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Developing Mathematical Literacy Using the Ramayana Ballet Context with Indonesian Realistic Mathematics Education

Monica Tiara Gunawan[1*], Hongki Julie[2], Marcellinus Andy Rudhito[3], Yosep Dwi Kristianto[4]
[1-3] Master's Program in Mathematics Education, Sanata Dharma University
Jl. Affandi, Mrican, Caturtunggal, Depok, Sleman, DIY 55281, Indonesia
[4] Department for STEM didactics, Linz School of Education, Johannes Kepler University Linz
Altenberger Straße 69, 4040 Linz, Austria

e-mail: * monicatiara.work@gmail.com
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*corresponding author**

Abstract

This article emphasizes the importance of the PMRI and ethnomathematics for meaningful learning. In addition, low mathematical literacy is caused by students' difficulties in connecting concepts with real-life contexts, while the integration of cultural contexts such as the Ramayana Ballet into PMRI remains limited. This study aims to (1) design and implement Hypothetical Learning Trajectory (HLT) with PMRI and LKPD with Ramayana Ballet Prambanan context to develop mathematical literacy skills, (2) describe students' mathematical literacy skills after experiencing learning on circle topic with PMRI. The type of research used is design research with stages (1) designing HLT, (2) implementing HLT, and analyzing students' mathematical literacy skills after experiencing learning. The data analysis technique used was reducing data, presenting data, and drawing conclusions. The results obtained were: (1) Mathematics learning in class VIII Pinisi effectively brought up all the characteristics of PMRI; and (2) Mathematical literacy skills of students in class VIII Pinisi after learning with the PMRI showed that students still had difficulties in several aspects, namely: (a) problem 1, writing complete information (level knowing), (b) problem 2, writing complete information, applying strategies and operations for problem solving (level applying), and (c) problem 3, providing mathematical arguments and assessing problem solving strategies and alternative solutions (level reasoning).

Keywords: Hyphothetical Learning Trajectory; Indonesian Realistic Matematics Education; Mathematical Literacy Skill

1. Introduction

Mathematics plays an essential role in everyday life and in developing critical thinking skills (Wu & Ye, 2015). However, many students still face difficulties in learning mathematics, particularly in connecting abstract concepts to real-world situations. To make learning more meaningful, teachers need to relate mathematical concepts to cultural contexts familiar to students (Rowlands & Carson, 2002). To understand the role of mathematics in everyday life, students need to master mathematical literacy skills (Rizki & Priatna, 2019). By incorporating local cultural elements, teachers can create innovative, engaging, and relevant learning experiences that help students develop mathematical literacy (Orey & Rosa, 2007). Mathematical literacy refers to an individual's ability to apply mathematical knowledge to solve real-world problems, reason mathematically, and make informed decisions as reflective citizens (Stacey, 2011). According to research Masriyani et al. (2022) strengthening mathematical literacy requires learning designs that are grounded in contexts students can imagine and relate to, enabling them to construct knowledge through meaningful experiences Strengthening mathematical literacy requires learning designs that are grounded in contexts students can imagine and relate to, enabling them to construct knowledge through meaningful experiences (Dahlan, 2019). Realistic problems in PMRI help students build knowledge and discover mathematical concepts, principles, definitions, and procedures (OECD, 2023) and (Lisnani, 2023). According to (OECD, 2018) mathematical literacy includes students' skills in mathematical reasoning and the use of concepts, procedures, facts, and tools to explain phenomena, including cultural phenomena. Ethnomathematics studies can be used to build the context of realistic problems in the PMRI. One promising approach is the Indonesian Realistic Mathematics Education (PMRI), adapted from the PMRI developed at the Freudenthal Institute. PMRI emphasizes learning through meaningful and imaginable situations, in line with Freudenthal's view of mathematics as a human activity based on real experience (Wijaya, 2008). Prior studies using PMRI have shown positive effects on students' mathematical reasoning and understanding through realistic problem contexts.

Indonesian Realistic Matematics Education (PMRI) is a mathematics learning developed since 1971 by a group of mathematicians from the Freudenthal Institute, Utrecht University in the Netherlands (Towe & Julie, 2020). This approach is based on Freudenthal's assumption that mathematics is a human activity and a process in building concepts. The philosophy of PMRI according to Julie et al. (2014) namely: (a) mathematics is formed by human activities, and (b) mathematics can be applied in human activities. In addition, there are five characteristics of PMRI, namely: (a) phenomenological exploration, (b) using vertical instruments, (c) student participation, (d) interactivity, and (5) synergy (Anggoro et al., 2018). According to Holisin (2007) there are five steps of PMRI, namely: (1) understanding contextual problems, (2) explaining contextual problems, (3) solving contextual problems, (4) discussing, and (5) concluding. Hypothetical Learning Trajectory (HLT) is a hypothesis or allegation of how students' thoughts, reactions, and understanding of each learning trajectory in order to achieve learning objectives that were initiated and applied by a mathematician named Simon (Yuliardi & Rosjanuardi, 2021). This is also in line according to HLT is a hypothesis of the process that learners will go through when they complete a series of tasks that result in the specified learning objectives (Simon et al., 2018). Meanwhile, ethnomathematics highlights mathematical ideas embedded in cultural practices. Previous studies have demonstrated the potential of ethnomathematics-based learning, for example using Minangkabau architecture, to increase motivation, critical thinking, and engagement (Fauzan et al., 2020). However, research using ethnomathematics alone often focuses on cultural content without structured learning trajectories, while PMRI based studies typically employ general contexts without emphasizing cultural elements. Some studies combining PMRI and ethnomathematics have shown promising outcomes (Kusumaningsih et al., 2020), but their scope remains limited in terms of specific mathematical topics and contexts.

Despite these developments, there is still a lack of research that integrates local cultural contexts such as the Ramayana Ballet Prambanan into the design of Hypothetical Learning Trajectories (HLT) within PMRI to develop students' mathematical literacy skills, particularly in the topic of circles.

Previous research has rarely explored how cultural contexts can be systematically embedded in the design and implementation of HLT to support literacy development. Interviews with mathematics teachers at Stella Duce 1 Junior High School, Yogyakarta, revealed that students still struggle to solve contextual mathematics problems. Challenges include maintaining student focus and engagement, as well as the limited variety of cultural context problems to strengthen mathematical literacy. An analysis of students' work on circle problems using the Ramayana Ballet context showed difficulties in understanding problems, applying formulas, and reasoning about mathematical relationships, for example : students have not been able to (1) understand the meaning of the problem, (2) explain the position of the points that are away from the center point of the circle, (3) explain the steps taken from three points to get the position described by the students, (4) know the known radius so that the application of the formula to determine the circumference, juring, and area of the circle is not correct, (5) define what a circle is, (6) explain the relationship between radius and diameter, (7) apply the phi value in the formula to determine the circumference, radius, and area of a circle correctly, (8) relate and explain the relationship between distance in the form of a circumference of a circle, speed, and travel time, and (9) determine the length of half of the fire track which is a semicircle correctly.

Based on this gap, this study seeks to fill the research void by integrating cultural contexts into PMRI-based HLT for circle topic. Specifically, this study aims to: (1) design and implement a Hypothetical Learning Trajectory (HLT) using the PMRI approach and the Ramayana Ballet Prambanan cultural context to develop the mathematical literacy skills of Grade VIII students, (2) describe students' mathematical literacy skills on circle topic after experiencing PMRI-based learning with cultural contexts.

2. Method

This research employed design research, which is appropriate for developing, implementing, and analyzing innovative learning designs in real classroom settings. Design research was chosen because it allows researchers to systematically design Hypothetical Learning Trajectories (HLT), test them in practice, and refine them through iterative cycles (Gravemeijer & Cobb, 2006). This approach fits the study's aim to explore how cultural contexts can be integrated into PMRI-based learning to develop students' mathematical literacy. Design research consists of three main phases, (1) preliminary design, (2) teaching experiment, and (3) retrospective analysis. The research was conducted in Class VIII Pinisi at SMP Stella Duce 1 Yogyakarta during the 2023/2024 academic year. The class consisted of 24 students. This class was purposively selected based on recommendations from the mathematics teacher, considering the students' readiness to engage in realistic mathematics activities and their prior exposure to circle topic. Ethical approval was obtained from the school and informed consent was secured from students. Students were informed about the purpose of the research, their voluntary participation, and their right to withdraw at any time. Data confidentiality and anonymity were maintained by using codes instead of students' real names.

The research was conducted from January to March 2024, covering three design research phases.

a. Preliminary Design
   Development of the HLT containing learning objectives, outcomes, activities, and hypotheses. Expert validation of learning and research instruments.
b. Teaching Experiment
   Implementation of the HLT in Class VIII Pinisi to observe how students engage with the Ramayana Ballet cultural context, the readability of problems, and the development of mathematical literacy skills.
c. Retrospective Analysis
   Analysis of students' mathematical literacy performance based on tests, field notes, and interviews to refine the HLT.

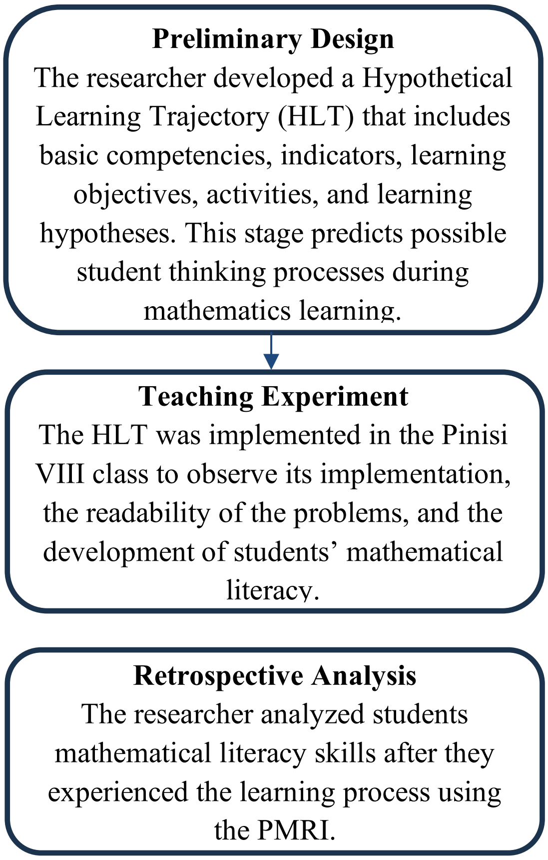

Figure 1. Three Stages of Design Research (Gravemeijer & Cobb, 2006)

The instruments consisted of (a) learning instruments: HLT and student worksheet, (b) research instrument: field note sheets, documentation, mathematical literacy test, and interview protocols. The credibility of the Ramayana Ballet cultural data was validated through source and technique triangulation, namely observation, interviews, and documentation. Source triangulation compares data from different informants, while technique triangulation compares data from the same source using different methods. For students' literacy data, technique triangulation was conducted through essay tests and interviews.

Data were collected through field notes, mathematical literacy tests, and interviews. Field notes were used to document classroom interactions, student engagement, and the implementation of each PMRI step. The mathematical literacy test was developed based on PUSMENDIK (2020) indicators, which include three level there is knowing, applying, and reasoning to assess students' skills after the learning intervention. Interviews were conducted with a group of students selected based on their test performance, categorized into high, medium, and low groups following Arifin & Nurdyansyah (2018) and (Arikunto, 2006) to gain deeper insights into students' understanding and problem-solving strategies. Interviews were only conducted with student representatives from each category based on the results of the written test.

Table 1. Group Criteria

Group	Group Category
High	$X > (\bar{X} + SD)$
Medium	$(\bar{X} - SD) \leq X \leq (\bar{X} + SD)$
Low	$X < (\bar{X} - SD)$

The data analysis technique used in this research is qualitative data analysis technique. According to Miles et al. (2014) there are three steps in analyzing qualitative data, namely:

a. Data Condensation
   Data obtained by researcher from field notes Field notes were categorized according to PMRI learning steps. Test and interview data were categorized based on mathematical literacy levels (knowing, applying, reasoning) and corresponding indicators.
b. Data Display
   Data were presented in tables and matrices to display patterns of students' performance and engagement across instruments.
c. Conclusion Drawing and Verification

Findings from tests, field notes, and interviews were triangulated to ensure validity. Field observations helped interpret test results, while interviews provided deeper insight into students' reasoning behind their written work. Where for each mathematics literacy indicator, the assessment rubric is applied consistently across all instruments. The rubric score of the level mathematical literacy ability is in Table 2, each student's score was analyzed at the indicator and level (knowing, applying, reasoning) to determine their overall literacy profile.

Table 2. Mathematical Literacy essay Test Indicators

Mathematicals Literacy Level	Aspect Level	Description	Item Test	Score
Knowing	Measure	Use measurement instruments and select appropriate units.	1a	2
	Identify	Identify numbers, expressions of quantity and shapes.	1b	2
		Identify mathematically equivalent identities (such as: decimals, percentages, fractions)		
	Classify	Classify numbers, expressions, quantities and shapes that have similar properties	1c	3
	Retrieve/obtain	Retrieve/obtain information from charts tables, text or other sources.	1d	3
Applying	Apply/execute	Apply/execute strategies and operations to solve real-world problems related to known mathematical concepts and procedures.	2a, 2c, 2d	2, 3, 3
	Interpet	Provide an interpretation or interpretation of the problem solving obtained.	2b	2
Reasoning	Analyzing	Determine, draw or use relationships in numbers, expressions, quantities and shapes.	3a	2
	Evaluate	Assess problem-solving strategies and alternative solutions.	3b, 3c, 3e, 3h	2, 3, 3, 3
	Integrating	Connect elements, different knowledge, link representations to solve problems.	3d	3
	Justifying	Provide mathematical arguments to support claims.	3f	3
	Summarize	Make valid inferences based on information and facts.	3g	2
		TOTAL POIN	40	
		FINAL TOTAL SCORE	$\frac{TOTAL\ SCORE \times 10}{3}$	

3. Results and Discussion

3.1 Results

a. PMRI

The Hypothetical Learning Trajectory (HLT) begins with the context of the Ramayana Ballet (Understanding the Problem), which is a manifestation of the principles of PMRI Phenomenology. In addition, each step of HLT (from Understanding to Concluding) is designed as an activity that encourages students to interact, model, and reflect, which aligns with the principle of Activity in PMRI. The HLT made by the researcher was planned in three meetings, each lasting 2 × 40 minutes. In the first and second meetings, researchers conducted face-to-face learning, while in the third meeting, researchers conducted literacy tests for students. The HLT used to teach circle topic at junior high school level using the PMRI was prepared based on the steps of teaching mathematics with the PMRI. Broadly speaking, the learning steps planned by the researcher are as follows Fauzana et al. (2020) understanding the problem, explaining the problem, problem solving, discussing the problem, summarizing. Understanding the problem and explaining the problem reflect Freudenthal's philosophy that mathematics learning should start from meaningful situations, supported by previous research showing that realistic problems in PMRI help students build knowledge and discover mathematical concepts (Van den Heuvel-Panhuizen, 2020). The HLT developed in three meetings is valid and practical because the process follows the steps of PMRI (understanding, explaining, problem solving, discussing, summarizing). This design successfully integrates the cultural context of the Ramayana Ballet *Anoman Obong* into the circle problem, fulfilling the objectives of the HLT design

b. Implementation of Mathematical Learning

The learning implementation followed the five steps of PMRI to achieve the objective of helping students discover and understand circle concepts (center, radius, diameter, circumference, arc length, and area) through the cultural context of the *Anoman Obon*g scene in the Ramayana Ballet Prambanan. This context naturally involves circular shapes (fire movement and safe zones), allowing students to mathematize real cultural phenomena; (1) Understanding the problem, students were introduced to the context through storytelling and video. They identified known, unknown, and questioned information. This reflects PMRI use of meaningful contexts, (2) explaining the problem, students categorized information and rephrased problems, showing progressive mathematization, (3) problem solving, in groups, students explored circle concepts through contextual problems, actively constructing knowledge, (4) discussing the problem, groups presented and compared solutions, highlighting interaction and negotiation of meaning, (5) summarizing, students reflected on circle concepts and relationships, bridging informal strategies to formal mathematics.

This process shows how PMRI principles were systematically applied to link local cultural contexts with mathematical learning. Implementation findings indicate that the HLT steps (understanding the problem, explaining, solving, discussion, and concluding) successfully engaged students in mathematizing activities within the context of Ramayana culture. For example, identifying circle elements, naming points, calculating arcs and areas. This aligns with the objectives of the HLT design because the HLT process facilitates the transition from meaningful situations to formal mathematical concepts, namely the development of mathematical literacy in the sense of PMRI (mathematizing). These findings show that the designed HLT successfully meets the aspect of contextual closeness and concept construction, which are the goals of the design.

c. Mathematical Literacy Skill

There are three essay test questions given, where for the knowing level four questions are presented with indicators of measuring, identifying, classifying, and retrieving/obtaining. The applying level presented four questions with indicators of applying/implementing, and interpreting. While the reasoning level presented eight questions with indicators of analyzing, evaluating, integrating, making justifications and concluding. The interview questions given are based on essay test questions. Based on the results of the data analysis of the mathematical literacy test for problem 1 level knowing conducted by researchers, it is obtained in Table 3.

Table 3. Student's Mathematical Literacy Ability for Problem 1

Problem Points	Aspect of Mathematical Literacy	Description
a	Measure	22 out of 24 students were able to determine the size using the measurement instrument choosing the correct unit based on the information provided in the question.
b	Identify	21 out of 24 students were able to identify through the position of points that have the same length from point O which is 76 cm.
c	Classify	15 out of 24 students were able to explain the steps starting from 3 points in the problem by classifying shapes that have similar properties.
d	Retieve/obtain	21 out of 24 students were able to obtain information based on the information in the problem and the process of problem-solving results for number 1 part a to part c, so that through the reflection process students were able to conclude the solution.

Table 4. Student's Mathematical Literacy Ability for Problem 2

Problem Points	Aspect of Mathematical Literacy	Description
a	Apply/execute	23 out of 24 students were able to apply or implement strategies and operations to solve real-world problems related to known mathematical concepts and procedures.
b	Interpret	22 out of 24 students are able to interpret, which is able to provide an interpretation or interpretation of the problem solving obtained in number 1 part a.
c	Apply/execute	24 out of 24 students are able to apply or implement strategies and operations to solve real-world problems related to known mathematical concepts and procedures.
d	Apply/execute	24 out of 24 students were able to apply or implement strategies and operations to solve real-world problems related to known mathematical concepts and procedures.

Table 5. Student's Mathematical Literacy Ability for Problem 3

Problem Points	Aspect of Mathematical Literacy	Description
a	Analyzing	17 out of 24 students are able to analyze, which is able to determine, describe, or use relationships in forms.
b	Evaluate	17 out of 24 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.
c	Evaluate	22 out of 24 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.
d	Intergrating	1 out of 24 students is able to integrate, which is able to connect elements, different knowledge, connect representations for problem solving.
e	Evaluate	14 out of 24 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.

Problem Points	Aspect of Mathematical Literacy	Description
f	Justifying	19 out of 24 students are able to justify, which is able to provide mathematical arguments to support claims.
g	Summarizing	13 out of 24 students are able to infer, which is able to make valid conclusions based on information and facts.
h	Evaluate	23 out of 24 students were able to evaluate where they were able to be able to assess problem solving strategies and alternative solutions.

The grouping of students in Table 6 is presented based on the test results using the criteria found in Table 2.

Table 6. Group Criteria

Group	Total Student	Percentage (%)
High	3	12.5
Medium	18	75.0
Low	3	12.5

Furthermore, based on the results above, the researcher determined proportionally the number of students to be interviewed in each group. The researcher selected 1 student in the high category, 3 students in the medium category, and 1 student in the low category to be interviewed regarding their mathematical literacy skills. The following is presented the interview results obtained for problem 1 in Table 7.

Table 7. Interview Result of Mathematical Literacy Skills on Problem 1

Problem Points	Aspect of Mathematical Literacy	Description
a	Measure	4 out of 5 students are able to measure by using measurement tools or instruments and choosing the right units.
b	Identify	3 out of 5 students are able to identify through specific points.
c	Classify	3 out of 5 students are able to classify shapes that have similar properties.
d	Retieve/obtain	3 out of 5 students are able to retrieve or obtain information from other sources.

Table 8. Interview Result of Mathematical Literacy Skills on Problem 2

Problem Points	Aspect of Mathematical Literacy	Description
a	Apply/execute	5 students were able to apply or carry out strategies and operations to solve real-world problems related to known mathematical concepts and procedures.
b	Interpret	3 out of 5 students are able to interpret, provide interpretation or interpretation of the problem solving obtained.
c	Apply/execute	2 out of 5 students are able to apply or implement strategies and operations to solve real-world problems related to known mathematical concepts and procedures.
d	Apply/execute	2 out of 5 students are able to apply or implement strategies and operations to solve real-world problems related to known mathematical concepts and procedures.

Table 9. Interview Result of Mathematical Literacy Skills on Problem 3

Problem Points	Aspect of Mathematical Literacy	Description
a	Analyzing	2 out of 5 students are able to analyze, which is able to determine, draw or use relationships in forms.
b	Evaluate	4 out of 5 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.
c	Evaluate	3 out of 5 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.
d	Intergrating	1 out of 5 students is able to integrate, which is able to connect elements, different knowledge, connect representations to solve problems.
e	Evaluate	1 out of 5 students is able to evaluate, which is able to assess problem solving strategies and alternative solutions.
f	Justifying	1 out of 5 students is able to justify, which is able to provide mathematical arguments to support claims.
g	Summarizing	4 out of 5 students are able to infer, which is able to make valid conclusions based on information and facts.
h	Evaluate	1 out of 5 students are able to evaluate, which is able to assess problem solving strategies and alternative solutions.

3.2 Discussion

a. PMRI

The finding that students performed very well in Applying/Executing on Points 2c and 2d in Table 4 and Measuring on Point 1a in Table 3 is consistent with the PMRI philosophy. PMRI, which starts from real contextual problems (Ramayana Ballet), effectively facilitates students in applying strategies and operations because concepts are developed from meaningful situations (Van den Heuvel-Panhuizen, 2020). However, the main weakness lies in aspects that require deep analysis and abstraction, namely integrating, classifying, and interpreting. This weakness is consistent with findings from national PISA assessments and other literacy studies such as Vidad & Quimbo (2021) which show that Indonesian students, although strong in procedural skills (knowing and applying basics), still struggle with reasoning, knowledge integration, and interpreting complex contexts. Problems that rely on measurement and procedures for applying formulas/steps provide room for students to use tactical knowledge that can be quickly practiced after contextual demonstrations (videos and discussions).

The PMRI makes it easier for students to relate concrete information, resulting in high achievement on this indicator. PMRI emphasizes the beginning of meaningful situations and the process of mathematizing. Many PMRI studies report improvements in conceptual understanding and application through contextual tasks, especially for concepts that can be modeled concretely. The results of this study are consistent with these findings, showing progress in knowing and applying, but similar to some PMRI studies, improvements in higher-level reasoning skills require argumentative task designs and more explicit learning activities. The 2022 PISA report highlights variations in mathematics proficiency profiles between countries, with some countries excelling in reasoning while others are weak (OECD, 2023). In addition, according to Aydın & Özgeldi (2019) shows that students have strengths in applying concepts but weaknesses in integration/reasoning, which aligns with the general patterns identified by PISA in many contexts, indicating the need for intensive practice in higher-order thinking processes

b. Implementation of Mathematical Learning

Studies that integrate local wisdom show that cultural context helps make abstract concepts more meaningful and increases students' interest and engagement (Bustan et al., 2022). Our results are consistent with those findings, namely in the context of the Ramayana Ballet, increasing engagement and facilitating transfer to procedures confirms that the effect on higher-order reasoning only occurs if the task is explicitly designed to encourage integration and argumentation. Although most traditional PMRI research uses everyday problems, this study innovates by integrating local culture (Ramayana Ballet) as a source of realistic situations. This integration makes HLT more culturally contextual, potentially enhancing local relevance and student motivation (Azhary & Fatimah, 2024). Furthermore, unlike most PMRI studies that use common everyday contexts, this research successfully integrated local wisdom, namely the Ramayana Ballet, as a "bridge" to mathematical concepts such as circles, arcs, and areas. This demonstrates that cultural context can serve as a rich and relevant PMRI "phenomenon" enhancing students' motivation and understanding of abstract concepts (Putri & Zulkardi, 2019) and (Azhary & Fatimah, 2024).

c. Mathematical Literacy Skill

The majority of students fall into the moderate category (75.0%), indicating that culturally based interventions within PMRI effectively improve mathematical literacy to an adequate level, although only 12.5% reach the high category. High scores were observed on the measuring and applying indicators, while interpreting, integrating, and justifying remained low because these tasks require metacognitive skills that have not been sufficiently practiced (Bakker & Gravemeijer, 2004). Although the HLT provides a strong contextual foundation, the learning activities have not adequately fostered argumentation, metacognitive reflection, or the integration of representations, resulting in weak reasoning. This finding aligns with previous studies indicating that context-based learning tends to strengthen procedural understanding but does not automatically improve reasoning without deliberate scaffolding (Van Den Heuvel-Panhuizen & Drijvers, 2014) and (Boesen et al., 2010).

Based on the interview results (Table 9) indicate that students performed better on basic evaluation and summarizing tasks but struggled with analyzing, integrating, and justifying. This finding is consistent with Boesen et al. (2010) who reported that students often succeed in procedural evaluation but face difficulties in reasoning and justification. Similarly, Van Den Heuvel-Panhuizen & Drijvers (2014) emphasize that PMRI contexts support understanding but require explicit scaffolding to develop argumentation skills. This pattern aligns with OECD (2018) which shows lower performance among Indonesian students on reasoning tasks. These results suggest that cultural contexts alone are not sufficient; targeted interventions are needed to strengthen reasoning abilities. The discussion and summarizing processes effectively helped students identify circle concepts, demonstrating the success of HLT in the knowing and applying domains. However, performance in the reasoning domain was not optimal, indicating the need for targeted reinforcement to develop students' critical and analytical thinking skills. Interview results supported these findings: students found concrete tasks easier but struggled to integrate representations and provide in-depth justifications. Overall, HLT effectively supported conceptual understanding and application, but additional strategies are needed to strengthen higher-order reasoning skills.

4. Conclusion

This study demonstrates that applying the PMRI through culturally relevant contexts, specifically the *Anoman Obong* scene of the Ramayana Ballet, effectively supports students in understanding and applying circle concepts while fostering mathematical literacy. The integration of ethnomathematics within the HLT allowed students to connect real cultural situations to mathematical ideas, aligning with the research objective of enhancing students' mathematical literacy through meaningful learning experiences. The findings show that students developed strong skills in measuring and applying procedures but faced challenges in reasoning indicators, particularly interpretation, integration, justification, and drawing valid conclusions. These patterns highlight the need for targeted interventions to strengthen higher-order reasoning skills within cultural contexts. Practically, this study provides valuable insights for teachers and curriculum developers: using local cultural contexts can make mathematics learning more meaningful and engaging, while also supporting literacy development. For policy, it suggests that integrating ethnomathematics into classroom practice can complement national efforts to improve mathematical literacy in line with PISA goals. A limitation of this study is that it was conducted in a single class with a limited number of participants, so the generalizability of the findings is restricted. Future research could explore the use of cultural contexts in other mathematical topics, involve larger and more diverse samples, and incorporate longitudinal designs to examine long-term effects on students' reasoning and literacy development. Additionally, including student work samples or interview excerpts can provide richer illustrations of how literacy skills evolve during instruction.

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