Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

April 2026. Vol. 14, No. 2
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 448-461

Impact of Ethnomathematics-Based Learning on Mbojo Students' Mathematical Communication Skills in Indonesia

[1]*Mariamah, [2]Nanang Diana, [3]Adi Apriadi Adiansha, [4]Muslim, [5]Khusnul Khatimah
[1,2,4] Master's Program in Pedagogy, STKIP Taman Siswa Bima, Indonesia
[3] Primary School Teacher Education, STKIP Taman Siswa Bima, Indonesia
[5] Mathematics Education, STKIP Taman Siswa Bima, Indonesia
*Corresponding Author e-mail: mariamahmariamah85@yahoo.co.id

Received: March 2026; Revised: April 2026; Published: April 2026

Abstract

Mathematical communication skills are essential for enabling students to express mathematical ideas, use representations, and explain reasoning clearly. However, elementary students often experience difficulties in using mathematical symbols, interpreting visual representations, and presenting problem-solving steps systematically. This study examined students' mathematical communication skills after the implementation of ethnomathematics-based learning using Mbojo cultural contexts. A quasi-experimental method with a one-group posttest-only design was employed. The participants were 15 fourth-grade students selected through total sampling. Data were collected using a mathematical communication skills test and analyzed using a one-sample t-test with a benchmark score of 70, based on the Minimum Mastery Criteria. The results showed that students' mean score was 73.87, which was significantly higher than the benchmark, $t(14) = 2.822$, $p = .015$. These findings indicate that ethnomathematics-based learning using Mbojo cultural contexts can support students' mathematical communication skills. However, due to the absence of a pretest and control group, the findings should be interpreted as evidence of students' achievement above the benchmark rather than strong causal evidence.

Keywords: Ethnomathematics; Mathematical communication; Elementary school students; Mbojo culture; Mathematics learning

How to Cite: Mariamah, M., Diana, N., Adiansha, A. A., Muslim, M., & Khatimah, K. (2026). Impact of Ethnomathematics-Based Learning on Mbojo Students' Mathematical Communication Skills in Indonesia. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *14*(2), 448–461. https://doi.org/10.33394/j-ps.v14i2.19875

https://doi.org/10.33394/j-ps.v14i2.19875

INTRODUCTION

Mathematical communication skills are essential in mathematics learning because they enable students to express ideas, explain reasoning, interpret mathematical representations, and present problem-solving processes clearly. These skills are closely related to students' ability to use mathematical language, symbols, diagrams, tables, and written explanations to communicate mathematical concepts and solutions. Communication is one of the five process standards in mathematics education, alongside problem solving, reasoning and proof, connections, and representation (NCTM, 2000). In the Indonesian curriculum context, the ability to communicate mathematical ideas is also emphasized as one of the objectives of mathematics education (Regulation of the Minister of Education and Culture No. 21 of 2016). Therefore, mathematical communication is not only a supporting skill but also a core competency that students need to develop from the elementary school level.

Mathematical communication allows students to clarify their understanding, organize their thinking, and share mathematical ideas with others. In mathematics learning, students need to discuss, explain, ask questions, write mathematical concepts, and collaborate with peers; therefore, communication skills play an important role in optimizing the learning process

(Kuala et al., 2018; Sari, 2017; Syukri et al., 2020). Mathematical communication also helps students exchange ideas and clarify mathematical knowledge through verbal, written, and representational forms (Suratno et al., 2019; Triana et al., 2019). Students with good mathematical communication skills are able to present mathematical problems and solutions in the form of diagrams, tables, algebraic expressions, and written explanations, as well as explain the strategies used to solve problems (Disasmitowati & Utami, 2017; Husnah & Surya, 2017).

However, students' mathematical communication skills remain a challenge in classroom practice. Several studies have reported that many students still experience difficulties in using mathematical language accurately, translating real-life situations into mathematical symbols, and explaining problem-solving steps systematically (Nabrisi et al., 2019; Rustam & Ramlan, 2017; Sarah et al., 2021; Wardono et al., 2020). Other studies also found that students often struggle to use mathematical symbols correctly, construct mathematical models, and solve problems accurately (Atika et al., 2020; Kusumah, 2020; Ulya et al., 2019; Wandari & Fardillah, 2017). These problems indicate that students' mathematical communication skills are still not optimal and need serious attention in mathematics learning (Aliyah et al., 2020; Argarini et al., 2020; Kamid et al., 2020; Nuraina & Mursalin, 2018; Siregar et al., 2020; Supriyanto et al., 2020; Yaniawati et al., 2019).

The same issue was also found in the preliminary observation conducted in this study. Based on an interview with a fourth-grade teacher on November 8, 2022, students' mathematical communication skills still needed improvement. Students were not yet able to use mathematical symbols correctly, draw geometric figures accurately, or solve mathematical problems in a sequential and systematic manner. Initial data collection also showed that mathematics instruction in elementary schools in Woha District, Bima Regency, had not yet integrated ethnomathematics. Many teachers were not familiar with the concept of ethnomathematics, and mathematics learning was still largely taught in an abstract and theoretical manner, with limited connection to students' cultural and daily-life contexts. This condition indicates the need for continuous innovation in mathematics learning so that instruction becomes more contextual and meaningful for students (Irfan, 2019; Putri et al., 2019).

One possible approach to address this issue is ethnomathematics-based learning. Ethnomathematics refers to mathematical ideas, practices, and knowledge embedded in the cultural activities of particular communities. Ethnomathematics includes mathematical practices that are experienced, developed, and integrated into the cultural activities of diverse groups (Sunzuma, 2020). It also grows and develops within the cultural life of a society (Turmudi et al., 2021). In mathematics learning, ethnomathematics allows students to connect mathematical concepts with familiar cultural objects, activities, and practices. This connection can make mathematics more meaningful because students are encouraged to relate abstract mathematical concepts to concrete experiences in their own cultural environment (Arisetyawan et al., 2014; Putra & Mahmudah, 2021).

Previous studies have shown that ethnomathematics-based learning can support students' mathematical understanding, mathematical abilities, problem-solving skills, and cultural awareness. Realistic mathematics learning based on ethnomathematics has been reported to improve students' cognitive level and problem-solving ability (Widada et al., 2018; Widada et al., 2019). Ethnomathematics-based teaching materials have also been shown to influence students' mathematical abilities and character development (Nuryadi et al., 2023). Other studies found that ethnomathematics can help students learn mathematical concepts while recognizing and appreciating local culture (Faiziyah et al., 2020; Sarwoedi et al., 2018; Utami et al., 2018). Several studies have further demonstrated that ethnomathematics-based learning can support students' mathematical communication skills through various learning models and cultural contexts (Farokhah et al., 2017; Hartinah et al., 2019; Herawaty et al., 2019; Kaselin et al., 2013).

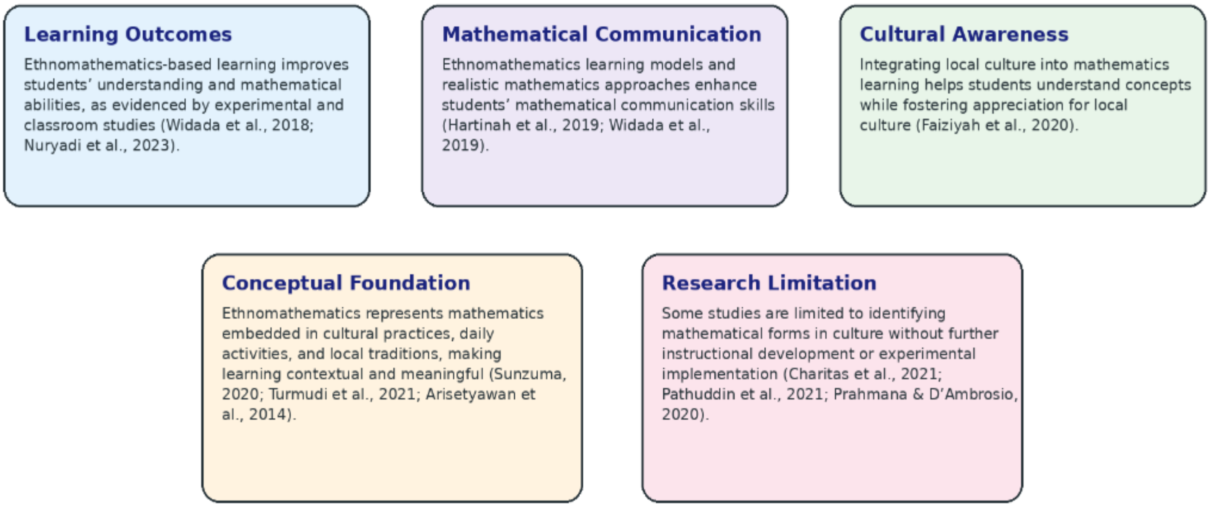


Figure 1. Overview of previous studies on ethnomathematics in mathematics education

As summarized in Figure 1, previous studies on ethnomathematics in mathematics education generally highlight five main areas: learning outcomes, mathematical communication, cultural awareness, conceptual foundations, and research limitations. These studies indicate that ethnomathematics can make mathematics learning more contextual and meaningful, while also strengthening students' appreciation of local culture. However, a number of ethnomathematics studies are still limited to identifying mathematical concepts embedded in cultural objects, symbols, artifacts, and traditional practices, without further examining their implementation in classroom learning or their effects on specific mathematical competencies (Charitas et al., 2021; Pathuddin et al., 2021; Prahmana & D'Ambrosio, 2020; Supiyati et al., 2019; Utami et al., 2019).

Although previous studies have discussed ethnomathematics in mathematics education, studies that specifically examine ethnomathematics-based learning in relation to elementary students' mathematical communication skills remain limited, particularly in the context of Mbojo culture in Bima, West Nusa Tenggara. Mbojo culture contains various mathematical elements that can be used as learning contexts, such as geometric forms in traditional houses, symmetrical patterns in woven fabrics, and mathematical ideas embedded in local cultural practices. These cultural elements provide meaningful contexts for helping students express mathematical ideas, use representations, and explain problem-solving processes.

Therefore, this study focuses on the implementation of ethnomathematics-based learning using Mbojo cultural contexts to examine students' mathematical communication skills. The novelty of this study lies in its specific focus on Mbojo culture as a source of mathematics learning and its emphasis on mathematical communication skills among elementary school students. By integrating local cultural contexts into mathematics learning, this study is expected to provide a more contextual, meaningful, and culturally relevant approach to support students' mathematical communication skills. Thus, this study aims to examine students' mathematical communication skills after the implementation of ethnomathematics-based learning based on Mbojo culture.

METHOD

Research Design

This study employed a quasi-experimental design to examine students' mathematical communication skills after the implementation of ethnomathematics-based learning. This design was selected because the researcher could not fully control or manipulate all variables in the classroom setting. The independent variable in this study was ethnomathematics-based learning, while the dependent variable was students' mathematical communication skills.

More specifically, this study used a one-group posttest-only design. In this design, the learning treatment was implemented in one class, and students' mathematical communication skills were measured after the treatment had been completed. Therefore, the analysis focused on whether students' posttest scores exceeded the predetermined benchmark score, rather than comparing learning outcomes between experimental and control groups. This design was considered appropriate for the limited classroom context, although the absence of a control group and pretest should be acknowledged as a methodological limitation.

Population and Sample

The population of this study consisted of all fourth-grade students involved in the mathematics learning context under investigation. The total population was 15 students. Because the population was relatively small and accessible, all members of the population were included as research participants. Thus, this study did not use random sampling.

The sampling technique used in this study was total sampling, meaning that the entire population was selected as the sample. Therefore, the sample consisted of 15 fourth-grade students. The use of total sampling was appropriate because the number of students was fewer than 100 and allowed the researcher to involve all available participants. However, the small sample size should be considered when interpreting the findings, especially in relation to the generalizability of the results to broader student populations.

Instrument and Procedure

The main instrument used in this study was a mathematical communication skills test. The test was developed based on indicators adapted from the National Council of Teachers of Mathematics (NCTM), including students' ability to express mathematical ideas orally and in writing, explain problem-solving strategies, and use appropriate mathematical representations, such as symbols, diagrams, tables, or graphs. As shown in Figure 2, the mathematical communication skills assessed in this study covered three main aspects: illustrating mathematical ideas as mathematical models, explaining ideas and mathematical relationships using real objects or visual representations, and using appropriate symbols, diagrams, or graphs to represent mathematical ideas.

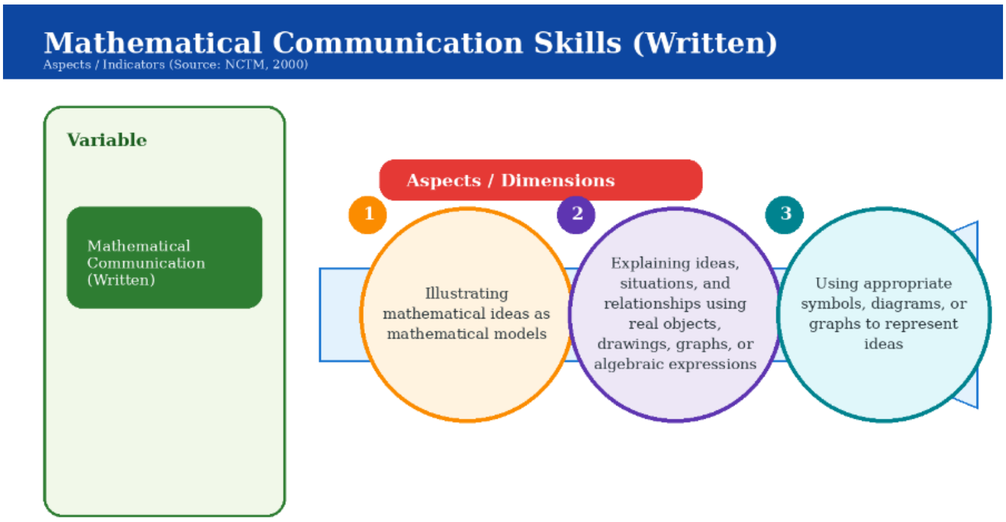


Figure 2. Aspects/dimensions of students' mathematical communication skills

The indicators presented in Figure 2 were used as the basis for developing the test items and scoring rubric. The test consisted of seven items designed to measure students' mathematical communication skills after the implementation of ethnomathematics-based learning. The learning procedure was conducted by applying mathematics instruction using Mbojo cultural contexts that were familiar to students. After the learning treatment had been completed, students were given the mathematical communication skills test as a posttest.

Instrument validity was examined through expert judgment involving three validators. The content validity of the instrument was analyzed using Gregory's formula, and the result showed a high level of content validity, with a coefficient of 1.00. In addition, empirical validity testing was conducted on the seven test items. The results of the item validity test are presented in Table 1.

Table 1. Results of the validity test of the mathematical communication instrument

Item Number	r-Value	Description
1	0.574**	Valid
2	0.680**	Valid
3	0.499*	Valid
4	0.588**	Valid
5	0.781**	Valid
6	0.515*	Valid
7	0.655**	Valid

As shown in Table 1, all seven items had correlation coefficients ranging from 0.499 to 0.781 and were categorized as valid. This indicates that each item was appropriate for measuring students' mathematical communication skills.

The reliability of the mathematical communication skills test was analyzed using Cronbach's Alpha. The results of the reliability analysis are presented in Table 2.

Table 2. Reliability test results of mathematical communication skills items

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.686	0.837	7

As presented in Table 2, the Cronbach's Alpha value was 0.686, while the Cronbach's Alpha Based on Standardized Items was 0.837. These results indicate that the mathematical communication skills test had acceptable internal consistency and was suitable for use in this study. Therefore, the seven-item test was considered valid and reliable for measuring students' mathematical communication skills after the implementation of ethnomathematics-based learning.

Data Analysis

The data were analyzed using SPSS version 26. Before hypothesis testing, a normality test was conducted to determine whether the posttest scores of students' mathematical communication skills were normally distributed. Since the sample consisted of fewer than 50 students, the Shapiro-Wilk test was used. The data were considered normally distributed when the significance value was greater than 0.05.

After the normality assumption was met, the data were analyzed using a one-sample t-test. This test was used to examine whether students' mathematical communication skills after the implementation of ethnomathematics-based learning differed significantly from the benchmark score. The benchmark value was set at 70, based on the Minimum Mastery Criteria for fourth-grade mathematics. The hypothesis was tested at a significance level of 0.05, where a significance value below 0.05 indicated a statistically significant difference from the benchmark.

RESULTS AND DISCUSSION

The following section presents the findings related to students' mathematical communication skills after the implementation of ethnomathematics-based learning. The data were analyzed using SPSS version 26 through several stages, including descriptive analysis, categorization based on the Minimum Mastery Criteria, normality testing, and hypothesis testing using a one-sample t-test. As shown in Figure 3, students' mathematical communication scores varied across participants, with the lowest score being 55 and the highest score being 95.

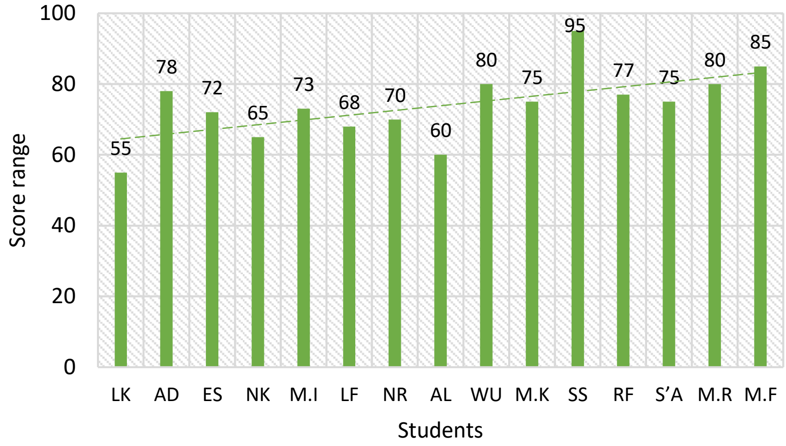


Figure 3. Data of students' mathematical communication skills

The distribution of scores indicates that most students achieved scores around or above the benchmark score of 70, although several students still scored below the expected criterion. This descriptive result provides an initial overview of students' mathematical communication achievement before the data were further classified into mastery categories and analyzed statistically.

To provide a clearer description of students' achievement, the scores were categorized based on the Minimum Mastery Criteria. The categorization of students' mathematical communication skills is presented in Table 3.

Table 3. Percentage of categories of students' mathematical communication skills

Number of Students	Percentage	Category
11 students	73%	Passed according to KKM
4 students	27%	Not Passed

As presented in Table 3, 11 students, or 73% of the participants, achieved scores that met or exceeded the Minimum Mastery Criteria. Meanwhile, 4 students, or 27% of the participants, did not reach the benchmark score. These results indicate that the majority of students demonstrated mathematical communication skills that met the expected standard. However, the presence of students who did not pass also shows that some learners still experienced difficulties in communicating mathematical ideas, particularly in using mathematical symbols, constructing representations, or explaining problem-solving steps systematically.

Before conducting hypothesis testing, a normality test was performed to determine whether the students' mathematical communication scores were normally distributed. The results of the normality test are presented in Table 4. This test was necessary because the one-sample t-test requires the data to meet the assumption of normality. Since the number of participants was fewer than 50, the Shapiro-Wilk test was used as the main reference, although the Kolmogorov-Smirnov result was also reported.

Table 4. Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Communication	0.182	15	0.194	0.971	15	0.878

As shown in Table 4, the significance value of the Kolmogorov-Smirnov test was 0.194, while the significance value of the Shapiro-Wilk test was 0.878. Both significance values were greater than 0.05, indicating that the students' mathematical communication scores were normally distributed. Therefore, the data met the assumption for parametric testing, and the one-sample t-test could be conducted to examine whether students' mathematical communication skills differed significantly from the benchmark score of 70.

The hypothesis test was conducted using a one-sample t-test. The null hypothesis stated that the mean score of students' mathematical communication skills was equal to 70, while the alternative hypothesis stated that the mean score differed from 70. The benchmark score of 70 was used because it represented the Minimum Mastery Criteria for fourth-grade mathematics. The results of the one-sample t-test are presented in Table 5.

Table 5. Results of t-test for students' mathematical communication skills

	t	df	Sig.	Mean Difference	95% Conf. Interval of Diff.	
					Lower	Upper
Mathematical communication	2.822	14	.015	3.86667	-1.5829	9.3162

As presented in Table 5, the one-sample t-test produced a t-value of 2.822 with 14 degrees of freedom and a significance value of .015. Since the significance value was lower than 0.05, the null hypothesis was rejected. This result indicates that students' mathematical communication skills differed significantly from the benchmark score of 70. The mean difference of 3.86667 shows that students' average score was approximately 3.87 points higher than the benchmark, meaning that the mean score was about 73.87.

Based on the hypothesis test results in Table 5, students' mathematical communication skills after the implementation of ethnomathematics-based learning were significantly above the predetermined benchmark. This finding indicates that the use of Mbojo cultural contexts in mathematics learning can support students in achieving the expected level of mathematical communication. The learning materials were connected to students' cultural experiences and daily life, so mathematical concepts were not presented only as abstract ideas. However, because this study used a one-group posttest-only design, the result should be interpreted as evidence that students' posttest achievement exceeded the benchmark, not as strong causal evidence of improvement from before to after the intervention.

The first indicator of mathematical communication ability is the students' capability to illustrate mathematical ideas into mathematical models. From the evaluation questions given in the form of story problems, 95% of the students were able to complete them well. Below are some examples of students' work related to their ability to illustrate mathematical ideas into mathematical models.

1. Lantai kamar mandi Ali sudah dipasang ubin berkuran kecil berbentuk persegi. Setiap ubin memiliki panjang sisi 3 cm. Berapakah luas setiap ubin tersebut?

⇩

Ali's bathroom floor has been installed with small square tiles. Each tile has a side length of 3 cm. What is the area of each tile?

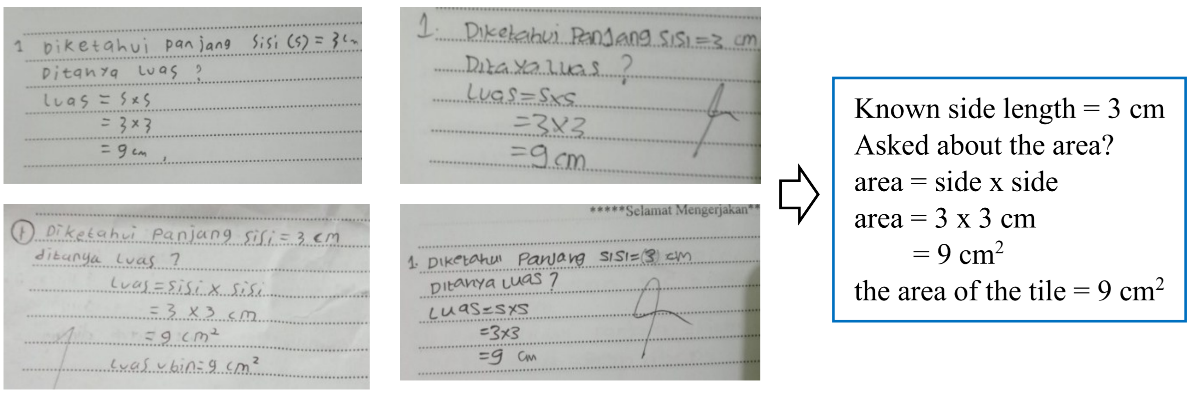


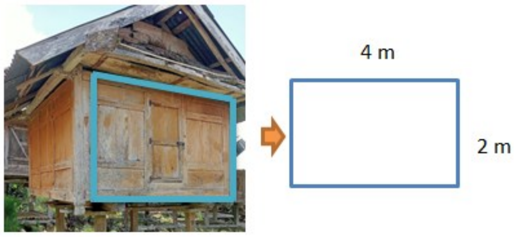
Figure 4. Student answer sheet for question number 1

From the students' answers, it can be seen that the students are able to write down what is known and what is asked from the given problem. They then determine the formula to solve it and correctly explain their answers. These steps indicate the achievement of the mathematical communication skills indicator, namely that students are able to illustrate mathematical ideas into mathematical models. The achievement of this communication skill indicator can be quantified with a percentage of 93%, meaning only 1 out of 15 students did not reach this indicator. This result aligns with Awa's (2013) opinion that the majority of students are able to express their mathematical communication skills by stating and illustrating a mathematical model into mathematical ideas. In this first indicator, some students only made errors in correctly writing mathematical symbols. For example, some students wrote the unit of area as meter (m) instead of the correct unit, which is square meter (m^2). This mistake is consistent with Maryani's (2011) statement that many students still make errors in writing mathematical symbols correctly.

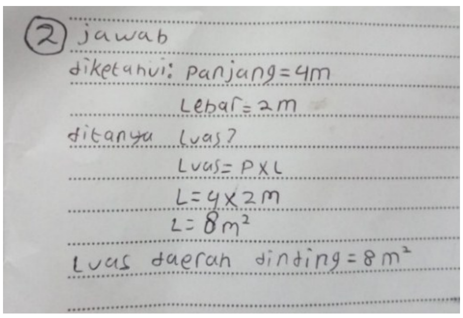
Regarding the second indicator of mathematical communication skills, which is students' ability to explain ideas, situations, and mathematical relationships using real objects, drawings, graphs, or algebra, students also performed well. This is evident from students' explanations in response to the given problems. According to Jazuli (2009), mathematical communication skills are the ability to express mathematical ideas through drawings and other visual forms. Below are the questions and students' explanations related to the second indicator of mathematical communication skills.

2. Dinding *Uma Jompa* bagian depan berbentuk persegipanjang seperti pada gambar di samping. Hitunglah luas daerah dinding rumah bagian depan tersebut!

The front of the Uma Jompa wall is rectangular as in the picture to the side. Calculate the area of the front wall!



From the students' answers, it is evident that they are able to explain the mathematical ideas from the given picture. The front wall of Uma Lengge can be described by the students in terms of its known length and width. The students are able to determine the formula used to solve the problem and can explain the answer accurately. Below is one example of a student's answer sheet.



Answer
Is known: long = 4 m
Wide = 2 m
Asked about the area?
Area = Long x Wide
Area = 4 x 2 m
Area = 8 m^2
The area of the wall is = 8 m^2

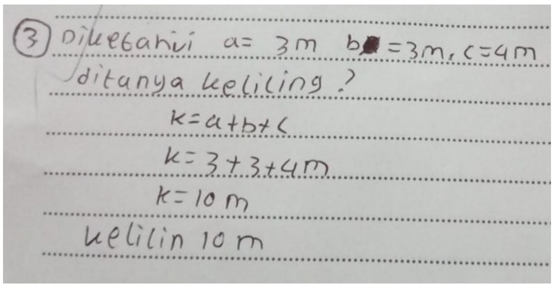
Figure 5. Student's answer sheet for question number 2

For this indicator, not all students were able to explain their answers correctly. Some students gave incorrect answers because they misunderstood what was known in the problem, which caused wrong solutions. This aligns with Romlah et al. (2019), who stated that students often lack carefulness in understanding the problem and in reading what the question asks, resulting in answers that do not match the requirements. Students did not clearly state the known and asked elements, making it difficult for them to solve the problem. Furthermore, students were not yet able to connect the image or real object to a mathematical idea because they did not fully understand the given question, so they could not illustrate the image correctly (Turrosifah & Hakim, 2020).

For the third indicator of mathematical communication ability, which relates to students' ability to express everyday events into mathematical language or symbols, students were also able to answer the questions correctly. The question given involved calculating the perimeter of the roof of the Uma Lengge. This roof shape is often encountered by students in their daily lives. Below is the description of the question and an example of a student's answer sheet.

3. Atap *Uma Lenge* bagian depan berbentuk segitiga. Panjang sisi a = 3 m, sisi b = 3 m dan panjang sisi c = 4 m. Berapa Keliling dari atap bagian depan *Uma Lengge* tersebut!

The front of the Uma Lengge roof is triangular in shape. the length of side a = 3m, side b = 3 m and side c = 4 m. what is the circumference of the front roof of the *uma lengge*!



Is known: a = 4 m,
b = 2 m,
c = 3 m
Asked about the around?
Around = a + b + c
Aroud = 3 + 3 + 4 m
Around = 10 m
Around 10 m

Figure 6. Student's answer sheet for question number 3

In question number three, some students still made errors in performing the addition operation for the three sides of the triangle. The mistake was in their calculation process, which aligns with the opinion of Hakim & Daniati (2014), who stated that the most common difficulties students face are related to implementing accurate calculation strategies and checking their results.

The findings indicate that students' mathematical communication skills after the implementation of Mbojo ethnomathematics-based learning exceeded the predetermined benchmark. This result suggests that integrating Mbojo cultural contexts into mathematics learning can support students in understanding and communicating mathematical ideas more meaningfully. Cultural elements such as symmetrical patterns in traditional weaving, traditional measurement practices, and geometric concepts in the architecture of the traditional Bima house, particularly Uma Lengge, served as authentic contexts for mathematics learning. Through these contexts, students were able to connect abstract mathematical concepts with objects and experiences that were familiar to their daily lives. This connection helped students become more active in discussing, asking questions, explaining ideas, and presenting mathematical reasoning orally and in writing, which are important indicators of mathematical communication skills (NCTM, 2000).

The results also show that students were able to understand mathematical problems by identifying known and asked information, selecting appropriate formulas, applying solution procedures, and drawing conclusions from the results obtained. During the learning process, students were encouraged to explain each step of their solutions systematically. As shown in Figure 7, students' solution processes reflected their ability to organize mathematical information and present answers in a structured manner. This finding indicates that ethnomathematics-based learning did not merely provide cultural examples, but also created opportunities for students to express mathematical ideas through symbols, diagrams, verbal explanations, and written reasoning.

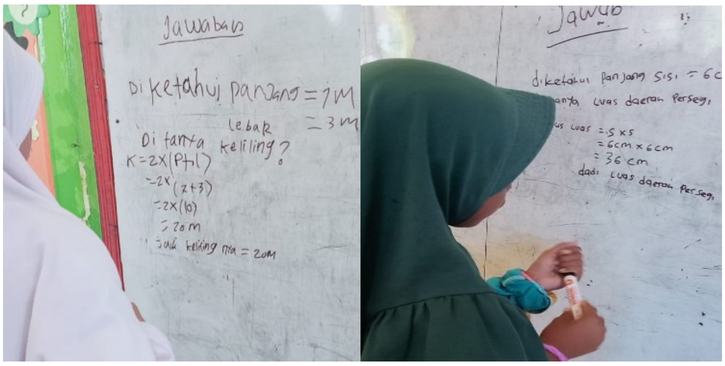


Figure 7. Students' solution explanation

These findings are consistent with the view that ethnomathematics can connect cultural experience with mathematical thinking. Ethnomathematics introduces cultural diversity into mathematics learning and creates space for dialogue, reasoning, and critical reflection among students (D'Ambrosio, 2001). In this study, the use of Mbojo cultural contexts enabled students to construct mathematical meaning from cultural objects and practices that were close to their lived experiences. This condition may have strengthened students' ability to communicate mathematical ideas because they were not required to interpret mathematics as an abstract and unfamiliar subject. Instead, they could relate mathematical concepts to concrete cultural contexts.

The findings are also in line with previous studies showing that local cultural contexts can support students' mathematical communication and representation skills. Learning based on local culture through the Realistic Mathematics Education approach has been reported to improve students' mathematical communication and representation (Putri & Zulkardi, 2017). Similarly, the use of cultural contexts in mathematics learning can encourage students to present ideas logically and discuss mathematical solutions with peers (Nurfadillah et al., 2020). In this study, Mbojo ethnomathematics helped students recognize that mathematics exists in their cultural environment, such as in woven patterns, traditional house structures, and daily practices. This recognition made learning more contextual and may have encouraged students to participate more actively in mathematical communication.

Ethnomathematics-based learning positions local culture as an instructional context. In this study, elements of Mbojo culture, including geometric patterns in traditional woven fabrics, the architecture of traditional houses, and traditional numerical or measurement practices, were used as learning resources. Contexts that are familiar and closely related to students' daily lives can help students understand mathematical ideas and become more emotionally engaged in the learning process. When students feel that learning materials are connected to their sociocultural environment, their motivation and confidence to express ideas may increase (Gay, 2010). This condition is important because confidence and active participation are closely related to the development of mathematical communication skills.

The use of cultural contexts also provided opportunities for students to discuss, explain, and justify mathematical ideas in both individual and collaborative learning activities. When students were asked to relate Mbojo cultural objects to mathematical concepts such as symmetry, area, perimeter, and geometric shapes, they were encouraged to use their own language, build reasoning, and express mathematical thinking. This is consistent with Vygotsky's theory, which emphasizes that social interaction and language play an essential role in cognitive development, including mathematics learning (Vygotsky, 1978). In this context, mathematical communication was developed through interaction, explanation, and negotiation of meaning rooted in students' cultural experiences.

In addition, familiar cultural contexts may reduce students' initial cognitive load. According to Cognitive Load Theory, learning becomes more efficient when students can process new information through contexts that are already familiar to them (Sweller, 1994). In this study, students did not need to spend excessive effort understanding unfamiliar problem contexts because the mathematical tasks were related to Mbojo culture. As a result, they could focus more on identifying mathematical information, selecting appropriate strategies, and explaining their solutions. However, because this study used a one-group posttest-only design, the findings should be interpreted carefully. The results show that students' mathematical communication skills exceeded the benchmark after ethnomathematics-based learning, but they do not provide strong causal evidence of improvement compared with a control group or pretest condition.

CONCLUSION

The results showed that students' mathematical communication skills after the implementation of ethnomathematics-based learning were significantly higher than the benchmark score of 70, $t(14) = 2.822$, $p = .015$. This finding indicates that ethnomathematics-based learning using Mbojo cultural contexts can support students' mathematical communication skills, particularly in helping them connect mathematical concepts with familiar cultural objects and daily experiences. The integration of local cultural contexts made mathematics learning more meaningful and less abstract, allowing students to express ideas, use mathematical representations, and explain problem-solving steps more clearly. In addition, this approach may strengthen students' appreciation of their local culture by showing that mathematical ideas are embedded in cultural practices and objects around them. However, because this study used a one-group posttest-only design without a pretest and control group, the findings should be interpreted as evidence that students' achievement exceeded the benchmark rather than as strong causal evidence of improvement.

RECOMMENDATION

Based on the findings of this study, teachers are encouraged to integrate ethnomathematics-based learning into mathematics instruction by utilizing local cultural contexts that are familiar to students, as this approach can support students in understanding and communicating mathematical ideas more meaningfully. The use of cultural elements such as traditional patterns, local architecture, and everyday practices can help make abstract mathematical concepts more concrete and relevant to students' experiences. Schools are also expected to support the implementation of this approach by providing adequate learning resources, facilitating teacher training, and encouraging the development of culturally responsive teaching materials. However, considering the limitations of this study, particularly the small sample size and the absence of a control group and pretest, future research is recommended to involve larger and more diverse samples and to employ more rigorous experimental designs, such as pretest-posttest or control group designs, in order to obtain stronger evidence regarding the effectiveness of ethnomathematics-based learning on students' mathematical communication skills.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the Head of STKIP Taman Siswa Bima, Dr. Ibnu Khaldun Sudirman, M.Si., for his support in the completion of this research and publication. The authors also thank the principal and teachers of SD Negeri Talabiu, Bima Regency, for their permission, assistance, and cooperation during the data collection process and the implementation of ethnomathematics-based learning. Appreciation is also extended to the fourth-grade students who actively participated in the learning activities.

FUNDING INFORMATION

This research received no external funding.

AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Mariamah	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	
Nanang Diana		✓					✓					✓		

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Adi Apriadi Adiansyah	✓						✓				✓	✓		✓
Muslim							✓				✓			✓
Khusnul Khatimah											✓			✓

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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