

Mathematical literacy levels in a social context: A sociomathematical analysis of eighth-grade middle school students

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Abstract

Mathematical literacy is recognized as a critical skill in facing the challenges of modern life, and a deep understanding of mathematical literacy at the junior high school level is important to form the basis of mathematical skills that are sustainable and relevant to students' social lives. This research aims to analyze the level of mathematical literacy of class VIII SMP students in a social context using a sociomathematical approach. This research uses descriptive research with a qualitative approach involving interviews, observations, questionnaires, and tests. The sampling technique for this research was purposive sampling with a total of 31 students divided into three main groups (high, medium, and low). Apart from that, the maximum variation sampling technique was also applied to ensure variations in student characteristics, so that the data obtained could describe the phenomenon comprehensively until it reached data saturation. Data analysis in this research uses the Miles and Huberman Model technique. The results of this research reveal that mathematical literacy and socio-mathematical norms support each other in creating meaningful learning. However, the gap between students with high, medium, and low mathematical literacy indicates the need for more inclusive and adaptive learning strategies to ensure that all students can develop optimally.

Keywords: Mathematical Literacy, Social Context, Sociomathematical Norms, Eighth-Grade Middle School Students, Mathematics Learning

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INTRODUCTION

Mathematical literacy is widely recognized as a crucial competency for navigating complex modern life, achieving academic success, and preparing individuals to actively participate in a technology- and data-driven society. According to the National Council of Teachers of Mathematics (NCTM), mathematical literacy encompasses not only the

mastery of mathematical concepts but also the ability to reason, model, communicate, and solve problems using mathematical representations in meaningful contexts (NCTM, 2000). Similarly, the Organisation for Economic Co-operation and Development (OECD), through the Programme for International Student Assessment (PISA), emphasizes that mathematical literacy is strongly associated with both individual life opportunities and a nation's social and economic well-being (OECD, 2023). These perspectives highlight the importance of developing mathematical literacy from early stages of formal education, including at the junior high school level.

At the individual level, mathematical literacy contributes significantly to personal empowerment and informed decision-making. Mathematical literacy enables students to interpret data, evaluate quantitative information, and apply mathematical reasoning in real-life situations. Empirical evidence suggests that students with higher levels of mathematical literacy demonstrate greater independence in making data-based decisions (Inayah et al., 2024). Moreover, mathematical literacy is not limited to procedural knowledge but involves the capacity to apply mathematical understanding in authentic contexts (Cahyani et al., 2022). Research has also shown that contextual and meaningful mathematics learning can enhance students' motivation and conceptual understanding (Annisa et al., 2023; Izah & Auliya, 2023; Mega & Faisal Madani, 2023; Silvi & Auliya, 2022). Consequently, integrating real-life and social contexts into mathematics instruction may increase students' engagement and interest in learning mathematics (Auliya, 2019; Hanik et al., 2024; Muhammad & Juandi, 2023). In addition, Umam et al. (2024) demonstrated that the implementation of Problem-Based Learning (PBL) supported by mathematics comic media in Grade VIII junior high school significantly improved students' mathematical problem-solving skills, reinforcing the role of contextual and engaging instructional approaches in supporting mathematical literacy.

Mathematical literacy further plays an essential role in developing problem-solving skills that are required in both everyday life and future professional environments. Martin (2000) found that individuals with strong mathematical literacy are more capable of solving complex problems and making well-reasoned decisions. In addition, mathematical literacy is closely linked to economic empowerment, as it enables individuals to recognize the role of mathematics in real-world contexts and supports access to diverse career opportunities (Baiduri, 2019; Lim et al., 2023; Sopandi et al.,

2024). Developing mathematical literacy at the junior high school level is therefore critical, as this stage forms a foundational period for students' future academic, social, and economic trajectories.

Junior high school, particularly Grade VIII, represents a pivotal stage in students' mathematical development. PISA results underline the importance of this level in building competencies required for higher education and lifelong learning (OECD, 2023), while NCTM emphasizes that mathematics instruction should be developmentally appropriate and responsive to students' cognitive and social characteristics (NCTM, 2000). For instance, Jannah et al. (2022) examined the mathematical literacy profiles of junior high school students in solving word problems based on their mathematics achievement levels and found notable differences in students' abilities to understand problems, apply strategies, and interpret solutions. These findings indicate that students' mathematical literacy varies significantly and is influenced by both cognitive and instructional factors.

Recent studies have also highlighted disparities in students' mathematical literacy levels, often influenced by social and economic factors. Budiasti et al. (2024) demonstrated that socioeconomic background plays a significant role in shaping inequalities in mathematics achievement. Similarly, inclusive mathematics education research emphasizes the need to accommodate diverse learning styles, cultural backgrounds, and ability levels to ensure equitable learning opportunities (Lumbantoruan, 2024; Rismen et al., 2022). However, while existing studies have examined mathematical literacy and contextual learning separately, limited research has explicitly explored mathematical literacy through a sociomathematical lens at the junior high school level, particularly for Grade VIII students.

Sociomathematical analysis offers a theoretical and analytical framework that emphasizes the interaction between social context and mathematics learning. This approach views mathematics not merely as abstract knowledge taught in classrooms, but as a socially constructed practice shaped by classroom norms, interactions, and cultural values (Chorney et al., 2024; Kang & Kim, 2016; Lim et al., 2023). Grounded in socioconstructivist theory, sociomathematical analysis highlights how sociomathematical norms such as what counts as a valid solution, explanation, or justification emerge through classroom discourse and influence students' understanding

of mathematics (Sulfikawati et al., 2016). Despite its potential, sociomathematical analysis has not been sufficiently utilized to examine students' mathematical literacy levels, particularly in the context of junior high school mathematics learning.

In this study, mathematical literacy is operationally defined as students' ability to formulate, apply, and interpret mathematics in various real-life contexts, including understanding problems, using appropriate mathematical concepts and procedures, reasoning logically, and communicating solutions effectively. This operational definition aligns with the PISA framework and provides a clear basis for empirical measurement in this research.

Based on the state of the art, the identified research gap lies in the lack of empirical studies that integrate mathematical literacy assessment with sociomathematical analysis at the Grade VIII junior high school level. Existing research has largely focused either on measuring mathematical literacy outcomes or on examining social aspects of mathematics learning, without systematically linking the two.

Building upon this theoretical foundation, the present study aims to examine the levels of mathematical literacy among grade VIII junior high school students through a sociomathematical lens. The focus is on understanding how social contexts and classroom norms shape students' mathematical literacy development. The research explores how social interaction patterns in classroom discussions contribute to the formation of sociomathematical norms, which in turn influence students' ability to apply mathematical knowledge to real-life contexts.

Through this research, the study contributes theoretically by integrating sociomathematical perspectives into the concept of mathematical literacy, thereby expanding its analytical scope. Practically, it offers insights for educators to design mathematics learning that is socially contextual, inclusive, and engaging for students. Methodologically, it contributes a framework for exploring sociomathematical interactions in classroom environments. The novelty of this study lies in its combination of mathematical literacy assessment with sociomathematical analysis, which has been rarely explored in prior research, particularly at the junior high school level in the Indonesian context.

To connect this introduction to the methodological section, this study employs a descriptive design involving grade VIII students. The research instruments consist of

mathematical literacy tests and classroom observation protocols designed to capture both cognitive and sociomathematical aspects of students' learning experiences.

METHODS

The participants of this study were 31 eighth-grade students from the selected junior high school. The sampling technique used was purposive sampling, in which three focal research subjects were deliberately chosen to represent high, medium, and low levels of mathematical literacy. In addition, maximum variation sampling was applied to ensure that the collected data reflected differences in students' characteristics, including socioeconomic background, academic achievement, and gender (Agustianti et al., 2022; Anjarwati et al., 2024). Although the total number of participants was fixed, data collection continued until the information obtained was considered sufficient and no new relevant insights emerged, ensuring the adequacy of the data for in-depth qualitative analysis (Miles et al., 2014).

After that, the data was analyzed using the Miles and Huberman Model technique. According to Miles et al. (2014), activities in qualitative data analysis are conducted interactively and continuously until completion, consisting of data reduction, data display, and conclusion drawing or verification. To ensure the credibility of the findings, data validation was performed through three types of triangulation: source triangulation, technique triangulation, and time triangulation (Margono, 2010; Moleong & Surjaman, 1989; Satori & Komariah, 2011; Sugiyono, 2008).

RESULT AND DISCUSSION

Results

[Table 1](#) presents the classification of the mathematical literacy levels of the three students selected as research subjects based on the results of the mathematical literacy test. Student A represents the high category (T), Student B the medium category (S), and Student C the low category (R). This classification was used to determine representative subjects for further qualitative analysis.

Table 1. Division of Mathematical Literacy Categories

No	Student Name	Mathematical Literacy Category
1	Student A	High (T)
2	Student B	Medium (S)
3	Student C	Low (R)

Mathematical Literacy Results

Mathematical literacy results were obtained through a test measuring students' ability to understand, interpret, and apply mathematical concepts in real-life contexts. The results show that most students were in the medium category, with 21 of 31 students, while 3 students were classified as having high mathematical literacy, and 7 students were in the low category. Based on these classifications, students' mathematical literacy levels were grouped into high, medium, and low categories as presented in [Table 2](#).

Table 2. Mathematical Literacy Test Results

Categories	High	Medium	Low
	$Value \geq \bar{X} + SD$	$\bar{X} - SD \leq Value < \bar{X} + SD$	$Value < \bar{X} - SD$
Amount	3	21	7
Total	31		

Sociomathematical Results

Sociomathematical norms were examined using a questionnaire that measured students' participation, communication, and agreement in solving mathematical problems within a social context. The results indicate that most students were in the medium category (23 students), while 6 students demonstrated high sociomathematical norms, and only 2 students were categorized as low. The distribution of students' sociomathematical norm levels is presented in [Table 3](#).

Table 3. Sociomathematical Norms Questionnaire Results

Categories	High	Medium	Low
	$Value \geq \bar{X} + SD$	$\bar{X} - SD \leq Value < \bar{X} + SD$	$Value < \bar{X} - SD$
Amount	6	23	2
Total	31		

Calculation Results of Mathematical Literacy Tests and Sociomathematical Norm Likert Scales

Based on the results of the socio-mathematical norms questionnaire, which can be seen in [Figure 1](#), the total score obtained by all students was 1.839. When compared with the assessment scale, this score was in the "good" category, where the "very good" score was 2.480, "good" was 1.860, "fairly good" was 1.240, and "poor" was 620. With a score of 1.839 out of an ideal total of 2.480, the student achieved approximately 74,19% of the maximum score, indicating the norm sociomathematics is very good.

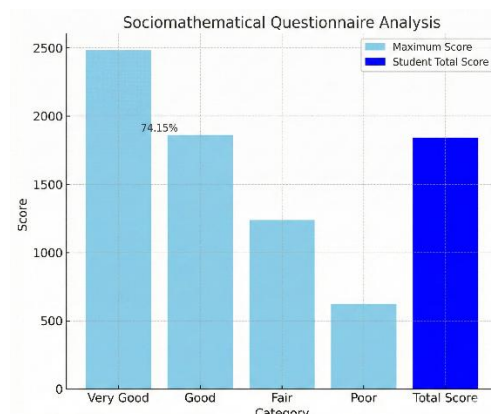


Figure 1. Sociomathematical Norms Questionnaire Analysis

Based on [Figure 1](#), the total sociomathematical score reached 1.850, equivalent to 74,15% of the maximum score, placing students in the “Good” category. This result indicates that most students have developed adequate sociomathematical awareness, such as the ability to participate in mathematical discussions, respect peers’ reasoning, and justify their answers appropriately. However, the gap between the maximum and obtained scores shows that these norms are not yet fully internalized by all students. Some students remain less active or struggle to connect mathematical ideas with social contexts. Therefore, while the sociomathematical environment in the class can be considered positive, further reinforcement is needed to ensure that all students engage equally in collaborative reasoning and reflective mathematical dialogue.

Based on the results of the mathematical literacy test, as seen in [Figure 2](#), the total score obtained by all students was 1.324. When compared to the assessment scale, this score falls into the “poor” category, where “very good” is 3.100, “good” is 2.480, “fair” is 1.860, and “poor” is 620. This score of 1.324 represents 42,71% of the maximum score, indicating very good mathematical literacy.

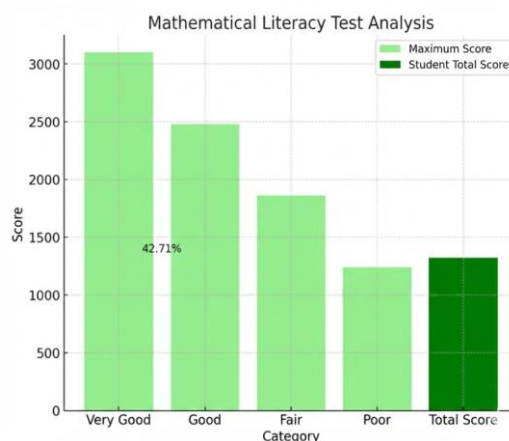


Figure 2. Analysis of Mathematical Literacy Tests

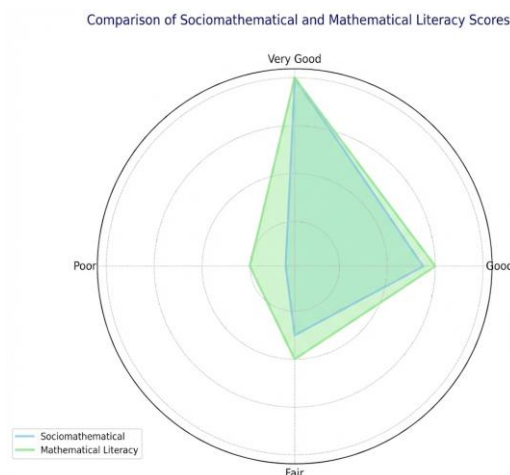


Figure 3. Comparison of Sociomathematical and Mathematical Literacy Scores

These results indicate that most students still face difficulties in understanding and applying mathematical concepts in everyday life. While these results do not categorize students as "poor," there is an urgent need to improve students' mathematical literacy skills through more effective learning approaches and additional support in the classroom, so that students can achieve better results in the future.

The radar chart in [Figure 3](#) depicts student achievement in two main aspects, namely socio-mathematical norms (blue area) and mathematical literacy (green area). The larger blue area indicates that the student's application of sociomathematical norms is in the "Good" category, with some approaching "Fairly Good". This indicates that the majority of students have adequate abilities in interacting, working together, and discussing in a mathematical context. However, students' scores did not reach the optimal level in the "Excellent" category, indicating that there is still room for improvement, especially in strengthening mathematical collaboration and communication.

On the other hand, the green area representing mathematical literacy shows a smaller score than the blue area. This indicates that students' mathematical literacy abilities tend to be lower, especially in the "Very Good" and "Good" categories. This lower distribution indicates that students face greater challenges in understanding and applying complex mathematical concepts. The need for more focused learning strategies and appropriate interventions is important to help students improve their mathematical literacy, especially in the higher categories.

Results of Observation and Interview Analysis

[Table 4](#) presents the results of observation and interview analysis of students with high, medium, and low mathematical literacy. This analysis focuses on student

collaboration in groups, problem-solving strategies, understanding of story problems, and understanding of statistical concepts. The results showed a clear difference between the three categories, where students in the high category showed active participation and structured strategies, while students in the medium and low categories tended to be more passive and had greater difficulty in understanding and applying mathematical concepts.

Table 4. Results of Observation and Interview Analysis

Theme	High Category	Medium Category	Low Category
Collaboration in Groups	Active, helps friends, confident, and discusses to understand the material.	Tends to be passive, listens more often, and is afraid of making mistakes when speaking.	Difficult to work in groups, prefer to be alone, and feel left behind in discussions.
Mathematical Problem Solving	Structured strategies, try to understand the questions, and discuss with friends or teachers if you experience difficulties.	Try yourself first, but often rely on friends when experiencing difficulties.	Don't have a clear strategy, get confused, and tend to give up if you don't understand the question.
Understanding Story Problems	Comfortable, able to relate questions to real situations, especially statistical material.	Having difficulty connecting problem information with the correct mathematical formula.	Very difficult, confused by the information in the story questions, and often doesn't do the questions.
Understanding Statistical Concepts	Confident enough, able to read and analyze data in tables or graphs with consistent practice.	Still confused about reading graphs or tables, need further guidance.	Great difficulty, tends to avoid statistical questions, not confident in reading data.

Data Validation

[Table 5](#) presents the results of data validation using triangulation of interviews, tests, questionnaires, and observations. The findings show consistent patterns across data sources for students in the high, medium, and low categories. Students in the high category showed strong math literacy and sociomath skills in all instruments, while students in the medium category showed moderate abilities with some limitations in participation and problem-solving. In contrast, students in the low category consistently showed difficulties in math literacy and social interaction, which confirms the consistency and credibility of the research findings.

Table 5. Data Validation

Research Subjects	Interview Findings	Mathematical Literacy Test Results	Sociomathematical Norms Questionnaire Results	Observation Results	Conclusion
T (High Category)	Active in discussions, helping friends, able to relate problems to real life, using various strategies.	High scores, especially on story problems and problem solving.	Very good, actively collaborate with high social skills.	Often actively involved, helps friends, contributes to discussions, and is collaborative.	Have high mathematical literacy and social skills, consistent with all findings.
S (Medium Category)	Often listens, not always active, has difficulty connecting problem information with formulas, and lacks self-confidence.	Medium scores indicate difficulty in word problems and problem-solving.	Good, but participation in discussions is not optimal.	Tends to listen, rarely contributes actively, and more often becomes a listener.	Mathematics ability and collaboration skills are moderate, according to test and questionnaire results.
R (Low Category)	Difficulty in group work, prefers to work alone, is confused by word problems, and often does not solve problems.	Low scores, especially on story problems and statistics.	Not well, difficulty in collaboration and social interaction.	Passive in discussions, prefers to work alone, confused in group discussions.	Mathematical literacy and social skills were low, consistent with all findings.

DISCUSSION

This research shows that the level of mathematical literacy of class VIII students at MTs Manbaul Huda Grobogan varies, with the majority in the medium category, and emphasizes the importance of socio-mathematical norms in supporting collaboration to strengthen mathematical understanding based on real-life contexts. The following is a discussion of the findings obtained.

Mathematical Literacy Level

The research results show that the level of mathematical literacy of students at MTs Manbaul Huda Grobogan varies, with 3 students in the high category, 21 students in the medium category, and 7 students in the low category. High category students can understand and solve context-based questions with structured strategies, such as reading questions carefully, identifying important information, and verifying answers. They can relate story problems to everyday situations because the context of the questions is relevant to their experience, reflecting comprehensive mathematical literacy. In contrast, students in the medium category show sufficient basic understanding but have difficulty dealing with questions with higher complexity, such as data analysis and advanced reasoning. They tend to depend on the help of teachers or friends, so they need a more personalized learning approach to improve their abilities.

Low category students face significant difficulties in understanding and solving social context-based questions, especially those involving tables and graphs. They are often confused about what the questions ask for, feel less confident, and are passive in class discussions. Observations show that these obstacles are cognitive and affective, so they require special approaches such as individual mentoring and simple context-based learning methods. With appropriate intervention, low category students are expected to increase their mathematical literacy and confidence in learning mathematics.

These findings are consistent with previous studies indicating that students often struggle to connect mathematical concepts with real-life contexts. For instance, Samosir et al. (2024) found that junior high school students tend to face difficulties in interpreting contextual and story-based problems, which limits their reasoning ability. Similarly, (Sopandi et al., 2024) emphasized that limited conceptual understanding and procedural dependence contribute to low mathematical literacy performance. On the other hand, Hanik et al. (2024) and (Annisa et al., 2023) demonstrated that contextual and socially relevant learning approaches can enhance students' mathematical literacy by increasing engagement and meaningful understanding. Thus, the current study supports previous evidence that students' literacy levels are not only determined by cognitive skills but also by how learning environments integrate real-life and social contexts into mathematical problem solving.

Application of Sociomathematical Norms

The application of socio-mathematical norms at MTs Manbaul Huda Grobogan shows significant differences between students with different mathematical literacy abilities. High category students are active in discussions, often become leaders, and make meaningful contributions, which shows excellent application of sociomathematical norms. On the other hand, students in the middle category tend to be more passive, even though they try to participate in the discussion. Lack of self-confidence and dependence on dominant friends are the main challenges for them. Meanwhile, low category students show minimal involvement in discussions due to a weak understanding of mathematics and feeling inferior, so they prefer to observe or work alone.

Efforts to increase sociomathematical norms can be carried out through inclusive and personal strategies. For medium category students, giving them special roles in discussions and communication exercises can help them be more confident. Low category students need intensive guidance, such as mentoring before discussions and assignments tailored to their abilities, to increase participation and self-confidence. Overall, the application of socio-mathematical norms is strongly influenced by students' mathematical understanding and self-confidence, so an integrated approach is needed to ensure all students can develop optimally.

These findings are in line with (Kang & Kim, 2016), who emphasized that sociomathematical norms are more effectively developed among students with higher mathematical confidence and conceptual understanding. Similarly, Lim et al., (2023) found that the establishment of such norms depends greatly on teacher facilitation to balance participation between dominant and passive students. This study's results also support the view of (Sulfikawati et al., 2016) that sociomathematical norms not only shape collaborative behavior but also reveal potential learning inequalities within the classroom. However, unlike Chorney et al. (2024), who observed a more balanced participation pattern in their context, this study found that social dominance and confidence levels still strongly influence the dynamics of discussion. Therefore, teacher intervention and equitable learning design remain essential in fostering inclusive sociomathematical interactions among students.

The Relationship between Mathematical Literacy and Sociomathematical Norms

This research shows a close relationship between mathematical literacy and socio-mathematical norms in mathematics learning. Students with high mathematical literacy are better able to apply sociomathematical norms effectively, such as actively contributing to discussions, leading groups, and providing logical explanations and validating solutions. In contrast, students in the middle category tend to be passive, dependent on more dominant friends, even though they understand the importance of collaboration. Low category students show minimal social involvement due to weak mathematical understanding, which makes them tend to be confused and more comfortable working individually. This relationship confirms that strong mathematical understanding supports meaningful social interactions in learning.

Learning approaches that integrate mathematical literacy and sociomathematical norms are essential to support the development of all students. Social context-based strategies can increase the relevance of mathematical concepts and encourage active collaboration. Students with low literacy require intensive guidance, such as additional practice and personal mentoring, to overcome barriers to understanding and begin to engage in sociomathematical norms. With an inclusive and adaptive approach, mathematical literacy and sociomathematical norms can reinforce each other, creating a supportive learning environment for all students.

These findings are consistent with the results of (Chorney et al., 2024), who found that students' reasoning and communication practices develop more effectively when sociomathematical norms are established through active classroom dialogue. Similarly, Yenmez & Erbaş (2022) emphasized that mathematical literacy is strengthened when students are encouraged to construct and justify ideas collaboratively within social learning environments. In contrast, (Kang & Kim, 2016) observed that in less interactive classrooms, sociomathematical norms tend to remain underdeveloped, leading to lower literacy outcomes. The current study supports these perspectives by demonstrating that students' mathematical literacy and sociomathematical behavior are mutually reinforcing. This confirms that literacy development is not only a cognitive process but also a social and communicative one, dependent on how students engage in reasoning and collective problem solving.

Supporting and Inhibiting Factors

The social context-based approach applied by teachers is the main factor in supporting students' mathematical literacy and socio-mathematical norms. Learning that links mathematical concepts with real situations, such as story problems that are relevant to everyday life, motivates students to think critically and understand the material in depth. Teachers who facilitate group discussions and provide space for students to share ideas also strengthen the application of sociomathematical norms. This approach encourages students to participate more actively, both in expressing opinions and listening to and respecting the opinions of friends.

However, lack of self-confidence in medium and low category students is the main obstacle to optimal achievement. They tend to be passive in discussions and have difficulty understanding questions based on social context, especially those involving data or statistics. To overcome this obstacle, teachers need to provide additional guidance, create an inclusive classroom atmosphere, and build students' sense of responsibility through specific roles in groups. Techniques such as providing constructive feedback, encouraging questions, and simple exercises can increase students' self-confidence and their engagement in learning. With more attention to student needs, these barriers can be overcome to support better learning outcomes.

These findings are consistent with Rismen et al. (2022), who emphasized that differences in learning styles and student confidence levels significantly affect mathematical literacy performance. Similarly, (Lumbantoruan, 2024) highlighted the importance of differentiated and inclusive learning designs that accommodate diverse abilities and social backgrounds to enhance participation. The current study supports these perspectives by showing that confidence and classroom inclusivity are key determinants in developing sociomathematical engagement. On the other hand, as Lim et al. (2023) suggested, the absence of consistent teacher mediation may hinder the establishment of equitable sociomathematical interactions. Thus, empowering teachers to implement adaptive strategies and fostering supportive peer collaboration are essential for sustaining both mathematical literacy and sociomathematical norms.

Pedagogical Implications

This research shows that social context-based mathematics learning is effective in increasing students' mathematical literacy while strengthening the application of socio-

mathematical norms in the classroom. Teachers are advised to use this approach by connecting mathematical concepts with real-life situations through relevant story-based problems, such as simple statistics or economics problems. This authentic approach helps students understand the application of mathematics in everyday life and improves their analytical and practical problem-solving skills.

Learning that emphasizes social interaction and collaboration is also important for developing sociomathematical norms. Teachers can design group discussions with structured roles so that students actively participate, improve mathematical communication, and respect each other's opinions. For students with low mathematical literacy, intensive guidance is needed through adaptive teaching, such as one-on-one or small group teaching, as well as providing positive feedback. With inclusive strategies and appropriate attention, social context-based learning can support the development of all students, both in mathematical literacy and socio-mathematical norms.

These pedagogical implications are supported by findings from (Hanik et al., 2024) and Annisa et al. (2023), who emphasized that integrating cultural and social contexts into mathematics lessons increases students' engagement and deepens conceptual understanding. Similarly, Chorney et al. (2024) and Yenmez & Erbaş (2022) found that when teachers intentionally establish sociomathematical norms through structured collaboration, students demonstrate stronger reasoning and communication skills. The current study reinforces these perspectives by highlighting that contextual, socially oriented instruction not only enhances mathematical literacy but also cultivates a classroom culture of dialogue, respect, and shared problem solving. Therefore, teachers play a crucial role as facilitators who bridge mathematical content with students' social realities to achieve more inclusive and meaningful learning outcomes.

CONCLUSION

This research analyzes the level of mathematical literacy of class VIII students at MTs Manbaul Huda Grobogan in the social context and the application of socio-mathematical norms during mathematics learning. The results show that students' mathematical literacy varies between high, medium, and low categories, with the majority being in the medium category. Students with high literacy are more active and able to apply concepts in the real world and socio-mathematical norms effectively, while low category students experience significant difficulties. This research also confirms the

strong relationship between mathematical literacy and socio-mathematical norms in creating meaningful learning, although there are opinions among students that more inclusive learning strategies are needed. Research limitations include a small sample size, focus on one class, and a cross-sectional design, so the results cannot be generalized. Further research is recommended involving broader samples, longitudinal designs, and innovative experimental learning models to understand the development of mathematical literacy and sociomathematical norms more comprehensively.

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AUTHOR CONTRIBUTIONS

The following are the contributions made by each author in this study:

First Author: Conceptualization, writing - original draft, editing, and visualization;

Second Author: Writing - review & editing, formal analysis, and methodology;

Third Author: Validation and supervision.

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