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Ethnomathematics-Based Contextual Learning to Improve Students' Mathematical Reasoning Ability

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ABSTRACT

Mathematical reasoning is a key component of mathematics learning because it enables students to develop logical, critical, and systematic thinking. However, students' reasoning ability often remains underdeveloped when instruction focuses mainly on procedures and provides limited opportunities to connect mathematical concepts with real-life contexts. This study examined the improvement of students' mathematical reasoning ability through ethnomathematics-based contextual learning. A quantitative pre-experimental design with a one-group pretest-posttest model was employed. The participants were fifth-grade students at SDN 002 Campalagian in the 2025/2026 academic year. Data were collected using an essay-based mathematical reasoning test and an observation sheet of students' learning activities. The data were analyzed using descriptive statistics, N-Gain analysis, and a paired-sample t-test. The findings showed that students' mathematical reasoning ability improved after the implementation of ethnomathematics-based contextual learning. The N-Gain results indicated a moderate to high level of improvement, and the paired-sample t-test showed a statistically significant difference between the pretest and posttest scores. Observation data also indicated that students were actively engaged during the learning process. These findings suggest that ethnomathematics-based contextual learning can support the development of students' mathematical reasoning ability by linking mathematical ideas to meaningful cultural and real-life contexts. This approach can be considered an alternative instructional strategy for promoting more meaningful mathematics learning in elementary classrooms.

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Introduction

Mathematics education plays a strategic role in developing students' higher-order thinking skills, particularly mathematical reasoning. At the global level, mathematical reasoning is widely recognized as an important indicator of educational quality because it enables students to analyze problems, construct logical arguments, and make justified decisions in mathematical contexts. Reports from the Programme for International Student Assessment (PISA), administered by the OECD, indicate that students' mathematical literacy in many countries continues to face serious challenges, particularly in reasoning and problem-solving (Kusmaryono & Kusumaningsih, 2023; Oktiningrum & Hartono, 2016; Ozkale & Ozdemir Erdogan, 2020). Recent PISA results show that many students remain at low to moderate proficiency levels, suggesting that they have not yet developed the ability to use mathematical reasoning effectively in solving contextual problems (Ismawati et al., 2023; OECD, 2023). This condition indicates that mathematics instruction in many educational contexts still tends to emphasize procedures and memorization rather than conceptual understanding and reasoning.

At the national level, similar problems are evident in educational assessment results in Indonesia. PISA results show that Indonesian students' mathematics performance remains below the international average, particularly in tasks that require reasoning, interpretation, and context-based problem-solving (Chen, 2022; OECD, 2023). In addition, the results of the National Assessment indicate that many students experience difficulties in solving numeracy literacy tasks, especially those that require them to connect mathematical concepts with real-life situations (Analisa et al., 2026; Sikko, 2023; Silitonga et al., 2022; Soraya & Pamungkas, 2024). These findings suggest that mathematics learning in Indonesia has not fully supported the development of students' higher-order thinking skills, particularly mathematical reasoning.

This problem was also found at the elementary school level. Preliminary observations conducted at SDN 002 Campalagian showed that students' mathematical reasoning ability was still relatively low. This condition was reflected in several indicators. Students had difficulty formulating conjectures in response to mathematical problems, providing logical reasons or justifications for their answers, and drawing conclusions from the problem-solving process. In addition, when students were given context-based problems, most of them tended to imitate examples provided by the teacher without understanding the meaning of the problems.

The observations also showed that the learning process was still dominated by conventional teacher-centered instruction. Teachers mostly explained the material directly, while students acted as passive recipients of information. Classroom interaction was limited, and students had few opportunities to discuss, ask questions, and develop their ideas. Learning materials were also often presented abstractly without sufficient connection to students' real-life experiences. As a result, students found it difficult to develop a deep understanding of mathematical concepts. This condition affected their engagement in learning. Students tended to be less active, less confident in expressing their ideas, and less motivated to solve problems that required higher-order thinking. These findings indicate that the mathematics learning process had not yet provided meaningful learning experiences for students.

In response to this problem, instructional innovation is needed to support the development of students' mathematical reasoning ability. One relevant approach is Contextual Teaching and Learning, which emphasizes the connection between learning materials and students' real-life contexts. Through this approach, students are expected to develop a more meaningful understanding of mathematical concepts because the concepts are linked to their everyday experiences (Marfu, 2022; Ramadhani et al., 2025).

However, in the Indonesian context, which is characterized by cultural diversity, contextual learning needs to be enriched with an approach that accommodates local cultural

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values. Therefore, the integration of ethnomathematics becomes important in mathematics learning. Ethnomathematics connects mathematical concepts with cultural practices in community life. By integrating local culture into instruction, students can learn mathematics through familiar contexts, making learning more relevant and engaging. Various cultural objects can be used as mathematics learning resources, such as traditional foods with three-dimensional shapes, patterns in crafts, and traditional building structures. The use of cultural contexts not only helps students understand mathematical concepts more concretely but also fosters awareness and appreciation of local culture (Annajmi et al., 2026; Ramadhani et al., 2025; Suherman & Vidákovich, 2025).

Previous studies have shown that contextual learning has a positive influence on students' mathematical abilities (Annajmi et al., 2026; Firdaus et al., 2021; Khaerani et al., 2024). Students who learn through contextual approaches tend to demonstrate better problem-solving and reasoning abilities than those who learn through conventional methods. Other studies have also shown that contextual learning can improve students' learning activities and motivation. In addition, studies on ethnomathematics have reported its contribution to improving the quality of mathematics learning. The integration of culture into mathematics instruction can enhance conceptual understanding and make learning more engaging and meaningful. Ethnomathematics can also bridge the gap between formal school mathematics and students' real-life experiences (Abi, 2016; Ascher, 1988; Cimen, 2014).

Nevertheless, most previous studies have examined contextual learning and ethnomathematics separately. Studies that integrate these two approaches remain limited, particularly those that specifically examine their role in supporting students' mathematical reasoning ability. In addition, existing studies have tended to focus on general learning outcomes rather than mathematical reasoning in depth. Furthermore, the cultural contexts used in previous studies are often general and have not sufficiently explored the specific potential of local culture. In fact, each region has unique cultural characteristics that can serve as contextual learning resources. Therefore, the limited exploration of local culture in mathematics learning represents an important research gap.

The novelty of this study lies in the integration of contextual learning and ethnomathematics into a systematic local culture-based instructional design aimed at improving students' mathematical reasoning ability. This approach is grounded in constructivist theory, which emphasizes that knowledge is constructed through meaningful learning experiences. Contextual learning theory supports the view that learning becomes more meaningful when it is connected to students' real lives, while ethnomathematics provides a foundation for understanding that mathematics is closely related to culture. By integrating these perspectives, the learning process is expected to create more meaningful experiences, increase student engagement, and support the development of mathematical reasoning. The use of local cultural contexts also adds value to this study by providing authentic and relevant learning experiences for elementary school students.

Based on this background, this study aims to analyze the implementation of ethnomathematics-based contextual learning in improving students' mathematical reasoning ability at SDN 002 Campalagian. Specifically, this study aims to: (1) examine the improvement in students' mathematical reasoning ability after the implementation of ethnomathematics-based contextual learning; and (2) describe students' learning activities and responses during the implementation of this approach. This study is expected to contribute to the development of more innovative, contextual, and local culture-based mathematics learning and to provide an alternative instructional approach for addressing students' low mathematical reasoning ability in elementary schools.

Method

Types of Research

This study employed a quantitative approach with a pre-experimental research design. This type of research was selected because the study did not involve a control group and did not apply full randomization of participants. Therefore, only one group was involved as the research subject. The research design used in this study was the one-group pretest-posttest design. In this design, one group received a treatment in the form of ethnomathematics-based contextual learning. Before the treatment was implemented, students were given a pretest to determine their initial mathematical reasoning ability. After that, students participated in the treatment, and at the end of the learning process, they were given a posttest to determine the improvement in their mathematical reasoning ability after the treatment. The research design is presented in the Table 1.

Table 1. One-Group Pretest-Posttest Design

Pretest	Treatment	Posttest
O_1	X (Ethnomathematics-Based Contextual Learning)	O_2

This design was used to examine the improvement in students' mathematical reasoning ability before and after the treatment. By comparing the pretest and posttest results, the researchers could identify changes or improvements in students' ability as a result of the implemented learning approach. Although this design did not include a comparison group, it still provided empirical evidence regarding the effectiveness of the implemented learning approach in an authentic classroom context. Therefore, the findings of this study are expected to provide preliminary evidence of the influence of ethnomathematics-based contextual learning on students' mathematical reasoning ability.

Participants

The population of this study consisted of all students at SDN 002 Campalagian in the 2025/2026 academic year. This population included students from different grade levels within the same school system, with relatively homogeneous characteristics in terms of curriculum, learning environment, and sociocultural background. The sample was selected using purposive sampling, namely the selection of research participants based on specific considerations relevant to the purpose of the study. Based on these considerations, the selected sample consisted of fifth-grade students at SDN 002 Campalagian in the 2025/2026 academic year. The selection of fifth-grade students as the sample was based on several academic considerations. First, at this level, students have acquired sufficient basic mathematical conceptual understanding, which enables them to develop mathematical reasoning ability more optimally. Second, fifth-grade students are generally at the stage of cognitive development from concrete operational thinking toward formal operational thinking, which is characterized by the emerging ability to think logically, connect concepts, and draw simple conclusions. Third, mathematics topics in Grade 5 begin to require higher-order thinking skills, particularly in understanding relationships among concepts and solving context-based problems. In addition, preliminary observations showed that fifth-grade students had several characteristics relevant to the purpose of this study, including low ability to provide logical reasons, draw conclusions, and solve contextual problems independently. These considerations made Grade 5 an appropriate subject for implementing ethnomathematics-based contextual learning.

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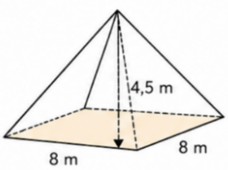
Instruments

Research instruments are tools used to collect data needed to answer the research questions. In this study, the main instrument was a mathematical reasoning ability test designed in the form of essay questions. In addition, a supporting instrument in the form of an observation sheet was used to collect data on students' activities during the learning process.

Mathematical Reasoning Ability Test

The mathematical reasoning ability test was used to measure students' ability to formulate conjectures, construct arguments, perform mathematical manipulation, and draw conclusions in solving problems (Fatmahanik, 2021; Marfu, 2022). This test was administered in two stages: a pretest to measure students' initial ability and a posttest to measure the improvement in their ability after the treatment. The test was designed in the form of essay questions to explore students' thinking and mathematical reasoning processes in greater depth. The test instrument used in this study is presented in the Table 2.

Table 2. Description of Test Items

No.	Item	Item Characteristics
1	Observe the Mandar woven motif often used in the traditional Lipa' Sa'be cloth.  a. If one basic motif, as shown in the picture, has a length of 6 cm and the motif is arranged repeatedly 7 times in sequence, what is the total length of the motif arrangement? b. Explain how you found your answer.	This item is based on the Mandar woven motif, Lipa' Sa'be, which contains a repeated pattern. Students are asked to: 1. identify the relationship between one motif and the total arrangement; 2. generalize the pattern through repeated multiplication; and 3. explain their thinking process. This item is semi-conceptual because students do not only use arithmetic operations, particularly multiplication, but also need to understand the concept of repeated patterns.
2	The Mandar community has a traditional house called Boyang. The roof of Boyang is shaped like a square pyramid.   The picture above shows the roof of Boyang. a. If the side length of the base of the Boyang roof is 8 m and the height of the roof is 4.5 m, what is the total surface area of the roof? Remember that only the roof is calculated, not the base or floor. b. Explain the steps of your solution.	This item uses the context of the Boyang traditional house, whose roof is in the form of a square pyramid. Students are asked to: 1. identify the three-dimensional shape; 2. use the formula for the surface area of a pyramid; and 3. explain the steps of their solution. This item is conceptual-procedural because students need to understand the geometry concept and apply the relevant formula.
3	In the Mappande Sasi traditional ceremony, the Mandar community prepares offerings in the form of songkol, shaped like small cone-shaped rice arrangements, arranged	This item is based on the Mappande Sasi tradition involving layered songkol arrangements. Students are asked to:

No.	Item	Item Characteristics
	in levels as shown in the illustration below.  a. If the songkol arrangement consists of 4 levels as shown in the picture, how many songkol are there in total? b. If the same arrangement is made 3 times for three different tables, how many songkol are needed in total? c. Explain how you found your answer.	1. determine the total number based on a layered pattern; 2. develop an addition strategy; and 3. generalize the result to a different condition. This item is a light non-routine problem because it does not directly require the use of a single formula but requires pattern understanding.

Observation Sheet

The observation sheet was used as a supporting instrument to observe students' activities during the learning process. Observation was conducted to obtain data on students' engagement in ethnomathematics-based contextual learning. The observed aspects included: (1) active participation in learning, (2) ability to express opinions, (3) involvement in group discussions, and (4) seriousness in completing tasks.

Research Procedures

The data collection procedure in this study was carried out systematically through several stages designed to obtain valid and relevant data in accordance with the research objectives. These stages consisted of the preparation stage, implementation stage, and final stage. The data collection procedure was conducted through three stages: preparation, implementation, and finalization. These stages were designed to obtain valid, relevant, and appropriate data, particularly in measuring students' mathematical reasoning ability through ethnomathematics-based contextual learning. In the preparation stage, the researchers carried out several initial activities to support the implementation of the study. This stage began with preliminary observations at SDN 002 Campalagian to identify learning problems, especially those related to students' mathematical reasoning ability. The researchers then developed learning materials in the form of lesson plans based on contextual learning integrated with ethnomathematics. The researchers also developed research instruments, including a mathematical reasoning ability test and an observation sheet of students' learning activities. The instruments were then validated through expert judgment by mathematics education experts. In addition, the researchers coordinated with the school and classroom teacher to ensure the readiness of classroom implementation.

The implementation stage was the main stage in the data collection process. At this stage, students were first given a pretest to measure their initial mathematical reasoning ability before the treatment was implemented. After that, students participated in learning activities using the ethnomathematics-based contextual approach. The learning activities were conducted over several meetings by connecting mathematical concepts with local cultural contexts that were close to students' lives. During the learning process, the researchers observed students' activities using the prepared observation sheet. This observation aimed to collect data on students' engagement, active participation, and responses during learning. After the entire learning sequence had been completed, students were given a posttest to measure their mathematical reasoning ability after receiving the treatment.

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In the final stage, the researchers collected all data obtained from the pretest, posttest, and observation of students' activities. The data were then classified according to their types and sources to facilitate data processing. Furthermore, the researchers processed and analyzed the data using the predetermined data analysis techniques. The analysis results were used to determine changes in students' mathematical reasoning ability after the implementation of ethnomathematics-based contextual learning. Based on these results, the researchers drew conclusions in accordance with the objectives and focus of the study.

Data Analysis

Data analysis in this study aimed to determine the improvement in students' mathematical reasoning ability after the implementation of ethnomathematics-based contextual learning. The analyzed data included pretest scores, posttest scores, and observations of students' activities during the learning process. Data analysis was conducted using descriptive analysis, normality testing, paired-sample t-test, effect size calculation, N-Gain analysis, and descriptive analysis of students' activities. Descriptive analysis was used to describe students' mathematical reasoning ability before and after the treatment. The data were analyzed by calculating the number of students, mean score, standard deviation, minimum score, and maximum score. This analysis was used to examine changes in students' mathematical reasoning achievement from pretest to posttest. Before conducting the mean difference test, a normality test was first performed on the difference scores between the posttest and pretest. The normality test was conducted using the Shapiro-Wilk test because the sample size in this study was fewer than 50 students. The data were considered normally distributed if the significance value was greater than 0.05. If the difference scores were normally distributed, the analysis proceeded using a paired-sample t-test. The paired-sample t-test was used to determine whether there was a significant difference between students' mathematical reasoning ability before and after the implementation of ethnomathematics-based contextual learning. The decision criterion was that if the significance value was less than 0.05, there was a significant difference between the pretest and posttest scores. Conversely, if the significance value was greater than 0.05, there was no significant difference between the pretest and posttest scores.

In addition to significance testing, this study also calculated the effect size to determine the magnitude of the improvement in students' mathematical reasoning ability after the treatment. Effect size was used to examine the practical meaning of the difference between pretest and posttest scores. Thus, the findings were not interpreted only based on whether a statistically significant difference existed, but also based on the magnitude of the improvement. The improvement in students' mathematical reasoning ability was also analyzed using N-Gain. N-Gain analysis was used to determine the level of improvement in students' ability after participating in the learning process. The N-Gain scores were then classified into three categories: high, moderate, and low. A high category was assigned when $g \geq 0.70$, a moderate category when $0.30 \leq g < 0.70$, and a low category when $g < 0.30$. Observation data on students' activities were analyzed using quantitative descriptive analysis by calculating the percentage of activity for each observed aspect. The observed aspects included active participation in discussions, ability to express opinions, group collaboration, and ability to complete tasks. The percentage results were then categorized into very active, active, moderately active, less active, and inactive categories.

Research Findings

This section presents data on students' mathematical reasoning ability before and after the implementation of ethnomathematics-based contextual learning. The data were obtained from pretest scores, posttest scores, and observations of students' activities during the learning process. The analysis included descriptive statistics, normality testing, paired-sample t-test, effect size calculation, N-Gain analysis, and analysis of students' learning activities.

Descriptive Analysis Results

Descriptive analysis was used to describe students' mathematical reasoning ability before and after the treatment. The results of the descriptive analysis are presented in Table 3.

Table 3. Descriptive Statistics of Pretest and Posttest Scores

Statistic	Pretest	Posttest
Number of Students	25	25
Mean Score	56.40	82.16
Standard Deviation	8.52	6.75
Minimum Score	40	70
Maximum Score	75	95

Based on Table 3, the mean score of students' mathematical reasoning ability increased from 56.40 in the pretest to 82.16 in the posttest. The mean difference between the posttest and pretest scores was 25.76 points. This increase indicates a change in students' mathematical reasoning achievement after participating in ethnomathematics-based contextual learning. The minimum score increased from 40 to 70, while the maximum score increased from 75 to 95. These findings show that both the lowest and highest student achievements improved after the treatment.

Normality Test Results

Before hypothesis testing was conducted, a normality test was first performed on the difference scores between the posttest and pretest. The Shapiro-Wilk test was used because the sample size was fewer than 50 students. The results of the normality test are presented in Table 4.

Table 4. Normality Test Results for Posttest-Pretest Difference Scores

Data	Shapiro-Wilk	Sig.
Posttest-pretest difference scores	0.956	0.347

Based on Table 4, the Shapiro-Wilk normality test for the posttest-pretest difference scores produced a significance value of 0.347. This value is greater than 0.05, indicating that the difference scores were normally distributed. Therefore, the mean difference test could be conducted using a paired-sample t-test.

Paired-Sample t-Test Results

The paired-sample t-test was used to determine whether there was a significant difference in students' mathematical reasoning ability before and after the implementation of ethnomathematics-based contextual learning. The results of the paired-sample t-test are presented in Table 5.

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Table 5. Paired-Sample t-Test Results

Data Pair	Mean Difference	Std. Deviation	t	df	Sig.
Posttest-pretest	25.76	9.20	14.00	24	p < .05

Based on Table 5, the paired-sample t-test produced a t-value of 14.00 with df = 24 and a significance value of p < .05. These results indicate a significant difference between the pretest and posttest scores. The mean posttest score was higher than the mean pretest score, with a mean difference of 25.76 points. Thus, students' mathematical reasoning ability increased significantly after the implementation of ethnomathematics-based contextual learning.

Effect Size

In addition to testing the significance of the difference, this study calculated the effect size to determine the magnitude of the improvement in students' mathematical reasoning ability after the treatment. The effect size calculation is presented in Table 6.

Table 6. Effect Size Results

Data	Effect Size	Category
Posttest-pretest	2.80	Large

Based on Table 6, the effect size was 2.80, which falls into the large category. This result indicates that the improvement in students' mathematical reasoning ability was not only statistically significant but also had strong practical significance in the learning process.

Improvement in Mathematical Reasoning Ability Based on N-Gain

The improvement in students' mathematical reasoning ability was also analyzed using N-Gain. This analysis was used to determine the category of improvement after students participated in the learning process. The mean N-Gain is presented in Table 7.

Table 7. Mean N-Gain of Mathematical Reasoning Ability

Data	Mean N-Gain	Category
Pretest-posttest	0.59	Moderate

Based on Table 7, the mean N-Gain score of students' mathematical reasoning ability was 0.59, which falls into the moderate category. This result indicates that the improvement in students' mathematical reasoning ability after participating in ethnomathematics-based contextual learning was at a moderate level. The distribution of students' N-Gain categories is presented in Table 8.

Table 8. N-Gain Categories of Mathematical Reasoning Ability

N-Gain Range	Category	Number of Students	Percentage
$g \geq 0.70$	High	10	40%
$0.30 \leq g < 0.70$	Moderate	15	60%
$g < 0.30$	Low	0	0%
Total		25	100%

Based on Table 8, 10 students, or 40%, were in the high improvement category, while 15 students, or 60%, were in the moderate improvement category. No students were in the low improvement category. These results show that all students experienced improvement in mathematical reasoning ability within the moderate and high categories.

Observation Results of Students' Learning Activities

Observations of students' learning activities were conducted during the learning process. These observations aimed to determine students' engagement in ethnomathematics-based contextual learning. The results are presented in Table 9.

Table 9. Percentage of Students' Learning Activities

Activity Aspect	Percentage	Category
Active participation in discussions	80%	Active
Expressing opinions	75%	Active
Group collaboration	82%	Very active
Completing tasks	78%	Active
Mean	78.75%	Active

Based on Table 9, the mean percentage of students' learning activities during the learning process was 78.75%, which falls into the active category. Group collaboration obtained the highest percentage, namely 82%, and was categorized as very active. Meanwhile, expressing opinions obtained the lowest percentage, namely 75%, but remained in the active category. These results indicate that students were actively engaged in ethnomathematics-based contextual learning. The criteria for students' activity categories are presented in Table 10.

Table 10. Criteria for Students' Learning Activity Categories

Percentage	Category
81%–100%	Very active
61%–80%	Active
41%–60%	Moderately active
21%–40%	Less active
0%–20%	Inactive

Based on the overall analysis, students' mathematical reasoning ability improved after the implementation of ethnomathematics-based contextual learning. This improvement was reflected in the increase in the mean score from pretest to posttest, the significant paired-sample t-test result, the large effect size, and the moderate N-Gain score. In addition, students' learning activities were categorized as active. These findings suggest that ethnomathematics-based contextual learning supported the improvement of students' mathematical reasoning ability and their engagement in the mathematics learning process.

Discussion

The improvement in students' mathematical reasoning ability in this study cannot be separated from the characteristics of learning that position real-life experience as the starting point for knowledge construction. Ethnomathematics-based contextual learning enables students to construct understanding through the interaction between mathematical concepts and familiar realities. In such situations, thinking processes are no longer merely mechanistic but develop through activities of connecting, interpreting, and reflecting on learning experiences. This is consistent with the constructivist view, which positions students as active subjects in constructing knowledge through meaningful experiences (Marfu, 2022).

Cognitively, the connection between cultural contexts and mathematical concepts provides a strong foundation for the development of reasoning. When students are presented with problems rooted in local culture, they tend to find it easier to identify patterns, understand relationships, and develop solution strategies. Cultural contexts serve as a bridge between abstract concepts and concrete experiences, allowing the process of abstraction to occur more

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naturally. In this condition, mathematical reasoning does not emerge merely as a final outcome but develops as part of an integrated thinking process (Annajmi et al., 2026; Suherman & Vidákovich, 2025).

The contextual approach in mathematics learning emphasizes the importance of connecting knowledge with its use in real-life situations. The findings of this study show that when mathematical concepts were presented in relevant contexts, students tended to be more active in exploring ideas and testing their understanding (Abi, 2016; Khaerani et al., 2024; Taufik & Gazali, 2024). Activities such as expressing opinions, discussing strategies, and evaluating solutions became important parts of the learning process. These activities contributed directly to the development of reasoning ability because students were encouraged not only to obtain answers but also to understand the reasons behind those answers.

On the other hand, the integration of ethnomathematics provided an additional dimension that enriched students' learning experiences. Mathematics was no longer viewed as a discipline separated from social life but as part of cultural practices embedded in society. Through this approach, students were able to see that mathematical concepts have real representations in various cultural activities (Adam, 2010; Bimantara, 2024; Nwigwe, 2026). This not only enhanced conceptual understanding but also developed students' awareness that mathematics has broad relevance in everyday life. Thus, learning became more meaningful and contextual.

Viewed from the perspective of previous research, the findings of this study are consistent with studies that emphasize the role of contextual learning in improving higher-order thinking skills. Learning that connects concepts with real-life situations can encourage students to think more deeply and reflectively. Similarly, studies in ethnomathematics have shown that integrating culture into learning can improve students' motivation and the quality of their understanding. However, most previous studies have positioned contextual learning and ethnomathematics separately, so the contribution of each approach has not been fully integrated into a coherent learning framework.

In this context, the present study contributes by showing that the integration of contextual learning and ethnomathematics can provide a more comprehensive support system for developing mathematical reasoning. The combination of real-life contexts and cultural values creates a learning environment that is cognitively relevant and socially meaningful. Students do not merely learn to understand concepts, but also connect them with their lived experiences and cultural environment. Thus, learning does not stop at knowledge transfer but develops into a broader process of meaning construction (Cimen, 2014; Taufik & Gazali, 2024). The findings also show that the improvement in mathematical reasoning ability was closely related to students' increased engagement in the learning process. This engagement was reflected in discussion activities, group interaction, and students' confidence in expressing opinions. From the perspective of social learning theory, this type of interaction plays an important role in cognitive development. Through interaction, students have opportunities to compare ideas, test arguments, and revise their understanding. This process indirectly strengthens reasoning ability because students are trained to justify their thinking logically.

In addition, learning based on cultural contexts also influenced students' affective aspects. The connection between learning materials and local culture created emotional closeness that could increase students' learning motivation (Cimen, 2014). Students tended to be more enthusiastic in participating in learning because they felt that the material was relevant to their lives (Abi, 2016; Firdaus et al., 2021; Rosyida & Bahtiar, 2024). This motivation became an important supporting factor in the success of learning because it influenced the intensity and quality of students' engagement. From a pedagogical perspective, the findings of this study indicate the need for a paradigm shift in mathematics learning. Instruction that has tended to focus on procedures and final answers needs to be redirected toward thinking processes and conceptual understanding. Teachers need to develop instructional strategies that connect mathematical concepts with real-life contexts and students' cultural experiences. In this way, learning does not only focus on cognitive achievement but also develops students' critical and reflective thinking skills (Rosalina et al., 2023; Susanti et al., 2024; Sutamrin & Khadijah, 2021).

Although the study produced positive findings, it has several limitations. The scope of the study was limited to one group of students, so the findings cannot be generalized broadly. In addition, the cultural contexts used in the learning process were still limited and therefore did not fully represent the broader potential of ethnomathematics. Future studies should involve broader samples and more diverse cultural contexts. Overall, ethnomathematics-based contextual learning shows strong potential for supporting the development of students' mathematical reasoning ability. The integration of real-life contexts and local culture not only enriches learning experiences but also strengthens the process of knowledge construction. These findings affirm that meaningful mathematics learning should connect abstract concepts with students' lived realities, allowing the knowledge they acquire to be used flexibly in various situations.

Conclusion

The implementation of ethnomathematics-based contextual learning showed considerable potential in promoting the development of students' mathematical reasoning. The learning process, which connected mathematical concepts with real-life experiences and local cultural contexts, helped students construct understanding in a more meaningful way. Students were not only able to solve problems procedurally but also showed improvement in providing reasons, identifying patterns, and drawing logical conclusions. This indicates that learning designed contextually and rooted in culture provides broader opportunities for the development of higher-order thinking skills.

In addition, students' active engagement during the learning process was one of the factors that strengthened this improvement. Learning activities that provided opportunities for discussion, argumentation, and idea exploration encouraged students to engage both cognitively and socially. This condition shows that effective mathematics learning is determined not only by the content delivered but also by how learning experiences are designed to be relevant to students' lives.

Conceptually, this study contributes to strengthening the integration of contextual learning and ethnomathematics as an instructional strategy that focuses not only on learning outcomes but also on thinking processes. The findings enrich the field of mathematics education by showing that mathematical reasoning can be developed from the elementary school level through contextual and culture-based approaches. Thus, mathematics learning can be directed to become more meaningful, relevant, and closely connected to students' lives.

However, this study has several limitations. The research was limited to one group of students, so the generalization of the findings should be made with caution. In addition, the cultural contexts used in this study were still limited and therefore did not fully represent the potential of ethnomathematics across broader cultural settings.

Based on these limitations, future studies are recommended to involve larger and more diverse samples and to develop richer variations of cultural contexts. The use of stronger research designs may also provide a more comprehensive understanding of the effectiveness of the learning approach. Furthermore, the systematic development of ethnomathematics-based

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learning materials is important to support more optimal implementation across different levels of education.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

All authors have read and approved the final version of this manuscript. N.S. contributed to formulating the research idea, designing the study, developing the instruments, and conducting field data collection. S. contributed to developing the theoretical framework, preparing the research methodology, and analyzing the data. M.A. contributed to interpreting the research findings, writing the manuscript, and editing and refining the article. All authors actively participated in discussing the research findings and approved the final version of the article for publication. The total contribution percentages for conceptualization, implementation, analysis, and manuscript writing were as follows: N.S.: 34%, S.: 33%, and M.A.: 33%.

Data Availability Statement

The authors declare that data sharing is not possible, as no new data was created or analyzed in this study.

References

Abi, A. M. (2016). Integrasi Etnomatematika Dalam Kurikulum Matematika Sekolah. *Jurnal Pendidikan Matematika Indonesia*, 1–6. https://doi.org/2477-5967

Adam, N. A. (2010). Mutual interrogation: A methodological process in ethnomathematical research. *Procedia - Social and Behavioral Sciences*, *8*, 700–707. https://doi.org/10.1016/j.sbspro.2010.12.097

Analisa, W., Harefa, P., Lase, S., Mendrofa, R. N., & Telaumbanua, Y. N. (2026). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Literasi Numerasi Matematika Siswa SMP Negeri 2 Sogaeadu. *VENN: Journal of Sustainable Innovation on Education, Mathematics and Natural Sciences*, 96–107. https://doi.org/10.53696/venn.v5i1.423

Annajmi, A., Kuswandi, D., Setyosari, P., & Praherdhiono, H. (2026). Integrating multiple representations and local cultural contexts into problem-based learning within a flipped classroom: A new framework for mathematics education. *Social Sciences and Humanities Open*, *13*. https://doi.org/10.1016/j.ssaho.2026.102797

Ascher, M. (1988). Graphs in cultures: A study in ethnomathematics. *Historia Mathematica*, *15*(3), 201–227. https://doi.org/10.1016/0315-0860(88)90062-6

Bimantara, A. R. (2024). Peran Etnomatematika Dalam Pembelajaran Matematika. *INNOVATIVE: Journal Of Social Science Research*, *4*, 1252–1258. https://doi.org/10.31004/innovative.v4i1.7712

Chen, Y. (2022). Measurement, Evaluation, and Model Construction of Mathematical Literacy Based on IoT and PISA. *Mathematical Problems in Engineering*, *2022*. https://doi.org/10.1155/2022/3278401

Cimen, O. A. (2014). Discussing Ethnomathematics: Is Mathematics Culturally Dependent? *Procedia - Social and Behavioral Sciences*, *152*, 523–528. https://doi.org/10.1016/j.sbspro.2014.09.215

Fatmahanik, U. (2021). Penalaran Spasial Geometri Ruang Mahasiswa Calon Guru MI/SD Berkemampuan Awal Tinggi Berdasarkan Gender. *BRILIANT: Jurnal Riset Dan Konseptual*, *6*(3). https://doi.org/10.28926/briliant

Firdaus, A., Asikin, M., Waluya, B., & Zaenuri, Z. (2021). Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Matematika Siswa. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *13*(2), 187–200. https://doi.org/10.37680/qalamuna.v13i2.871

Ismawati, E., Hersulastuti, Amertawengrum, I. P., & Anindita, K. A. (2023). Portrait of Education in Indonesia: Learning from PISA Results 2015 to Present. *International Journal of Learning, Teaching and Educational Research*, *22*(1), 321–340. https://doi.org/10.26803/ijlter.22.1.18

Khaerani, K., Arismunandar, & Tolla, I. (2024). The role of ethnomathematics in improving the quality of mathematics learning: literature review. *Indonesian Journal of Intellectual Publication*, (5), 20–26. https://doi.org/2774-1915

Kusmaryono, I., & Kusumaningsih, W. (2023). Evaluating the Results of PISA Assessment: Are There Gaps Between the Teaching of Mathematical Literacy at Schools and in PISA Assessment? *European Journal of Educational Research*, *12*(3), 1479–1493. https://doi.org/10.12973/eu-jer.12.3.1479

Marfu, S. (2022). Model Pembelajaran Matematika untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Prosiding Seminar Nasional Matematika*, *5*, 50–54. https://journal.unnes.ac.id/sju/index.php/prisma/

Nwigwe, E. O. (2026). Understanding Place-based education in Nigeria: A structured narrative review of its status, barriers, and African comparative insights. In *Social Sciences and Humanities Open* (Vol. 13). Elsevier Ltd. https://doi.org/10.1016/j.ssaho.2025.102409

OECD. (2023). *PISA 2022 Results (Volume I) : The State of Learning and Equity in Education*. OECD. https://doi.org/10.1787/53f23881-en

Oktiningrum, W., & Hartono, Y. (2016). Developing pisa-like mathematics task with indonesia natural and cultural heritage as context to assess students mathematical literacy. *Journal on Mathematics Education*, *7*(1), 1–10. https://doi.org/10.22342/jme.7.1.2812.1-8

Ozkale, A., & Ozdemir Erdogan, E. (2020). An analysis of the interaction between mathematical literacy and financial literacy in PISA*. *International Journal of Mathematical Education in Science and Technology*. https://doi.org/10.1080/0020739X.2020.1842526

Ramadhani, R., Soeharto, S., Arifiyanti, F., Prahmana, R. C. I., Saleh, A., & Lavicza, Z. (2025). Assessing quality and biases in ethnomathematics-based numeracy worksheets: A Many-Facet Rasch Model analysis. *Social Sciences and Humanities Open*, *12*. https://doi.org/10.1016/j.ssaho.2025.101736

Rosalina, M. D., Daniela Iman, P., & Anggraini, V. R. (2023). Pengaruh Kemampuan Literasi Digital Terhadap Kemampuan Berpikir Kritis Siswa SD Kelas VI. *Jurnal Riset Teknologi Dan Inovasi Pendidikan*, *6*(1), 1–10. https://doi.org/https://journal.rekarta.co.id/index.php/jartika

Rosyida, L., & Bahtiar, M. D. (2024). Pengaruh kecerdasan emosional, self confidence, dan literasi digital terhadap kemampuan berpikir kritis siswa kelas X akuntansi SMK negeri 4 surabaya. *Jurnal Pendidikan Ekonomi (JURKAMI)*, *9*(2), 382–395. https://doi.org/10.31932/jpe.v9i2.3603

Sikko, S. A. (2023). What Can We Learn from the Different Understandings of Mathematical Literacy? *Numeracy*, *16*(1). https://doi.org/10.5038/1936-4660.16.1.1410

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.5005 Volume 6, No 2, April - June 2026, pp. 552 – 567

Silitonga, E. A., Simajuntak, M. R., & Sipayung, T. N. (2022). Pelatihan Peningkatan Kemampuan Literasi-Numerasi Siswa Sekolah Dasar Sebagai Implementasi Kegiatan Program Kampus Mengajar Angkatan 3. *Madaniya*. https://doi.org/10.53696/27214834.255

Soraya, R., & Pamungkas, A. (2024). Training on Strengthening Literacy and Numeracy in the Learning Process For Teachers of SD Negeri 04 Kelapa Tujuh North Lampung. *Jurnal Pengabdian Masyarakat Bidang Eksakta*, *5*, 2024–2025. https://doi.org/10.37638/PadamuNegeri.5.1.607

Suherman, S., & Vidákovich, T. (2025). Ethnomathematical test for mathematical creative thinking. *Journal of Creativity*, *35*(2). https://doi.org/10.1016/j.yjoc.2025.100099

Susanti, Zainal, A., & Mirna. (2024). Analisis berpikir kritis matematis siswa smp/mts melalui penerapan strategi scaffolding. *Journal Mathematics Education Sigma [JMES]*. https://doi.org/10.30596/jmes.v5i2.19619

Sutamrin, & Khadijah. (2021). Analisis Kemampuan Berpikir Kritis dalam Project Based Learning Aljabar Elementer. *Jurnal Ilmiah Pendidikan Matematika*, 28–41. https://doi.org/10.46918/equals.v4i1.892

Taufik, A., & Gazali, M. (2024). the effectiveness of ethnomathematics in improving the mathematical reasoning ability of elementary school students class v in math lesson. *Numbers : Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, 66–73. https://doi.org/https://mathedu.joln.my.id/index.php/edu/article/view/58

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