany pedagogical innovation to ensure equity.

While there is a substantial body of research on CTL within individual countries, comparative cross-national studies, especially those examining the integration of cognitive and linguistic dimensions in solving word problems, remain limited. This study addresses this gap by analyzing CTL practices in Indonesia and Malaysia and their influence on elementary students' numeracy literacy, particularly in solving word problems. It explores how curriculum design, teacher preparedness, and sociocultural dynamics shape the effectiveness of CTL implementation in these two distinct yet comparable educational contexts (Agusfianuddin et al., 2024; Suciyati et al., 2022).

The novelty of this research lies in two contributions: first, the methodological integration of performance metrics with classroom observations to capture nuanced patterns of engagement and understanding; and second, a contextual comparative framework that highlights how sociocultural and linguistic factors affect instructional success. By employing a mixed-method design that combines quantitative data with qualitative insights, this study provides a multidimensional analysis often absent in prior research, which tends to treat curriculum and cognition separately (Aini et al., 2024; Liu et al., 2025).

This study contributes to mathematics education reform by offering actionable insights for policymakers, educators, and curriculum developers. It emphasizes the importance of designing instructions that is cognitively appropriate, linguistically accessible, and culturally situated. By demonstrating the pedagogical value of CTL and empirically mapping student learning patterns, the study addresses the urgent call for scalable, equitable solutions to the persistent numeracy literacy gap across diverse socioeconomic contexts (Vessonen et al., 2025; Ting et al., 2024). By reinforcing the role of CTL in promoting equity and contextual relevance, the findings advocate culturally responsive teaching and sustained teacher development.

Ultimately, this research seeks to inform policy and practice by providing contextually grounded recommendations for enhancing numeracy instruction. Acknowledging and addressing the specific challenges faced in Indonesia and Malaysia, it supports the development of more effective, inclusive, and adaptable education systems that empower students to become critical thinkers and problem solvers in a globalized world.

2. Methodology

This study is a development study that aims to produce a learning program based on a contextual literacy approach to improve students' problem-solving skills in solving mathematical word problems. The development design was adapted from the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model proposed by Molenda (2003), which consists of five stages: analysis, design, development, implementation, and evaluation.

The ADDIE model was selected for two main reasons. First, it provides a systematic framework for developing instructional products. Second, the inclusion of validation and testing stages helps improve the quality and effectiveness of the developed program.

The procedure for developing the blended learning program is illustrated in Fig. 1.

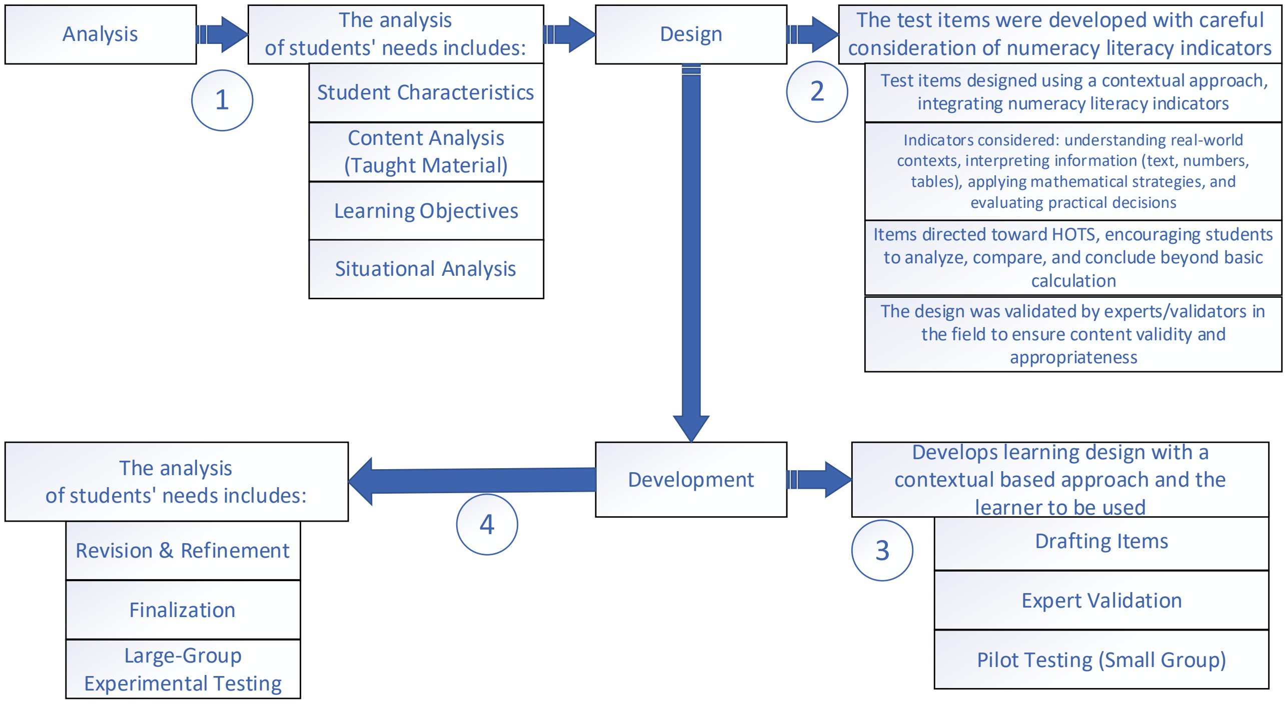

Fig. 1: ADDIE model

The study began with a needs analysis aimed at mapping students' numeracy literacy abilities. The results indicated that elementary school students in Indonesia and Malaysia experienced difficulties in understanding word problems, particularly when tasks involved only direct calculations or abstract language. At this stage, most test items were still classified as LOTS (Lower Order Thinking Skills), which emphasized computational ability without connecting to real-life contexts. Therefore, the primary need was the development of test instruments that are contextual, closely aligned with students' everyday experiences, and capable of fostering Higher Order Thinking Skills (HOTS).

At the Design stage, the test items were constructed with reference to numeracy literacy indicators, including contextual understanding, interpretation of information, application of mathematical strategies, and evaluation of calculation results in relation to practical decisions. The items were designed not merely to require simple calculations but to encourage students to analyze, compare, and draw conclusions. In this way, the developed world problems functioned as a tool to cultivate contextual problem-solving skills rather than serving as mechanical arithmetic exercises.

The Development stage focused on expert validation to ensure the content, language, and contextual appropriateness of the instrument. A small-scale trial with 60 students (30 from Indonesia and 30 from Malaysia) was conducted to identify weaknesses such as overly long sentences, unfamiliar terminology, or contexts that were less relevant to students' daily lives. Based on the validation results and trial findings, revisions and refinements were made until the instrument achieved validity, reliability, and contextual relevance. This process ensured that the test items measured not only computational skills but also students' ability to understand problem statements, reason mathematically, and connect solutions to real-life situations.

After the implementation stage has been completed, the evaluation stage is continued with several indicators described in Fig. 2.

The Implementation stage was carried out on two scales. First, the revised instrument was tested on a small group of 60 students to evaluate its feasibility, clarity, and effectiveness. The findings were used to further refine the test items. Second, the finalized instrument was administered to a larger group of 240 students (120 from Indonesia and 120 from Malaysia) to obtain more comprehensive and representative data. This large-scale trial aimed to ensure the validity and reliability of the instrument, as well as to compare students' problem-solving patterns across countries.

Finally, the data collected were analyzed using both quantitative and qualitative approaches. Quantitative analysis was conducted to evaluate validity, reliability, and performance trends, while qualitative analysis provided deeper insights into students' numeracy literacy skills after the implementation of the contextual learning model. The qualitative analysis focused on students' written responses to word problems, highlighting their mathematical reasoning, interpretation of contextual information, and problem-solving strategies. This dual approach enabled a comprehensive evaluation of students' performance, capturing both numerical proficiency and their ability to apply mathematical reasoning in real-life contexts.

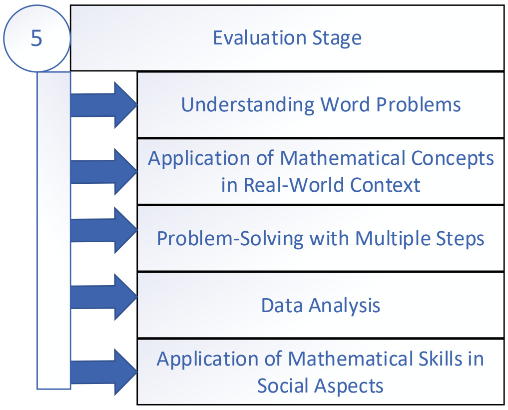

Fig. 2: Evaluation stage of the ADDIE model

In the discussion section, the results will be presented by mapping students' written responses using qualitative analysis. The analysis focuses on several dimensions of numeracy literacy that emerge from students' problem-solving processes.

1. Understanding Word Problems: This dimension examines students' ability to comprehend the problem statement, identify relevant information, and distinguish between essential and non-essential data. It highlights whether students can translate narrative contexts into mathematical representations.
2. Application of Mathematical Concepts in Real-World Contexts: This component evaluates how students apply mathematical knowledge to practical situations, such as calculating expenses, interpreting quantities, or connecting numbers with everyday life experiences.
3. Problem-Solving with Multiple Steps: Analysis in this aspect focuses on whether students can organize solutions in sequential steps, demonstrate logical reasoning across processes, and maintain accuracy from one stage of calculation to another.
4. Data Analysis: This part assesses students' ability to interpret, organize, and make sense of numerical or contextual data. It considers how students extract meaning from tables, graphs, or descriptive information embedded in the problems.
5. Application of Mathematical Skills in Social Aspects: Beyond individual problem-solving, this indicator explores how students connect mathematical reasoning with broader social situations, such as budgeting for group activities, planning community events, or evaluating shared resources.

Through these dimensions, the qualitative analysis not only assesses the correctness of answers but also provides a deeper understanding of students' reasoning processes, their contextual awareness, and the integration of mathematical literacy into real-life decision-making.

3. Results and discussion

3.1. Test development analysis results

This study began with a needs analysis of students to improve their numeracy literacy skills. As part of the initial stage, a diagnostic assessment was conducted with students in Indonesia and Malaysia to identify and compare their levels of numeracy literacy, as well as to determine the equivalence of abilities between the two groups before further intervention was carried out. After confirming that both groups had comparable abilities, a comprehensive needs analysis was conducted.

The results of the needs analysis indicated that elementary school students still tended to experience difficulties in understanding word problems, especially when the questions only involved direct calculations or used overly abstract language. At the initial stage, most of the items were still classified as LOTS (Lower Order Thinking Skills), which only required students to perform calculations without guiding them to understand the context, reason, or make decisions.

The primary need of students is the strengthening of numeracy literacy, namely the ability to understand information presented in word problems, interpret the given data, apply appropriate mathematical operations, and connect the results of calculations with real-life situations. Therefore, the test items need to be developed to be more contextual, closer to students' everyday experiences, while also demanding higher-order thinking skills.

At the Design stage, the test items were developed with careful consideration of numeracy literacy indicators, such as:

- Understanding real-world problem contexts (e.g., shopping at the school cooperative, going on a museum trip, or activities in the canteen).
- Interpreting information presented in the form of text, numbers, tables, or everyday situations.
- Using relevant mathematical strategies to solve problems.
- Evaluating calculation results in relation to practical decisions (whether the money is sufficient, how much profit is made, or what percentage of income is spent).

In addition, the items were designed to move toward Higher Order Thinking Skills (HOTS), where students are not only asked to perform simple calculations but are also encouraged to analyze, compare, and draw conclusions. In this way, word problems function as a medium to train students in solving contextual problems, rather than being limited to arithmetic exercises. At the Development stage, the items that had been designed were tested and revised to ensure their suitability with students' abilities and needs. One important finding was that students often experienced difficulties in understanding word problems, either because of long sentences, the use of unfamiliar terms, or the lack of contextual cues.

To address this, the development of items was carried out by:

- Using simple language is appropriate to the comprehension level of elementary school students.
- Providing clear and structured information (e.g., number of items, price, time, or percentage).
- Offering real-life situations familiar to students so they can easily visualize the problem.
- Adding challenging elements (e.g., some goods being damaged, insufficient money, or limited travel time) to encourage students to think critically.

With this strategy, the test items not only assess computational ability but also foster students' skills in understanding the text of word problems, reasoning mathematically, and connecting the calculation results with real-life situations.

The Implementation stage was first conducted with a small group to test the effectiveness and comprehensibility of the developed test. The research subjects consisted of 60 elementary school students, divided into 30 students from Indonesia and 30 students from Malaysia. The selection of these two groups was intended to provide an initial comparison of numeracy literacy conditions across countries while maintaining a balanced proportion.

The test was administered in a conducive classroom environment, adhering to research ethics standards, including providing an initial explanation of the test objectives and procedures. Each student received a test sheet containing 10 numeracy literacy-based word problems that had been previously developed. These items covered indicators such as contextual understanding, mathematical reasoning, and contextual problem-solving skills (HOTS).

Teachers at each school helped ensure that students understood the instructions, but did not provide guidance with the answers. The allocated time for completing the test was 60 minutes, adjusted to the concentration span of elementary school students. During the implementation, the researchers conducted observations to record students' responses, including difficulties they encountered when reading, understanding, or solving the word problems.

The results of this implementation were expected to provide an initial overview of:

- Students' comprehension of word problems containing numeracy literacy indicators.
- Differences in problem-solving strategies between Indonesian and Malaysian students.
- The level of difficulty encountered, whether in terms of language, context, or mathematical concepts.

The data obtained from this stage served as an essential basis for reflection and refinement of the test before it was applied to a larger sample. Thus, the small-group implementation functioned as a bridge to ensure that the developed test was valid, reliable, and aligned with the needs of measuring numeracy literacy skills among elementary school students in both countries.

The results of the test development in the form of word problems using the ADDIE model, in the comparative study of numeracy literacy at the elementary school level, are described in Table 1.

Table 1: Design test questions in initial conditions

No.	Problem/question
1	A farmer has 120 mango trees. Each tree produces 15 mangoes. If each mango is sold for Rp 2,000, how much money will he get?
2	A student buys 5 notebooks at Rp 8,000 each and 3 pencils at Rp 2,500 each. How much is the total cost?
3	A car travels 60 km in one hour. If it travels for 4 hours, how far will it go?
4	In the park, there are 15 trees. Each tree has 200 leaves. If 5 times more trees are planted, how many leaves in total?
5	A box has 24 bottles. Each bottle costs Rp 4,000. If the shop sells 15 boxes, how much money does it get?
6	A store sells 3 apples at Rp 10,000 each and 2 oranges at Rp 12,000 each. How much is the total cost?
7	A train has 12 carriages, each with 45 seats. How many passengers are filled if all seats are filled?
8	A merchant buys 100 kg of rice at Rp 12,000/kg and sells it at Rp 15,000/kg. How much profit?
9	A family spends Rp 750,000 per week. How much do you cost in 4 weeks?
10	A farmer has 150 chickens producing 75 eggs per day. If each egg sells for Rp 2,500, how much income in 10 days?

The test items developed at the initial stage were still dominated by LOTS (Lower Order Thinking Skills) questions. The characteristics of these questions are simple, requiring only the ability to perform direct calculations or apply basic formulas without linking them to real-life situations. For example, students were only asked to calculate the product of the number of trees and the fruits produced, or to find the total cost of shopping without considering whether the available money was sufficient.

LOTS-type questions are useful for measuring mastery of basic arithmetic, but their weakness lies in the fact that students are not trained to understand context, think critically, or connect problems with everyday life. As a result, the questions remain abstract and less relevant to the real-life experiences of elementary school students.

To improve the questions and make them more meaningful, revisions and contextualization were carried out so that the problems are closer to the daily experiences of elementary school students. The contexts selected are situations they often encounter, such as shopping at the school cooperative, going on a museum trip, taking care of the school garden, or activities in the school canteen. In this way, students are not only performing calculations but also understanding the story, analyzing real-life conditions, and making decisions. The following Table 2 shows the corrections made.

Table 2: The corrections made

No.	Weakness of the initial question	Revision (closer to elementary school context)
1	Only direct calculation, no real condition	Add a condition where some fruits are rotten/unsellable
2	Only a simple shopping calculation	Add the context of shopping at the school cooperative + question on whether the money is sufficient or not
3	Only a straight distance problem	Add the context of a museum trip + whether they arrive on time
4	Only a tree multiplication problem	Add the context of the school garden + some leaves fall
5	Only a water bottle sales problem	Add the context of the school canteen + some bottles remain unsold
6	Only total fruit price calculation	Add the context of shopping at the market + check if payment is sufficient
7	Only seat counting	Add the context of a train ride + calculate ticket revenue
8	Only direct profit and loss	Add the condition where not all rice is sold
9	Only total expenditure calculation	Add the context of comparing with family income (percentage of expenses)
10	Only egg sales income calculation	Add the condition where some eggs are unsold/broken

After the initial small-group trial was deemed successful, the next step was to implement the test with a larger group to obtain more comprehensive and representative data. The research subjects in this stage consisted of 240 elementary school students, with 120 students from Indonesia and 120 students from Malaysia. The larger number of respondents was intended to strengthen the validity and reliability of the numeracy literacy test instrument based on word problems. The test was administered simultaneously in designated schools, involving local teachers and proctors to ensure order and discipline during the process. Each student received the same test package containing 10 revised and developed numeracy literacy word problems. These items measured three main aspects: the ability to understand the problem context, reason mathematically, and solve real-life problems (HOTS).

The procedure began with a brief explanation to the students about the test instructions, including the time allocation of 60 minutes. All instructions were delivered using simple language so they would be easily understood by the students. Teachers and the research team ensured that students could focus on completing the test without disturbance, but were not allowed to provide any assistance with the answers. During the test, the researchers also conducted direct observations to record students' expressions, strategies, and difficulties in understanding and solving the word problems. Additionally, the data collected at this stage were used to compare patterns of problem-solving and numeracy literacy performance between Indonesian and Malaysian students.

The results of the large-group implementation served as the primary basis for:

a. Testing the consistency of the instrument across a wider number of respondents.
b. Analyzing variations in students' strategies in solving problems, both individually and between groups of countries.
c. Identifying residual weaknesses in the items (e.g., questions being too difficult, ambiguous, or not contextually appropriate).
d. Determining the validity, reliability, and discrimination power of the items before applying final analysis using Structural Equation Modeling (SEM).

Thus, the large-group implementation not only tested the instrument on a wider scale but also ensured that the numeracy literacy test could accurately capture the critical thinking and problem-solving abilities of elementary school students in Indonesia and Malaysia.

After the corrections, the questions that were initially LOTS (Lower Order Thinking Skills) and only emphasized basic arithmetic skills were developed into HOTS (Higher Order Thinking Skills) questions that integrate numeracy literacy indicators. At this stage, the questions no longer ask students to simply perform calculations, but also to:

- Understand the context: recognize real-life situations familiar to elementary school students (school cooperative, canteen, garden, market shopping, etc.).
- Reason mathematically: connect information, apply concepts of percentage, comparison, and logic.
- Solve problems: make decisions based on data, for example whether the money is sufficient, how much loss occurs if goods are damaged, or what portion of family income is spent on necessities.

Thus, the developed questions can measure numeracy skills more comprehensively, train critical thinking, and foster decision-making abilities that are relevant to real life. The results of the question design after revisions are presented in Table 3.

Student Response Analysis Stage: After the numeracy literacy test was implemented with 240 elementary school students (120 from Indonesia and 120 from Malaysia), the next step was to conduct an analysis of the students' responses. This analysis aimed to explore in greater depth how students understood, reasoned, and solved the given word problems, as well as to map their achievement based on numeracy literacy indicators.

1. Collection of Student Responses: All student answer sheets were collected, checked for completeness, and then categorized as correct, incorrect, or partially correct. In addition, observation notes taken during the test were also used as supplementary data to strengthen the analysis.
2. Classification Based on Numeracy Literacy Indicators: The analysis of student responses was carried out with reference to numeracy literacy indicators, namely:

- Understanding context: the extent to which students were able to identify key information in the word problems, such as numbers, units, or given conditions.
- Mathematical reasoning: students' ability to choose strategies, perform calculations, and apply appropriate mathematical concepts.
- Problem-solving: the accuracy of the final answer in relation to the problem context, including students' ability to make logical decisions (e.g., determining whether the money is sufficient, or calculating profit/loss).

3.2. Understanding word problems

After developing the test of Numeracy Literacy in Solving Word Problems for elementary school students in Indonesia and Malaysia regarding numeracy literacy skills, particularly in solving word problems through a contextual learning approach, the analysis results are presented based on the students' work:

Problem 1: A farmer has 120 mango trees, each producing 15 mangoes. Each mango sells for Rp 2,000. If 20% of the mangoes are rotten and cannot be sold, how much income does the farmer get?

The analysis of students' solutions to Problem 1 shows that both Malaysian and Indonesian students followed similar steps when calculating the farmer's income. Most Malaysian students began by determining the total production (120 × 15 = 1,800 mangoes) and then multiplying this amount by the selling price of Rp 2,000 to obtain Rp 3,600,000. Their responses were generally procedural, focusing on arithmetic operations without additional contextual explanation. Indonesian students used the same steps, also arriving at Rp 3,600,000, but their answers more commonly included narrative elements, such as explicitly referring to the result as the farmer's "income" or "sales revenue." Although both groups performed the calculations correctly, most students overlooked the 20% spoilage condition stated in the problem, indicating limited attention to embedded contextual details. Overall, Malaysian students tended to emphasize structured computation, whereas Indonesian students showed a greater tendency to interpret the result within real-life contexts.

Table 3: Design of questions after revision

No.	Hots question	Numeracy literacy indicators
1	Mango farmer: A farmer has 120 mango trees, each producing 15 mangoes. Each mango sells for Rp 2,000. If 20% of the mangoes are rotten and cannot be sold, how much income does the farmer get?	Understanding information, calculating percentages, and interpreting results in an income context
2	School shopping: A student buys 5 notebooks at Rp 8,000 and 3 pencils at Rp 2,500. If she has Rp 60,000, is her money enough? If yes, how much change will she get?	Understanding shopping context, comparing needs and resources, and making decisions
3	School trip: A car travels 60 km/h. Students go to a museum 250 km away. If they leave at 7:00 and the trip takes 4.5 hours, will they arrive before 12:00?	Understanding distance–time–speed relation, analyzing lateness, and making decisions
4	School garden: The school has 15 trees, each with 200 leaves. The school plants 5 times more trees. If 20% of the leaves fall, how many remain?	Using multiplication, percentages, and interpreting results in a real context.
5	Canteen water: A box has 24 bottles, each Rp 4,000. The canteen sells 15 boxes. If 30% remain unsold, how much money is earned?	Applying arithmetic and percentages in a sales context
6	Fruit market: prices: Apple = Rp 10,000, orange = Rp 12,000, banana = Rp 7,000, mango = Rp 15,000, watermelon = Rp 20,000. A customer buys 3 apples, 2 oranges, and 1 watermelon. If she pays Rp 100,000, is it enough?	Understanding price information, calculating totals, and evaluating the sufficiency of money
7	Train ride: A train has 12 carriages, each with 45 seats. If 80% are occupied, how many passengers? If each ticket costs Rp 20,000, how much revenue?	Representing percentages, reasoning with data, and interpreting income
8	Rice merchant: A merchant buys 100 kg of rice at Rp 12,000 and sells it at Rp 15,000. If only 80 kg is sold, how much profit is made?	Understanding profit loss, connecting data, and analyzing results
9	Family budget: A family spends Rp 750,000 weekly. In 12 weeks, how much? If income is Rp 4,000,000/month, what fraction of income goes to groceries?	Comparing spending and income, using proportions, and drawing conclusions
10	Chicken farm: A farmer has 150 chickens producing 75 eggs/day. Each egg sells for Rp 2,500. In 10 days, how much income? If 20% of eggs are unsold, what is the actual income?	Calculating production, applying a percentage, and interpreting net income

In general, the understanding of numerical literacy in this problem among primary school students in Malaysia and Indonesia follows a very similar process, as both countries use the same approach in basic mathematical operations such as multiplication and income calculation. The primary difference lies in how the material is presented, particularly in using contexts relevant to students' daily lives, which may be adapted to the culture and habits of each country. Nevertheless, both countries emphasize a systematic understanding of mathematical steps, including:

a. Calculating the total output based on the number of items (trees and fruits).

b. Performing multiplication to determine total income.

However, in practice, students in Indonesia tend to be more accustomed to problems related to daily life, such as agriculture, which aligns with their local context. Meanwhile, in Malaysia, similar problems may be adjusted to reflect their economic or cultural background.

3.3. Application of mathematical concepts in a real-world context

In Problem 4, students were asked to find the number of trees and leaves in a school garden after an expansion: “The school has 15 trees, each with 200 leaves. The school plants five times more trees. If 20% of the leaves fall, how many remain?” The responses from Malaysian and Indonesian students show similar calculation methods, but with differences in focus and contextual understanding.

Malaysian students typically begin by calculating the number of newly planted trees (15 × 5 = 75), followed by determining the total number of trees (15 + 75 = 90). They then multiplied the total number of trees by the number of leaves per tree, resulting in 90 × 200 = 18,000 leaves. Their explanations generally followed a clear, step-by-step order, consistent with the structure of the problem. This pattern suggests a strong procedural orientation, where students break the task into sequential operations.

Indonesian students used the same calculations and also arrived at 18,000 leaves. However, their explanations more often included narrative elements that linked the numbers to the real-world context of the school garden. They described the result as “the total number of leaves produced by all trees,” showing a tendency to frame mathematical procedures within meaningful situations.

Although both groups correctly calculated the number of trees and leaves, many students in both countries overlooked the condition stating that 20% of the leaves would fall. If this condition were applied, the final total would be 14,400 leaves. This oversight indicates that students only partially interpreted the contextual information. Overall, the findings suggest that Malaysian students demonstrated stronger procedural accuracy, while Indonesian students showed greater contextual awareness. This highlights the need for instruction that helps students combine contextual clues with mathematical procedures when solving real-world problems.

The problem-solving approaches of primary school students in both Malaysia and Indonesia are therefore similar but differ in emphasis. In Malaysia, instruction generally focuses on the initial multiplication step to determine the number of new trees, followed by calculating the total number of leaves. This approach reinforces basic multiplication and introduces the idea of quantitative growth in real situations.

Indonesian students follow the same steps, but teaching practices place more emphasis on connecting calculations to daily life. Students are often presented with problem contexts related to familiar activities, such as gardening or agriculture, which helps them understand mathematical ideas in a more concrete way. Although the mathematical procedures are largely the same in both countries, the contexts are adapted to match students’ cultural backgrounds and everyday experiences, strengthening their numerical understanding. As a result, while the computational steps remain consistent, differences in contextualization influence how students relate to and interpret the problems.

3.4. Problem-solving with multiple steps

Problem 6 required students to carry out multi-step reasoning in a real-life purchasing situation: “Fruit Market: Prices—Apple = Rp 10,000, Orange = Rp 12,000, Banana = Rp 7,000, Mango = Rp 15,000, Watermelon = Rp 20,000. A customer buys 3 apples, 2 oranges, and 1 watermelon. If she pays Rp 100,000, is it enough?” The solutions provided by Malaysian and Indonesian students show similar computational procedures but different levels of contextual interpretation.

Most Malaysian students solved the problem by dividing it into clear sub-calculations. They first found the cost of the apples (3 × 10,000 = Rp 30,000), then the cost of the oranges (2 × 12,000 = Rp 24,000), and finally the cost of the watermelon (1 × 20,000 = Rp 20,000). After completing these steps, they added the amounts to obtain a total of Rp 74,000. Their explanations focused on systematic and sequential steps, reflecting a structured approach to multi-step problem solving with limited reference to the real-life context.

Indonesian students used the same calculations and also reached a total cost of Rp 74,000. However, their responses were more narrative. In addition to calculating the total, many explicitly explained that the Rp 100,000 was sufficient and identified the amount of change. This indicates a stronger tendency among Indonesian students to interpret mathematical results within the practical decision-making context of the problem.

Both groups showed accurate multi-step reasoning, but they differed in how deeply they incorporated contextual meaning. Malaysian students focused primarily on procedural accuracy and the efficiency of calculations, while Indonesian students extended their reasoning to include conclusions about payment sufficiency and remaining money. These differences likely reflect broader classroom practices, where Malaysian instruction emphasizes structured computation, whereas Indonesian teaching often encourages connecting mathematical results to daily life situations. Overall, the findings show that although students in both countries can perform multi-step calculations, their approaches differ in how explicitly they integrate real-world interpretation into their solutions. The contrast in numerical literacy between Malaysian and Indonesian students is also reflected in how they describe their steps, even though they arrive at the same final cost. Malaysian students typically begin by calculating the price of each fruit separately. For example, apples at Rp 10,000 each lead to a cost of 3 × 10,000 = Rp 30,000. Two oranges at Rp 12,000 each cost 2 × 12,000 = Rp 24,000. One watermelon at Rp 20,000 costs 1 × 20,000 = Rp 20,000. They then add these three amounts—Rp 30,000, Rp 24,000, and Rp 20,000—to obtain Rp 74,000.

Indonesian students follow the same mathematical steps but present them more directly and simply. They compute the cost of each fruit: 3 × 10,000, 2 × 12,000, and 1 × 20,000—and then sum the results to get Rp 74,000. While both groups use nearly identical procedures, Malaysian students tend to describe each step in more detail, whereas Indonesian students prefer a more straightforward explanation. These subtle differences highlight variations in emphasis rather than in mathematical understanding.

3.5. Data analysis

Problem 8 assessed students' ability to analyze numerical data in a financial context: "A merchant purchases 100 kilograms of rice at Rp 12,000 per kilogram. If the merchant sells the rice at Rp 15,000 per kilogram, how much profit will the merchant earn?" The answers from Malaysian and Indonesian students highlight two different but equally valid approaches to calculating profit.

Malaysian students generally used a concise method by first finding the profit per kilogram. They subtracted the purchase price from the selling price (15,000 − 12,000 = Rp 3,000) and then multiplied this amount by the total quantity of rice (100 kg) to obtain a total profit of Rp 300,000. This approach shows an emphasis on numerical efficiency and direct computation, enabling students to reach the answer through the shortest calculation pathway.

Indonesian students, in contrast, tended to use a more detailed and analytical method. Instead of starting with the unit difference, they calculated the total purchase cost (100 × 12,000 = Rp 1,200,000) and the total revenue (100 × 15,000 = Rp 1,500,000). They then subtracted these two amounts to find the profit (1,500,000 − 1,200,000 = Rp 300,000). This approach reflects a broader understanding of financial processes by showing how costs and revenues interact to produce profit.

Both groups arrived at the correct profit amount, but their different approaches reflect instructional tendencies in each country. Malaysian students preferred a streamlined strategy, suggesting that their learning environment emphasizes efficient and direct computation. Indonesian students demonstrated a more descriptive, concept-oriented approach, consistent with teaching practices that encourage linking numerical calculations to broader economic reasoning. These findings show that students may use different analytical styles even when applying the same mathematical concepts, highlighting the value of instructional design that supports multiple valid methods for solving problems.

3.6. Application of mathematical skills in social aspects

Problem 10: A farmer has 150 chickens producing 75 eggs per day. Each egg sells for Rp 2,500. In 10 days, how much income is earned? If 20% of the eggs are unsold, what is the actual income?

The solutions from Malaysian and Indonesian students followed similar computational steps, but their explanations differed in style and emphasis. Most Malaysian students began by identifying the farmer's daily egg production (75 eggs). They then calculated the 10-day total (75 × 10 = 750 eggs) and determined the income by multiplying the total eggs by the selling price (750 × 2,500 = Rp 1,875,000). Their explanations were generally concise and procedural, focusing on the sequence of calculations needed to reach the answer.

Indonesian students used the same mathematical steps: calculating 75 eggs per day, 750 eggs in 10 days, and a total income of Rp 1,875,000. However, their explanations were typically more descriptive, often restating the real-life context or explicitly referring to "the farmer's income." Although both groups arrived at the correct numerical result, Malaysian students emphasized procedural clarity, whereas Indonesian students tended to include contextual or narrative elements in their explanations.

Two main solution patterns appeared. The first approach involved calculating the total eggs over 10 days and then multiplying by the price. The second approach directly calculated the daily income and multiplied it by 10 days.

Interview data support these observations. Malaysian students generally provided brief answers focused on clear numerical steps. For example, when solving a similar problem, they calculated mango production per tree (120 × 15 = 1,800 mangoes), multiplied by the selling price (1,800 × 2,000 = Rp 3,600,000), and concluded with the farmer's total earnings. Culturally, Malaysian students seemed more accustomed to a structured, step-by-step format and were less likely to add contextual explanations.

Indonesian students followed almost the same numerical sequence. However, they more frequently used terms such as "income" or "sales revenue," linking the results to real-life economic meaning. This reflects a cultural tendency in Indonesia to connect mathematics with everyday experiences. While both groups reached the same answer, Indonesian students were more likely to frame their results in terms of the farmer's actual financial situation. In comparing the two groups, Malaysian students displayed a stronger focus on the procedural steps of problem solving, whereas Indonesian students placed more emphasis on contextual meaning. Malaysian explanations tended to be formal and numerical, while Indonesian explanations were more narrative. These differences appear to reflect broader educational approaches: Malaysia emphasizes procedural discipline and efficiency, while Indonesia emphasizes contextual teaching that links calculations to socio-economic realities.

Despite their correct calculations, neither group considered the additional condition that 20% of the eggs were unsold. If this detail were included, 20% × 750 = 150 eggs would remain unsold, leaving 600 eggs sold. Thus, the actual income would be 600 × 2,500 = Rp 1,500,000. This indicates that students in both countries focused primarily on the core numerical information and tended to overlook secondary contextual details.

A similar pattern appeared in other items assessing the Application of Mathematical Concepts in Real-World Context. For example, in a problem involving tree planting and leaf production, Malaysian students emphasized logical, procedural steps—calculating additional trees, total trees, and total leaves (15 × 5 = 75; 15 + 75 = 90; 90 × 200 = 18,000 leaves). Indonesian students followed the same steps but were more likely to describe the outcome narratively as "the total number of leaves produced by all the trees." Again, neither group applied the additional context that 20% of the leaves fell, which would reduce the total to 14,400 leaves.

These findings highlight consistent differences in problem-solving orientation. Malaysian students focused on following a structured sequence closely aligned with the problem's wording, while Indonesian students often interpreted results within a practical, real-world context.

The same pattern was observed in multi-step financial problems. Malaysian students systematically calculated the price of each fruit, added the results, and stated the total cost. Indonesian students performed identical calculations but also explained whether the customer's money was sufficient and identified the amount of change, showing stronger contextual interpretation. A similar distinction occurred in a data analysis problem involving rice sales. Malaysian students used a concise approach by calculating profit per kilogram and multiplying by quantity. Indonesian students used a more detailed method by computing total cost, total revenue, and profit. Malaysian students emphasized efficiency, whereas Indonesian students emphasized conceptual understanding of financial transactions.

Overall, the results across multiple problems reveal two distinct orientations: Malaysian students: procedural, efficient, step-by-step, and focused mainly on numerical accuracy. Indonesian students: contextual, narrative, and inclined to interpret results within real-life situations.

Although both groups consistently produced correct calculations, they often overlooked additional contextual conditions, such as unsold products or fallen leaves. This suggests that while their computational skills are strong, both groups would benefit from instruction that emphasizes careful interpretation of problem contexts along with computation.

The findings of this study indicate that elementary students in both Malaysia and Indonesia exhibit comparable competencies in solving mathematical word problems when contextual learning strategies are applied. Across both contexts, students demonstrated a consistent ability to handle basic operations such as multiplication, profit calculation, and proportional reasoning. These findings affirm the relevance of contextualized mathematical instruction in cultivating numeracy literacy at the elementary level. As observed by Takaria et al. (2022), foundational numeracy competencies play a significant role in shaping students' ability to approach and solve problems systematically, a notion supported by Griffin et al. (2018) and reaffirmed by Vessonen et al. (2025) in their meta-analysis of numeracy skill acquisition.

This study extends current knowledge by juxtaposing cognitive and instructional tendencies of Indonesian and Malaysian students, highlighting both procedural commonalities and strategic divergences in word-problem solving. While pedagogical literature acknowledges the general effectiveness of contextual learning approaches, the novelty of this research lies in its empirical examination of localized instructional content and its implications for cognitive development. This comparative lens helps identify country-specific educational gaps and enriches the framework for developing tailored interventions (Suciyati et al., 2022; Suseelan et al., 2023a; 2023b; Vessonen et al., 2025).

In Indonesia, word problems frequently mirror daily agricultural and household scenarios, helping students engage with material that resonates with their lived experiences (Iswara et al., 2022). This culturally grounded instruction promotes deeper understanding and emotional engagement, as shown by Wahyuni and Agustika (2021) and further supported by Agusfianuddin et al. (2024), who note that familiarity with context reduces cognitive load and enhances retention. In contrast, the Malaysian curriculum integrates commercial and transactional themes, reflecting societal emphasis on economic literacy. These contextual differences highlight a broader pedagogical strategy across Southeast Asia to align numeracy education with practical life applications (Suseelan et al., 2023a; 2023b; King and Powell, 2023).

These contextual patterns are supported by studies on the effectiveness of ethnomathematics-based content (Iswara et al., 2022; Aini et al., 2024), which show improved engagement and comprehension when problems are grounded in real-life local situations. In both countries, embedding mathematics in familiar social scenarios has led to heightened cognitive processing and student enthusiasm, underscoring the significance of culturally responsive teaching (Lestari et al., 2023; Putri et al., 2021).

Student response analyses reveal differences in cognitive style. Malaysian learners commonly use structured problem-solving sequences, identifying known quantities early and applying mathematical operations stepwise. This structured decompositional approach aligns with Kourtit (2021) and Vessonen et al. (2025), who argue that such navigation strategies promote cognitive economy. Indonesian students, on the other hand, exhibit more integrative reasoning, often embedding calculations within broader socio-environmental narratives. These differing strategies reflect underlying educational and cultural influences that shape heuristic development (Agusfianuddin et al., 2024; Liu et al., 2025).

Crucially, several implications emerge. First, embedding instruction within culturally authentic contexts can significantly enhance the transfer of mathematical knowledge to real-world situations. This is validated by Aini et al. (2024), who demonstrate that localized narratives in word problems enhance motivation and cognitive accessibility. Second, curriculum designers must ensure alignment between students' cultural backgrounds and instructional content, an approach found effective in both Indonesian and Malaysian classrooms (King and Powell, 2023; Aini et al., 2024). Third, professional development programs should emphasize the dual integration of numeracy and language skills, a recommendation echoed by Huang et al. (2024) and Strohmaier et al. (2022).

Furthermore, dynamic assessment models, scaffolding strategies (Stevens et al., 2023), and technological aids (Ting et al., 2024) have shown effectiveness in both settings. Video-supported interventions and formative feedback loops help address real-time misconceptions (Huang et al., 2024), while schema-based learning fosters structured cognitive processing (Powell et al., 2021). The use of analogical reasoning (Nurroini et al., 2023; Yosa et al., 2022) and metacognitive prompts (Strohmaier et al., 2022) has also been validated in helping students plan and reflect on problem-solving strategies.

This study reveals that students' numeracy literacy is intricately linked to their linguistic abilities. As identified by King and Powell (2023), language barriers can hinder mathematical comprehension, particularly in contexts where bilingualism or regional dialects influence classroom interaction. To address this, researchers have proposed integrated instructional models that combine vocabulary development with mathematical concept teaching (Stevens et al., 2023; Huang et al., 2024). When implemented alongside culturally contextualized learning, such models yield higher engagement and improved performance outcomes. Moreover, the role of classroom environment and teacher expectations has emerged as a significant moderator of students' problem-solving success. Educators who adopt inquiry-based approaches and foster supportive classroom climates report better student outcomes (Agusfianuddin et al., 2024). These findings affirm that teacher training and attitudes are just as crucial as curriculum content in shaping numeracy development.

In line with this, Bahtiar et al. (2020) emphasized that mathematical communication and logical thinking significantly influence students' numeracy literacy, a finding consistent with the comparative study of Indonesia and Malaysia. Mathematical communication strengthens the dimension of understanding word problems, as students who can restate problem statements are better able to identify relevant data and translate it into mathematical representations. Logical thinking, in turn, supports the application of mathematical concepts in real-world contexts and problem-solving with multiple steps, enabling students to connect concepts with everyday situations and to organize solutions systematically. Furthermore, the synergy of communication and logic reinforces the dimensions of data analysis and application of mathematical skills in social aspects, where students are required to interpret data, present analytical results, and make logical decisions in collaborative settings (Vygotsky, 1978; Gravemeijer and Doorman, 1999). Thus, numeracy literacy extends beyond computational ability to encompass the integration of communication and logic across understanding, application, sequential problem-solving, data interpretation, and social contexts, requiring instruction that is contextual, collaborative, and oriented toward higher-order thinking skills (Griffin et al., 2012; Suseelan et al., 2023a; 2023b).

In summary, this study enriches the comparative research landscape by demonstrating that numeracy literacy is shaped not only by arithmetic skills but also by cognitive strategies, linguistic fluency, and cultural context. It underscores that contextual learning, when combined with evidence-based teacher training and adaptive pedagogy, serves as a powerful catalyst for enhancing elementary students' mathematical proficiency. By highlighting nuanced instructional differences between Indonesia and Malaysia, this work provides an empirical basis for refining curriculum design, teacher education, and policy formulation (Vessonen et al., 2025; Suseelan et al., 2023a; 2023b; Liu et al., 2025).

4. Conclusions

This study concludes that while elementary students in Indonesia and Malaysia share similar abilities in performing basic mathematical calculations, their approaches to solving word problems differ based on instructional delivery and contextual exposure. Indonesian students typically engage with problems rooted in their immediate environment, such as agricultural and ecological scenarios. Conversely, Malaysian students often encounter problems framed within economic and business contexts. These contextual distinctions influence students' problem-solving strategies, reflecting the educational practices and cultural settings of each country.

The findings underscore the value of contextual learning to enhance students' comprehension and application of mathematical concepts. When instructional content is aligned with students' real-life experiences, it fosters deeper engagement and more effective learning. Context-based learning approaches have demonstrated their potential to improve mathematical reasoning and support the development of numerical literacy.

This research contributes to the advancement of mathematics education by highlighting the importance of designing instructional strategies that are culturally and contextually responsive. It provides practical guidance for educators to recognize and accommodate variations in students' problem-solving styles across different educational systems. These insights are valuable for curriculum developers aiming to create adaptive, inclusive, and effective mathematics programs.

Moreover, the study emphasizes the necessity of developing high-quality, contextually grounded teaching materials. Instructional resources that incorporate familiar scenarios and real-world relevance can significantly enhance learning outcomes. As such, the findings of this research serve as a foundational reference for improving the design and implementation of mathematics instruction, ultimately supporting the goal of strengthening numerical literacy among elementary school students.

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Compliance with ethical standards

Ethical considerations

This study was approved by the Research Ethics Committee of Universitas Muhammadiyah Makassar (Ethical Clearance No. 59/LP3M/05/A.4-VIII/XII/46/2024). The research was classified as minimal risk. Permission was obtained from the participating schools in Indonesia and Malaysia. Informed consent was secured from school authorities, teachers, and parents or legal guardians of all participating students. Student participation was voluntary, and all data were collected anonymously to ensure confidentiality.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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