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Students' Mathematical Literacy Skills in Solving Contextual Problems Based on Local Sasak

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Abstract

Students' Mathematical Literacy Skills in Solving Contextual Problems Based on Local Sasak. *Students' persistently low mathematical literacy skills are often attributed to learning processes that are overly abstract and disconnected from reality. To address this gap, integrating cultural contexts into education is essential. This study aims to analyze students' mathematical literacy skills in solving contextual problems based on the local culture of the Sasak tribe. Employing a descriptive qualitative approach, participants were selected from class VIII-B at MTsN 2 Mataram, involving three subjects representing high, moderate, and low ability categories. Data were collected through essay tests laden with Sasak ethnomathematics (Peresean, Gendang Beleq, and Kain Songket contexts) and in-depth interviews, then analyzed via data reduction, data display, and conclusion drawing. The results indicate that high-ability students can comprehensively formulate, employ, and interpret mathematical problems. Moderate-ability students demonstrate adequate procedural mastery but exhibit weaknesses in symbolic modeling. Conversely, low-ability students experience epistemological obstacles and logical errors starting from the initial formulation stage. The study implies that although Sasak culture functions effectively as cognitive scaffolding, its application necessitates reinforcing fundamental conceptual understanding and implementing differentiated learning approaches.*

INTRODUCTION

21st-century education demands the mastery of mathematical literacy as a primary foundation for logical, analytical, and critical thinking in facing various global challenges. Conceptually, mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in various contexts of life (OECD, 2019). Despite its crucial urgency, empirical reality shows that students' mathematical literacy levels remain a matter of concern. On an international scale, the results of the 2022 Programme for International Student Assessment (PISA) revealed that the average mathematical literacy score of Indonesian students experienced a significant decline and consistently remained far below the international average standard (Lewalter et al., 2023). In line with these findings, the national education portrait through the publication of the National Assessment results confirms that the majority of Indonesian students are still trapped in low-level cognitive thinking skills and are very weak when asked to solve contextual problems (Asesmen, 2024).

Responding to this literacy crisis, educational researchers and experts believe that the main cause is rooted in classroom learning processes that are overly abstract and alienated from the reality of students' lives. Ojose (2011) asserts that mathematical literacy can only develop optimally if students are able to see the relevance and use mathematics as a rational tool in their real lives. To bridge the gap between formal mathematics and reality, the integration of local wisdom or an ethnomathematics approach emerges as a strategic solution. Problem-based contextual learning wrapped in local cultural elements is believed to provide deep meaning to mathematical symbolic representations and procedures (Gravemeijer & Doorman, 1999). Furthermore, Rosa & Orey (2011) argue that cultural elements are proven to function as strong cognitive scaffolding to facilitate students' mathematical understanding towards formal-deductive thinking.

Support for this ethnomathematics approach is also widely echoed by experts who highlight the importance of integrating sociocultural contexts. Rahmawati et al. (2025) state that integrating cultural practices into mathematics learning can minimize students' cognitive load in understanding unfamiliar contexts, so their working memory capacity can be purely focused on core mathematical ideas. This is in line with the view of Omere & Ogedengbe (2022), who assert that ethnomathematics-based instruction is capable of bridging the gap between informal knowledge at home and formal knowledge at school. This approach allows students to see mathematics not as an abstract subject imposed from the outside, but as a science rooted in their own community identity, which in turn fosters a sense of belonging and self-confidence when solving problems (Sunzuma & Maharaj, 2019; Wulandari et al., 2024).

Various previous studies have attempted to examine and respond to students' low mathematical literacy, but the majority of these studies still rely on generic problem contexts. For example, Sriningsih et al. (2022) and Sari et al. (2021) have analyzed the profile of middle school students' mathematical literacy skills using standard PISA-model test instruments. In addition, similar research by Sumeyye et al. (2023) also successfully described students' strategies in solving everyday mathematical problems. Unfortunately, these studies are still fixated on general problems that are often adopted from Westernized situations or urban realities, and have not accommodated the wealth of local culture where the students reside. The absence of this local context proximity often makes students in regional areas continue to find it difficult to imagine the phenomena presented in the questions.

On the other hand, research specifically raising the theme of ethnomathematics has also been widely conducted, but still leaves a significant gap regarding cognitive analysis. Research by Roza et al. (2020) shows that ethnomathematics learning is very effective in increasing learning interest, but has not comprehensively touched upon the aspect of mathematical literacy as required by PISA. Meanwhile, Runtu et al. (2023) found that even though mathematical problems were wrapped in local culture, the majority of students with low basic abilities still experienced severe epistemological obstacles. Furthermore, a meta-analysis by Wirawan et al. (2024) indicates that the effectiveness of the current ethnomathematics approach is still highly variable because it depends on students' conceptual readiness. From these various reviews, a research gap is clearly visible, namely the very limited empirical studies that dissect the profile of mathematical literacy skills based on specific cognitive stages (formulating, employing, and interpreting) when students from various ability strata are directly confronted with cultural artifacts of the Sasak Tribe.

Departing from this gap, the novelty of this research rests on the development and exploration of contextual problem instruments that combine the international mathematical literacy framework with authentic artifacts of the Sasak Tribe in West Nusa Tenggara, such as geometry in the *Peresean* arena, rhythmic patterns in *Gendang Beleq*, and social arithmetic in *Kain Songket*. This invention is solidly constructed on the anthropological perspective of ethnomathematics from D'Ambrósio (2006), which positions culture as an essential container for understanding a society's mathematics. Complementing this foundation, Kusaeri (2019) along with Stacey & Turner (2015) put forward a supporting theory that high-quality contextual assessments must be built from real situations that have the potential for actual realization (realizable) by students' reasoning. The synthesis of these primary theories makes the Sasak cultural identity not just a narrative patch, but a crucial analytical instrument for tracking the impact of cognitive disparities on the mathematical abstraction process.

Based on the theoretical urgency and empirical gaps that have been outlined, the main focus of this study is directed at an in-depth evaluation related to students' thinking processes and mathematization competencies. This study aims to comprehensively describe and analyze the profile of students' mathematical literacy skills in solving contextual problems based on the local culture of the Sasak Tribe at MTsN 2 Mataram. An empirical mapping regarding the disparity in students' literacy skills on materials nuanced with local wisdom is considered highly essential. The results of this analysis are expected to be utilized as a foundational pillar for educators in designing differentiated pedagogical interventions and compiling evaluation instruments that are aligned with 21st-century demands without having to uproot the sociocultural roots of the learners.

METHOD

This study employed a qualitative research design using a descriptive method. This design was chosen because it aimed to deeply and comprehensively uncover and analyze the phenomena concerning students' thinking processes and mathematical literacy skills. The research was conducted at MTsN 2 Mataram. This location was selected considering that the madrasah is a flagship school accommodating diverse student backgrounds while strongly integrating a local cultural atmosphere into its academic environment. The participants were selected using a purposive sampling technique. From the eighth-grade (Class VIII) population, six subjects were chosen to represent three categories of basic mathematical ability: two high-ability students, two moderate-ability students, and two low-ability students. The participant selection was based on their average scores from an initial mathematics ability test and direct recommendations from the mathematics teacher.

The research instruments utilized consisted of two main types: test instruments and interview guidelines. The test comprised three essay questions specifically designed to measure mathematical literacy indicators (formulating, employing, and interpreting) laden with Sasak ethnomathematics. Specifically, the first question addressed the area of the *Peresean* arena (geometry material), the second question explored the rhythmic patterns of the *Gendang Beleq* musical instrument (Least Common Multiple and number patterns material), and the third question examined material efficiency and pricing in the production of *Kain Songket* (social arithmetic material). Prior to field implementation, all instruments were subjected to expert validation to ensure the appropriateness of the content, language, and instrument readability.

The data collection procedures began with the administration of the written test to all students in the sample class. Subsequently, the written works of the six selected subjects were analyzed in depth. After the written test phase was completed, the researcher conducted task-based interviews to confirm the thinking processes behind the participants' written responses. This interview technique was applied to extract cognitive information that was not apparent on the answer sheets, such as the rational arguments behind the selection of mathematical formulas or the doubts experienced by the subjects during problem-solving. All interview sessions were audio-recorded and transcribed verbatim for further analysis.

Data analysis was performed applying the interactive model developed by Miles, Huberman, and Saldaña, which included three main stages: data reduction, data display, and conclusion drawing. Data reduction was conducted by selecting, focusing, and abstracting the students' answers that were relevant to the mathematical literacy indicators. Data display was presented through descriptive narratives comparing the subjects' work across the different ability levels. Finally, conclusion drawing was carried out to address the research focus regarding the profile of students' mathematical literacy skills. To ensure data validity, method triangulation was conducted by cross-verifying the consistency among the written test results, the interview transcripts, and the researcher's field notes.

RESULT AND DISCUSSION

This section details the empirical findings regarding the profile of students' mathematical literacy skills in class VIII-B at MTsN 2 Mataram in solving contextual problems based on Sasak ethnomathematics. The initial data recapitulation from 21 students indicated a varied distribution of abilities: 10 students were in the low-ability category, 7 in the moderate-ability category, and 4 in the high-ability category. An in-depth analysis was subsequently focused on three representative subjects to describe the processes of mathematization, interpretation, and cognitive conclusions at each ability level.

Mathematical Literacy Profile of the High-Ability Subject (ST)

Subject ST demonstrated a highly mature mastery of mathematical literacy across all three indicators of the PISA framework. At the formulating stage for the *Peresean* arena problem (Question 1), ST exhibited sharp abstraction skills. Relevant information from the cultural narrative was successfully extracted, specifically identifying the diameter ($d = 14\ m$) and the distance between spectators ($0.5\ m$). The physical reality of the arena was accurately transformed into a formal geometric model using the circle circumference formula ($C = \pi \times d$).

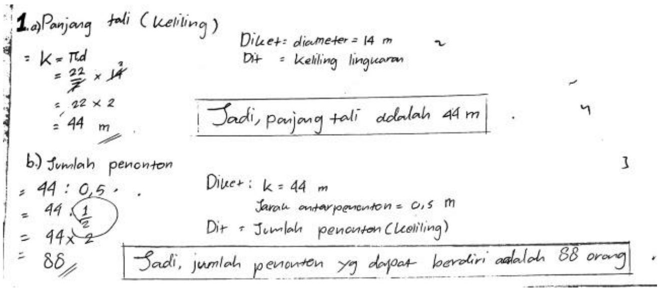

Figure 1. ST's Test Result for Question 1

At the employing stage, ST's procedural fluency was highly optimal. Substituting the values into the formula yielded a circumference of 44 meters, which was then divided by 0.5 without any operational difficulties regarding decimal numbers to find a capacity of 88 spectators. Similar analytical excellence was evident in the *Gendang Beleq* problem (Question 2). The initiative to convert the duration unit from 3 minutes to 180 seconds was taken independently, followed by the precise application of the Least Common Multiple (LCM) concept to obtain a 12-second interval.

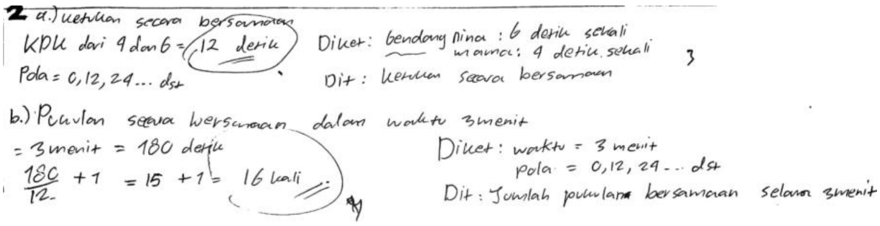

Figure 2. ST's Test Result for Question 2

High-level critical reasoning was demonstrated by ST at the interpreting stage when evaluating mathematical realities. For the *Peresean* problem, ST refuted their own mathematical assumptions by arguing that in the real world, *Peresean* arenas are rarely precise circles and spectators tend to crowd together. Similarly, in the *Kain Songket* problem (Question 3), the accurate execution of multi-step multiplication resulted in a total cost of IDR 952,000, which was interpreted as a logical nominal value within the economic context of traditional weavers.

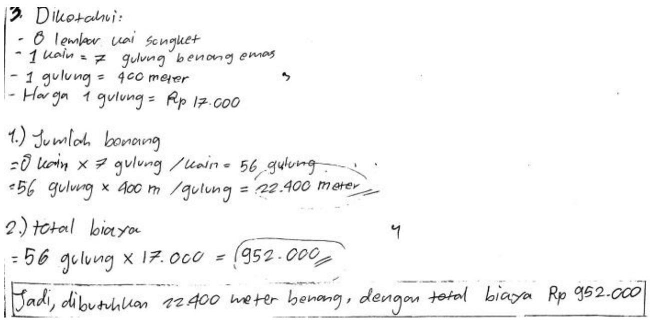

Figure 3. ST's Test Result for Question 3

The experimental conclusion for Subject ST indicates that students in the high-ability category have comprehensively achieved a functional level of mathematical literacy, where cultural elements are seamlessly processed as critical mathematical thinking instruments.

Mathematical Literacy Profile of the Moderate-Ability Subject (SS)

Subject SS possessed adequate procedural capacity but experienced significant weaknesses in mathematical conceptualization. At the formulating stage of the *Peresean* problem, the symbolic modeling utilized was arbitrary. Variables were represented with random alphabets, such as "let the diameter be A, and the distance between spectators be B." This indicates that these variables were merely mechanical labels rather than representations of the arena's physical quantities.

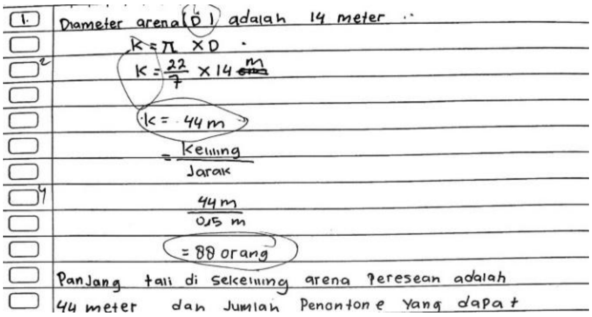

Figure 4. SS's Test Result for Question 1

At the employing stage, SS's computational operations successfully obtained the figure of 88 people. However, empirical evidence from the interview tracking revealed operational doubts ("multiplied and then divided, I think") as well as psychological barriers toward decimal numbers ("dizzy because there are commas"). For the *Gendang Beleq* problem, the ability to identify beat intervals and calculate the LCM was performed accurately.

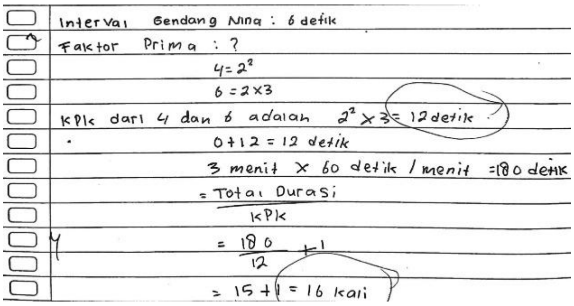

Figure 5. SS's Test Result for Question 2

An in-depth interpretation of these achievements indicates that SS's success was not based on independent cognitive construction. The admission that the LCM strategy was the result of algorithmic memorization from worksheets and the internet confirms that SS's literacy skills were trapped in the phenomenon of "procedural imitation." At the interpreting stage of the *Peresean* problem, the attitude displayed tended to be superficial. The situation was considered illogical purely because it was "complicated to calculate," rather than through an evaluation of the phenomenon's congruence with real life.

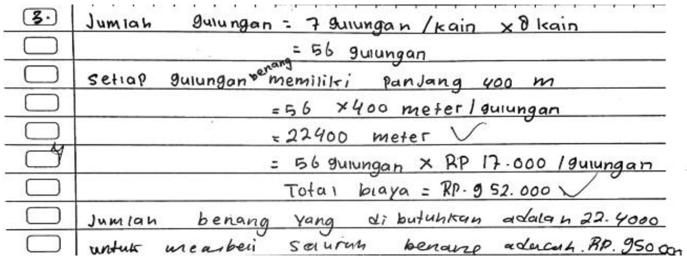

Figure 6. SS's Test Result for Question 3

The conclusion for Subject SS is that students in the moderate category tend to focus on executing procedural computations (meaningless computation) without a deep understanding of the cultural context or the physical reality of the presented problems.

Mathematical Literacy Profile of the Low-Ability Subject (SR)

Subject SR exhibited severe cognitive deficits and epistemological obstacles across all stages of problem-solving. At the formulating stage of the *Peresean* problem, a cognitive impasse (blank) occurred. The action taken was merely copying numbers from the narrative text without any ability to transform them into any mathematical structure or model.

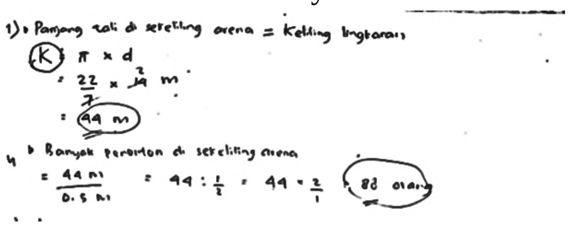

Figure 7. SR's Test Result for Question 1

At the employing stage, the use of the circle circumference formula coincidentally yielded a result of 44 meters. Interview interpretation revealed that SR's argumentation was circular and relied on blind memorization ("if I use another formula, the result won't fit"). This conceptual breakdown was clearly validated in the *Gendang Beleq* instrument, where SR completely failed to identify the LCM concept and instead experienced a fundamental terminological misconception by using the term "factorial."

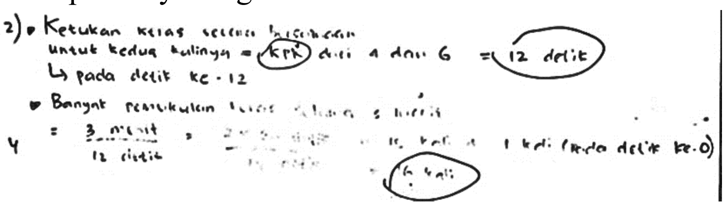

Figure 8. SR's Test Result for Question 2

The most fatal logical error was executed in the *Kain Songket* problem. Instead of multiplying the number of yarn rolls by the price per roll, SR multiplied the entire total length of the yarn (22,400 meters) by the unit price of IDR 17,000. This operation resulted in an irrational cost of IDR 380,800,000.

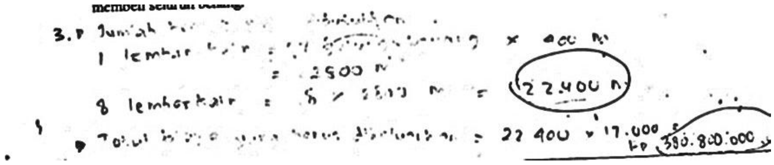

Figure 9. SR's Test Result for Question 3

This failure at the interpreting stage confirms the absence of number sense. The reality that a cost of hundreds of millions of rupiahs to weave a small-scale cloth is an absolute impossibility was completely unrealized by the subject. The numerical output from the mathematical calculations had no rational connection to real-world reality. The analytical conclusion for Subject SR indicates that students with low basic abilities experience systemic failures starting from the horizontal mathematization stage, rendering the complex Sasak cultural narrative not as cognitive scaffolding, but as a cognitive load that triggers a chain of errors.

This study maps the profile of students' mathematical literacy within the Sasak cultural context, revealing a sharp cognitive disparity. Success is highly determined by effectiveness at the formulating stage, aligning with the OECD (2019) framework. High-ability subjects (ST) demonstrated fluency in horizontal mathematization translating real-world problems into mathematical symbols allowing subsequent steps to proceed coherently. This proves that students with established cognitive structures can utilize cultural elements as effective thinking tools.

Conversely, the failures of moderate (SS) and low-ability (SR) subjects reflect procedural imitation. As Ojose (2011) argued, memorizing algorithms without understanding leads to meaningless computation. For instance, SR's logical error calculating hundreds of millions of rupiahs to weave a small cloth exhibits a severe lack of number sense and a disconnection between formal school mathematics and everyday common sense. This corroborates Fardian et al. (2025) concerns regarding systemic issues in Indonesian education, where students excel in mechanistic calculations but struggle with logical deduction in contextual scenarios.

While ethnomathematics serves as cognitive scaffolding by reducing students' psychological distance from mathematics (Harding, 2021), this study reveals a crucial paradox: cultural familiarity does not guarantee analytical success. For low-achieving students, integrating complex cultural contexts risks creating an extraneous cognitive load (Knight & Galletly, 2020). The simultaneous burden of interpreting lengthy cultural narratives and executing mathematical procedures ultimately overloads their working memory capacity.

These findings explain the persistently low reasoning skills highlighted in the 2022 PISA results for Indonesia (Lewalter et al., 2023) and align with Wirawan et al. (2024), who noted that ethnomathematics effectiveness depends on students' conceptual readiness. The novelty of this research lies in proving that integrating Sasak culture is only effective when accompanied by explicit mathematization assistance. Without mastering basic concepts, the cultural context merely serves as window dressing that does not substantially aid the problem-solving process.

Consequently, this study emphasizes the necessity of differentiated instruction in local wisdom-based curricula. Teachers must provide tiered support tailored to each student's Zone of Proximal Development rather than merely presenting contextual problems. Future research should focus on developing structured Sasak ethnomathematics modules that incrementally train mathematization skills. Furthermore, longitudinal studies are needed to determine if sustained exposure to culture-based problems can permanently enhance students' number sense and mathematical literacy.

CONCLUSION

This study concludes that students' mathematical literacy in solving Sasak culture-based contextual problems is highly dependent on their cognitive readiness. High-ability students successfully achieve functional literacy, proficiently formulating, employing, and interpreting cultural phenomena into mathematical models. Conversely, moderate- and low-ability students struggle with procedural imitation and epistemological obstacles. For these students, complex cultural narratives create an extraneous cognitive load that hinders the horizontal mathematization process rather than assisting it.

The implication of these findings is that ethnomathematics should not be viewed as an instant solution for low literacy. Instead, local wisdom must be strategically integrated as cognitive scaffolding within a differentiated learning framework. Educators must proactively design contextual assessments tailored to students' Zone of Proximal Development, providing explicit guidance for low-achieving students to effectively bridge concrete cultural contexts with formal mathematical abstraction.

This study is limited by its small sample size at a single institution and its narrow focus on three specific Sasak cultural artifacts *(Peresean, Gendang Beleq, and Kain Songket).* Additionally, the cross-sectional design prevents the measurement of long-term impacts. Therefore, future longitudinal studies involving larger, more representative samples and diverse ethnomathematical modules are highly recommended to further generalize and enrich the literature on culture-based mathematics education.

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