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Students' Mathematical Literacy through Ethnomathematics-based Learning

Suci Maulina[1*], Junaidi[1], Mahyatun Nufus[1], Nanda Rizka Maulida[1]

[1]Mathematics Education Department, Jabal Ghafur University, Indonesia
*Email: *sucimaulina@gmail.com*

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Abstract. *Mathematical literacy is one of the 21st-century skills students need to have. However, the PISA 2022 results revealed that Indonesian students' mathematical literacy decreased. Therefore, the government suggests that teachers integrate literacy activities in the teaching and learning process, including mathematics learning. This study integrated ethnomathematics of Aceh culture as an attempt to develop students' mathematical literacy. This study intends to describe students' mathematical literacy through ethnomathematics-based learning in two school settings: suburban and rural. This study employed a descriptive method. The participants involved 42 Grade 10 students from suburban and rural high schools in Pidie Regency, Indonesia, selected by the purposive sampling technique. Data were collected from students' written answers to the problems listed in the worksheet and analyzed descriptively. The finding revealed that, overall, the mathematical literacy of suburban school students surpassed that of rural school students. Among the mathematical literacy aspects, employing received the highest score, and interpreting got the lowest for both schools. The implications of this study are discussed further in this paper.*

Keywords: *ethnomathematics; mathematical literacy; Aceh culture; mathematics learning*

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Introduction

Mathematical literacy is one of the 21st-century skills students need to have, which is part of the Indonesian government's agenda, National Literacy Movement (*Gerakan Literasi Nasional*) initiated by The Ministry of Education and Culture of Indonesia (Kementerian Pendidikan dan Kebudayaan, 2017). This movement was a response to the Programme for International Student Assessment (PISA) results in 2016, where Indonesia scored 397 and 386 in reading and mathematics, respectively (OECD, 2016) and placed Indonesia ranking 64th out of 72 countries. However, the PISA 2018 report revealed that Indonesian students' mathematical literacy decreased (OECD, 2019). Indonesia ranked 74 out of 79 countries. From 2015 to 2018, Indonesian students' reading skills decreased to 371, the same as the score achieved in 2001, while their mathematics skills decreased to 379. Similarly, PISA 2022 reported that Indonesian students' scores for mathematics and reading decreased to 366 and 359, respectively (OECD, 2023). This result signifies that the National Literacy Movement should be implemented thoroughly. The government suggests that teachers integrate literacy activities in the teaching and learning process and assessment through learning instructions and learning environments, which allow for critical and creative thinking, communication, collaboration, and literacy (Kementerian Pendidikan dan Kebudayaan, 2017).

Mathematics learning at schools integrating literacy activities has not yet been optimally conducted. Teachers tend to teach students mathematical concepts without taking into account students' mathematical literacy. They are most likely to provide students with routine problems (Genc & Erbas, 2020), which involve insufficient mathematical literacy and critical thinking. Specifically, in Indonesia, teachers tend to give plain word problems that can be solved using formulas or procedures (Wijaya, Van den Heuvel-Panhuizen, & Doorman, 2015). As a result, students' mathematical literacy has not been developed. In addition, some students often perceive mathematics as a tedious subject (Larkin & Jorgensen, 2016) and irrelevant to their lives (Rakhmawati & Alifia, 2018). Therefore, mathematics learning needs to be situated within contexts to make it more meaningful (Saputra, Maulina, Mirunnisa, & Razi, 2022), such as using the context of culture. Culture globally has become a recommended context for teaching mathematics (Obiakor, Obiakor, Obiakor, & Obiakor, 2020). Specifically, in Indonesia, integrating culture into mathematics learning is suggested as it can instill character in students (Widiantari, Suparta, & Sariyasa, 2022). In mathematics education, the integration of mathematics and culture is called ethnomathematics. Ethnomathematics was first introduced by D'Ambrosio to describe the mathematical practice of a group or culture and is considered the study of mathematics in a cultural context (D'Ambrósio & Knijnik, 2020). Thus far, mathematics tends to be perceived as an abstract subject free from culture (Rosa, 2020). Mathematics is a subject inherited by mathematicians with different cultural backgrounds.

Researchers suggest that the curriculum of school mathematics involves ethnomathematics (Bishop, 2010; Rosa, 2020) as it contributes to the development of problem-solving (Rosa, 2020) through understanding situations rather than algorithmic procedures (Rosa, D'Ambrosio, Orey, Shirley, Alangui, Palhares, & Gavarette, 2016). Integrating culture in the mathematics curriculum provides long-term benefits for students because it can foster their perception that mathematics is a part of everyday life, deepen students' understanding, and increase their ability to create meaningful connections between mathematics, student life, and culture (Rosa & Orey, 2015). Two objectives of learning mathematics can be achieved through ethnomathematics: building a multicultural context for developing mathematical knowledge and skills and helping students connect with other disciplines (Rosa, 2020). One of the curriculum's most important goals is to place mathematics in an appropriate sociocultural context so that students can apply their understanding effectively by constructing meaning relevant to the abstract mathematical concepts and methods learned at school (Rosa & Orey, 2015).

Furthermore, ethnomathematics supports literacy and matheracy. Based on ethnomathematics perspectives, literacy is understood as integrating learning at schools and cultural contexts (Rosa & Orey, 2015). They further state that numeracy is a symbolic and analytical tool that helps students develop creativity and critically understand and solve mathematical problems. Meanwhile, matheracy is broader than basic mathematical abilities because it includes numeracy and literacy concepts and involves more complex mathematical reasoning abilities. In this case, ethnomathematics is related to developing competencies, abilities, and skills by studying mathematical ideas, procedures, and practices related to sociocultural contexts. This process supports students in developing mathematical reasoning and problem-solving skills in various situations, thereby enhancing the overall quality of education (Rosa, 2020).

Ethnomathematics has been studied in Indonesia since 2013 (Hidayati & Prahmana, 2022). Many researchers have explored ethnomathematics in various Indonesian cultural objects, such as traditional houses (Hariastuti & Budiarto, 2022), traditional cakes (Nursyahidah & Albab, 2021), traditional dances (Musawwir & Suryadi, 2021), *batik* (Manoy & Purbaningrum, 2021), and others. Several Indonesian researchers have used ethnomathematics to develop several mathematical abilities, such as problem-solving (Widada, Herawaty, Anggoro, Yudha, & Hayati, 2019), mathematical understanding (Herawaty, Widada, Nugroho, & Anggoro, 2019), reasoning (Maidiyah, Anwar, Mailizar, Zaura, Suryawati, & Harnita, 2021; Ramadhani & Saragih, 2022), and mathematical literacy (Runtu, Pulukadang, Mangelep, Sulistyaningsih, & Sambuaga, 2023). Several researchers have also developed problems equivalent to PISA in the context of ethnomathematics (Usnul, Johar, & Sofyan, 2019). The results of a systematic literature review revealed that the development of PISA problems in local contexts, such as traditional houses and historical sites, was less than the development of PISA problems in global contexts (Rastuti & Prahmana, 2021). Furthermore, the most researched topic related to ethnomathematics in Indonesia involves geometry (67%); on the other hand, algebra is still limited (7%) (Hidayati & Prahmana, 2020). Therefore, ethnomathematics-based math problems with local contexts must be developed further to enrich mathematical learning resources and increase students' mathematical literacy.

To fill the gap in the previous studies, the current study intends to implement ethnomathematics-based learning. In addition to contributing to the development of ethnomathematics research in Indonesia, the current study would help teachers integrate ethnomathematics in learning to develop and improve students' mathematical literacy skills as still many teachers who do not know how to integrate ethnomathematics in the classroom, even remain unfamiliar with ethnomathematics (Mabotja, 2023; Mania & Alam, 2021), especially in Aceh. Ethnomathematics-based learning will be implemented in two schools in suburban and rural areas. Previously, students from both schools had not experienced ethnomathematics-based learning. However, the suburban school had an extracurricular activity that allowed students to learn Aceh culture by visiting historical sites, while the rural school did not. Through this study, students from both schools will experience ethnomathematics-based learning to develop their mathematical literacy. Based on a literature search, no research compared the mathematical literacy of students taught through ethnomathematics in terms of different school settings. These different school settings would be the novelty of this research since it will capture the mathematical literacy of students from different backgrounds. Therefore, the current study aims to investigate the mathematical literacy of students from two different school settings during ethnomathematics-based learning. In particular, the study will be guided by the following research question: How is the mathematical literacy of students from suburban and rural schools through ethnomathematics-based learning?

Method

This study employed a descriptive method. This descriptive method aims to describe a phenomenon that involves activities, relationships, similarities, characteristics, changes, and differences between one another (Creswell & Creswell, 2017). It specifies the phenomenon and identifies patterns in data to answer questions about what, who, when, where, and to what extent (Loeb, Dynarski, McFarland, Morris, Reardon, & Reber, 2017). This study employs the descriptive method to depict students' mathematical literacy through ethnomathematics-based learning.

The participants involved 42 tenth-grade students of two senior high schools in Pidie Regency, Aceh Province, Indonesia. One of the schools is located in a suburban area, while the other is in a rural area. A suburban area is defined as an area far from the city and usually used as a residence area for people who work in the city; on the other hand, a rural area is used for farming communities and has the lowest density (Khattri, Riley, & Kane, 1997). Based on the criteria, one of the schools is classified as a suburban school and attended by most students living near the city. The other school is considered a rural school, dominated by rural students who live nearby. These schools were chosen by purposive sampling under the criteria: students were taught using *Kurikulum Merdeka* (Independent Curriculum), students had not learned arithmetic sequences before in the tenth grade, and easy access to the school. Each school has two classes for Grade 10, and only one class was permissible to become the research subjects. Therefore, one class from each school became the sample of this study: 20 students from the suburban school and 22 from the rural school.

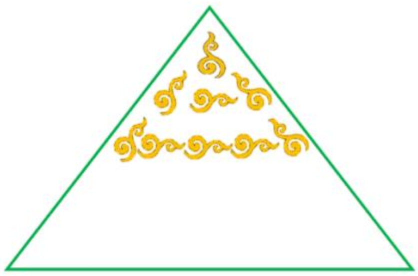
Data were primarily collected from students' written answers on the problems used in the worksheet to describe students' mathematical literacy during ethnomathematics-based learning. Before use, the problems were validated by two mathematics education lecturers and two math teachers. They were then revised according to the validators' suggestions. After they were declared valid, they were then used in the classroom. Besides, data from interviews with teachers and some students were used as supplementary to support the main data.

The integration of ethnomathematics of Aceh culture was applied to the topic of arithmetic sequence, which is included in quantity content comprising numbers and patterns (Fatmawati & Ekawati, 2016). In this case, we chose *Rumoh Aceh* (a traditional house) and motifs used in *Rumoh Aceh*. Prior to the instruction, we had a brief discussion with math teachers about the student's ability level and their math background. Subsequently, we designed the lesson plan and student worksheet based on the student's background. After the lesson plan and worksheet were validated by two math lecturers and two math teachers, we then had a focus group discussion with the teachers as to how the learning process would be conducted based on the lesson plan and student worksheet, the scenario that might happen during the learning process, and strategies to anticipate students' difficulties. Having all set, the teachers implemented ethnomathematics-based learning in the classroom for two meetings on arithmetic sequence. As the students encountered arithmetics sequence for the first time, the material given was the introduction to arithmetics sequence, guiding students on finding the formula of an arithmetic sequence they had not yet found in junior high schools. The problems given are presented in Figure 1. The activities for the two meetings are described below.

In the opening, the teacher gave an apperception by recalling what students understand about patterns and presented some examples of patterns that appeared in daily life, such as the pattern of sunflower seeds, the pattern from flower crowns, cubical numbers from cubes, and the pattern of leaves. After that, the teacher explained the significance of the learning sequence in our everyday lives. For instance, patterns and sequences create interesting and neat motifs, shapes, and designs. Last, students were informed about the learning objectives of today's lesson.

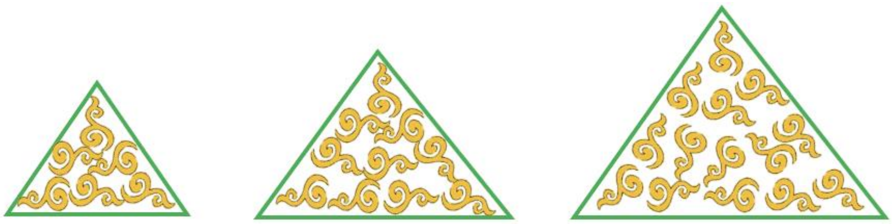
In the main activity, the teacher shared information about Aceh culture with students through Aceh's traditional house, Rumoh Aceh. The teacher also explained parts of Rumoh Aceh and its philosophy and meaning created behind those. Next, the teacher focused on describing the design and motifs used in Rumoh Aceh and their meanings. Subsequently, students sat in a group and were given a worksheet integrating ethnomathematics. In the worksheet, students were given the activity of designing the ventilation (*tulak angen*) of Rumoh Aceh using an Acehnese motif. The motif used is called *awan-awan*, meaning God's greatness and power. The carving of this motif was placed in the ventilation row by row so that each row creates a pattern. The students were then asked to identify the number of carvings in each row and find the general form (U_n) to describe the sequence. Furthermore, in the second activity, students were asked to place the carving in the ventilation area, where its size kept increasing. When the size of ventilation increases, the number of carvings also increases. The number of carving follows a pattern and develops an arithmetic sequence. Observing the pattern, students identified the sequence and predicted the number for the following terms. Last, students were asked to find the general form (U_n) to describe the sequence. After solving the problems in their group, students had a whole class discussion. They presented what they found from the activities, where students were encouraged to give responses, opinions, or justifications for the solutions. From the previous activity, students, along with teachers, built the concept of an arithmetic sequence and discovered the general form of an arithmetic sequence.

Problem 1:



The motif in the picture is one of the Acehnese motifs used in *Rumoh Aceh*, the cloud motif. This motif is taken from nature, namely the shape of clouds or waves. It symbolizes God's power and greatness.
The left side is a picture of Rumoh Aceh's ventilation (*lubang angen*), designed using the cloud motif. How many motifs are in the seventh line if you were asked to arrange the motifs until the seventh line? Could you find the general form for the number of motifs in each line?

Problem 2:



Based on the pictures, please complete the table below.

Tolak angen	1	2	3	4	5	6	7	8	9	10
Motif	6	…	…	…	…	…	…	…	…	…

How many motifs are in the twelfth ventilation? Could you find the general form for the number of motifs in each ventilation?

Figure 1. Problems

In the closing activity, with the teacher's guidance, students concluded what they had learned from the lesson. They also reflected on today's lesson, their challenges when solving the problems, and their strategies to overcome them.

Further, data analysis employed descriptive analysis involving descriptive statistics. Descriptive analysis measures of central tendency (such as mean, median, and mode), measures of variation (range and standard deviation), and basic frequency analyses are useful statistical tools for description. Descriptive analysis simplifies data to better understand a phenomenon (Loeb et al., 2017). Students' responses were analyzed following the PISA 2022 mathematical literacy framework (OECD, 2023), as listed in Table 1.

Table 1. The PISA 2022 mathematical literacy framework

Process	Description
Formulating	• Recognize mathematical structure (including regularities, relationships, and patterns) in problems or situations. • Simplify a situation or problem in order to make it amenable to mathematical analysis (for example, by decomposing)
Employing	• Perform a simple calculation • Devise and implement strategies to determine a mathematical solution • Apply mathematical facts, rules, algorithms, and structures when finding solutions • Make generalizations based on the results of applying mathematical procedures to find solutions
Interpreting	• Evaluate a mathematical outcome in terms of the context. • Interpret a mathematical result back into the real-world context

The students would get one point if they performed the indicators of mathematical literacy in their answers; otherwise, they would get zero. Each aspect's points are summed up and counted for its total score, mean, standard deviation, and percentage. This analysis was conducted in two ways: an analysis of each school and an analysis of both schools as a unit. Both schools were analyzed by aggregating all students as a whole, and then a descriptive analysis was performed, similar to the individual school analysis.

Results and Discussion

Students' responses were analyzed following the PISA 2022 mathematical literacy framework (OECD, 2023), including (1) formulating the situation mathematically, (2) employing mathematical concepts, facts, procedures, and reasoning, and (3) interpreting and evaluating mathematical results. The finding revealed that the mathematical literacy of students from the suburban school obtained an average score of 74.38 with a standard deviation of 6.69. Meanwhile, students from the rural school received an average score of 71.88 and a standard deviation of 11.85. These scores indicate that students performed sufficient mathematical literacy through ethnomathematics-based learning. However, students from suburban schools have more dispersed scores for mathematical literacy than those from rural schools. The highest score received by the students in the suburban school is 81.25, and the lowest is 62.5. Meanwhile, the students in the rural schools got 87.5 as the highest score and 31.25 as the lowest. In general, students from both schools gained an average score of 73.07 in mathematical literacy with a standard deviation of 9.71. The results of students' mathematical literacy from both schools are listed in Table 2.

Table 2. Results of students' mathematical literacy

School	Mean	SD	Max	Min
Suburban (N = 20)	74.38	6.69	81.25	62.5
Rural (N = 22)	71.88	11.85	87.5	31.25
Both (N = 42)	73.07	9.71	87.5	31.25

In the following section, we will describe students' mathematical literacy in each aspect of the process. Table 3 summarizes students' mathematical literacy in each strand.

Table 3. Students' mathematical literacy in each strand

School	Formulating			Employing			Interpreting		
	Mean	%	SD	Mean	%	SD	Mean	%	SD
Suburban (N = 20)	15.63	62.5	3.21	48.13	96.25	4.58	10.63	42.5	2.94
Rural (N = 22)	17.61	70.45	5.33	46.31	92.61	8.33	7.95	31.82	3.44
Both (N = 42)	16.67	66.67	4.51	47.17	94.35	6.79	9.23	36.90	3.45

Formulating

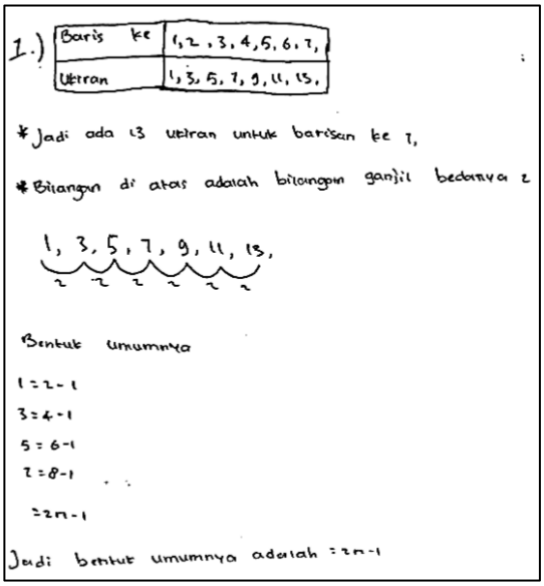
Formulating signifies recognizing and identifying mathematical patterns in problems or situations and simplifying a problem to make it amenable to mathematical analysis (OECD, 2023). According to the analysis of the students' answers (see Table 4), the result found that the ability of students from both schools to formulate the problem reached the average score of 16.67 (SD = 4.51, 66.67%), where the highest score is 25. The lowest is 12.5 (out of 25). The detailed result of this aspect is presented in Table 4.

Table 4. Student's ability to formulate the problem

School	Recognize (%)	Simplify (%)	Max (out of 25)	Min (out of 25)
Suburban (N = 20)	100	25	18.75	12.5
Rural (N = 22)	100	40.90	25	12.5
Both (N = 42)	100	33	25	12.5

Among two indicators of formulating, all students (N = 42) could recognize and identify the pattern in the problems. On the other hand, only six students (14.29%) were able to simplify the patterns in both questions through decomposition, and 16 students (38.09%) did it only for one of the questions, and the rest (N=20, 47.62%) did not simplify the patterns albeit noticed them.

If we look closer at the student's ability in each school, students from the rural school performed better in formulating the problems (M = 17.61, SD = 5.33), although their scores tend to be dispersed, compared to those in suburban school (M = 15.63, SD = 3.21). The maximum score the suburban school students received is 18.75, lower than the highest score of rural school students, 25, which is the full point. More rural school students simplified the problem (40.90%, see Table 5) by decomposing them to seek the regularities since they had difficulties finding the general form directly if compared to suburban school students (25%). This factor contributes to the student's scores in the formulating indicator. Meanwhile, half suburban school students (N=20) did a similar vein, but the rest ignored the pattern simplification. This may explain why the students from the suburban school received lower scores in this aspect. The following Figure 2 depicts students' work from the rural school.



1.)

Baris ke	1, 2, 3, 4, 5, 6, 7,
Ukiran	1, 3, 5, 7, 9, 11, 13,

* Jadi ada 13 ukiran untuk barisan ke 7,
* Bilangan di atas adalah bilangan ganjil bedanya 2

$\underbrace{1, 3}_{2}, \underbrace{5}_{2}, \underbrace{7}_{2}, \underbrace{9}_{2}, \underbrace{11}_{2}, \underbrace{13}_{2},$

Bentuk umumnya

1 = 2 - 1
3 = 4 - 1
5 = 6 - 1
7 = 8 - 1
= 2n - 1

Jadi bentuk umumnya adalah = 2n - 1

- So, there are 13 carvings in the 7th row
- The sequence consists of odd numbers with a difference of 2.

  The general form is
  $1 = 2 – 1$
  $3 = 4 – 1$
  $5 = 6 – 1$
  $7 = 8 – 1$
  .
  .
  $= 2n – 1$

  So, the general form is $2n – 1$

Figure 2. One of the rural school student's answer

Based on Figure 2, one of the rural students noticed that the sequence is all odd numbers. She simplified the pattern by decomposing each term of the arithmetic sequence. She identified that the difference is two and wrote the decomposition form of an even number subtracted by 1. She recognized that the even number can be written by $2n$, arriving at the general form $2n$-1. Such a simplifying method helps her to get the solution. Albeit simple, this problem was challenging for them and allowed for productive struggles. Based on the interview, the math teacher from the rural school admits that they have difficulty in math and need more time to solve math problems than students in the suburban school. However, using the context of Aceh culture, where the question asked them to draw the motifs at the beginning, assists them in identifying the sequence. This argument is aligned with some students' responses during the interview, mentioning that "the picture and context of Aceh culture help me understand and solve the sequence." They also stated, "If there is no picture, I will struggle to tackle the problem."

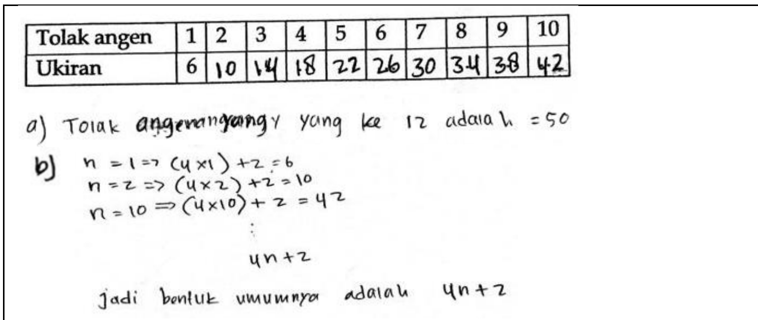
Employing

Employing refers to students' ability to do computations and manipulations and apply the concepts and facts they know to arrive at a mathematical solution (OECD, 2023). In this study, indicators include performing a simple calculation, devising and implementing strategies to solve a problem, applying mathematical facts, rules, algorithms, and structures, and making generalizations based on the results of applying mathematical procedures. Table 5 illustrates the results of students' mathematical literacy in this aspect.

Table 5. Students' ability to employ

School	Calculation (%)	Strategy (%)	Apply rules/facts (%)	Generalization (%)	Max (out of 50)	Min (out of 50)
Suburban (N = 20)	92.5	100	100	92.5	50	37.5
Rural (N = 22)	97.7	97.7	93.18	81.82	50	12.5
Both (N = 42)	95	98	97.6	86.9	50	12.5

The result showed that the ability of students to employ procedures gained an average score of 47.17 (SD = 6.79, 94.35%, see Table 3). This score indicates that students perform with a highly sufficient ability to employ. However, students' ability in this aspect is more dispersed compared to the ability to formulate a problem, where the highest score is 50 and the lowest is 12.5 (see Table 6). Regarding the components of employment, almost all students from both schools were able to apply strategies to solve the problem (98%), use rules or mathematical facts to solve the problem (97.6%), and perform simple calculations (95%). Their strategies include decomposition of the number (simplifying the problem), guessing and checking, looking for patterns, thinking of a related problem, and using arithmetic sequence formulas (using equations). However, not all the students can generalize the problems (86.9%). Some of them arrive at the incorrect generalization.



Tolak angen	1	2	3	4	5	6	7	8	9	10
Ukiran	6	10	14	18	22	26	30	34	38	42

a) Tolak angen yang ke 12 adalah = 50

b) n = 1 => (4×1) + 2 = 6
n = 2 => (4×2) + 2 = 10
n = 10 => (4×10) + 2 = 42
⋮
4n + 2

Jadi bentuk umumnya adalah 4n + 2

a) The 12th ventilation consists of 50 carvings.
b)

So, the general form is 4n+2

Figure 3. One of the rural school student's answer

If we look at students' ability in each school, based on Table 3, students from the suburban school (M = 48.13, 96.25%, SD = 4.58) outperformed those in the rural school (M = 46.31, 92.61%, SD = 8.33) in employing aspect. Although not significant, the students from the suburban school have a similar ability in this aspect, while the rural school students' ability dispersion is wider. Based on the interview with the teachers, it is understandable that students in the suburban school were enrolled through an entry test, including a math test, while students in the rural school were not. Thus, it is unsurprising that suburban students have better scores. Nevertheless, with an average score of 46.31 (92.61%), rural students' ability to employ is considered good when implementing ethnomathematics-based learning. It is supported by their math teacher's statement during the interview that the problem-solving ability of students in that school is meager, and their prior knowledge is inadequate; the teacher needs two meetings to make them understand a topic. Thus, with their low problem-solving ability and insufficient math prior knowledge, covering all topics is challenging due to time constraints. Yet, they started to show highly satisfying results in this aspect. The student's answer is demonstrated in Figure 3.

Interpreting

Interpreting relates to students' ability to reflect upon mathematical solutions or conclusions (OECD, 2023). In this aspect, students are assessed on their ability to evaluate the solution they have obtained to determine whether it is reasonable and interpret the result back into the real-world context. The result of students' mathematical literacy in this aspect is depicted in Table 6.

Table 6. Students' ability to interpret the result

School	Evaluate (%)	Interpret (%)	Max (out of 25)	Min (out of 25)
Suburban (N = 20)	77.5	7.5	18.75	6.25
Rural (N = 22)	63.64	0	12.5	0 (unidentified)
Both (N = 42)	70.23	3.6	12.5	0 (unidentified)

The findings demonstrated that the ability of students to interpret the results has an average score of 9.23 (SD = 3.45, 36.90%) with the highest score of 12.5 out of 25 (see Table 3). This aspect received the lowest score than the other two, formulating and employing. More than half of the students evaluated their answer (70.23%) but did not interpret it back into the context used, contributing to the low score. Besides, more students evaluate their answers to the first question than the second one. However, only three students interpreted the results based on the context (3.6%). This result is not surprising since they had been previously provided with more routine problems without context, resulting in unfamiliarity with non-routine problems.

According to Table 3, when comparing students' mathematical literacy from the two schools in this aspect, suburban school students outperformed those in rural schools with average scores of 10.63 (42.5%) and 7.95 (31.82%), respectively. The score dispersion of rural school students (SD = 3.44) is slightly higher than suburban school students (SD = 2.94).

Based on the results, we highlight some significant findings. First, generally, all students performed sufficient mathematical literacy during ethnomathematics-based instruction. Surprisingly, students from rural schools (the mean is 71.88 with the highest score of 87.5) could gain an average score approaching the scores of students from suburban schools (the mean is 74.38 with the highest score of 81.25). Whereas, in the regular math classroom, according to the teacher in the rural school, rural students often feel much more struggle and need more time to solve problems; they are also considered to have low achievement in mathematics compared to those in the suburban school. Regarding the exposure to ethnomathematics, neither school has previously taught using the ethnomathematics approach. Yet, students in suburban schools had an extracurricular activity, such as visiting cultural sites such as *Rumoh Aceh*, while rural students did not. As such, suburban students became familiarized with the cultural context during ethnomathematics-based learning more quickly than rural students. Despite this, the mean scores obtained by students from both schools are not highly different. This is supported by Jacob and Dike (2023), who suggest that ethnomathematics assists students in reconstructing their understanding of mathematics more effectively, regardless of their cognitive level. They also stated that teachers served as facilitators instead of knowledge transmitters in ethnomathematics-based learning. Therefore, it helps students build mathematical understanding and literacy.

Moreover, taking a closer look at the aspects of mathematical literacy, employing received the highest score for both schools. If we compare the two schools, suburban students outperformed rural students in this aspect. This result is unsurprising as suburban students are expected to have better basic mathematical knowledge than rural students. Genc and Erbas (2020) stated that math anxiety, interest in math, and basic arithmetic knowledge also contribute to students' mathematical literacy. According to the teacher from the rural school, although during the implementation of ethnomathematics-based learning, students struggled in the beginning, their struggle was productive, and the context helped them move forward. Also, as facilitators in ethnomathematics-based learning (Jacob & Dike, 2023), the teachers gave students scaffoldings. In this respect, Susanta, Sumardi, Susanto, and Retnawati (2023) found that using context in tasks impacts students' literacy activities, stimulates creativity and critical thinking, and helps them figure out the pattern. Also, using pictures in the task gives visual information and helps students understand the problems (Hoogland, de Koning, Bakker, Pepin, & Gravemeijer, 2018).

Further, the aspect that received the lowest score was interpreting in both schools. Comparing the two schools, suburban students have slightly higher average scores than rural students in interpreting. This result is confirmed by Runtu et al. (2023), who reported that, in the ethnomathematics context, interpreting is the least improved among other mathematical literacy dimensions. Rum and Juandi (2022) also found that most students have difficulty interpreting and reasoning the problem. Several studies reported that interpreting becomes the major challenge faced by students in solving contextual problems, including ethnomathematics context, and they frequently fail to interpret the context because they ignore the context and treat the problems as procedural mathematical problems (Widjaja, 2013). A rare encounter with literacy contextual problems in regular math classrooms in both schools may also contribute to this issue as students struggle to associate the results they found with the problem context. As such, teachers must expose students to problem-solving and making concepts in the real world (Enderson & Colwell, 2021) and meaningful contexts related to students (Zahner, 2021). It is also essential for teachers to connect mathematics with life during the teaching and learning process (Ada, Tapan Broutin, Kaleli Yilmaz, & Bayram, 2021), consider contexts to choose from, and empower students to identify math content in contextual problems (Kolar & Hodnik, 2021).

Conclusion

The current study aims to investigate the mathematical literacy of students from suburban and rural schools during ethnomathematics-based learning. The results revealed that most students in the two schools demonstrate sufficient mathematical literacy. Overall, the mathematical literacy of suburban school students surpassed that of rural school students. However, in formulating aspects, students in the rural school performed better scores than students in the suburban school. On the other hand, students from the suburban school did better in employing and interpreting. Last, among the aspects, the students from both schools scored the highest in employing but the lowest in interpreting. The results suggest that teachers shall situate mathematics within contexts to familiarize students with contextual problems, including implementing ethnomathematics-based learning. Integrating ethnomathematics into learning also enhances students' problem-solving ability and mathematical literacy.

Further, it is worth acknowledging the limitations of this study. The subjects of this study were limited to 42 students from two schools. It is recommended that future studies use more significant numbers of students to get more comprehensive findings. Second, this study involves only two suburban and rural school settings. Thus, future studies are suggested to involve students from urban schools and compare students' mathematical literacy in three school settings. It is also suggested that future studies use different methods to analyze students' mathematical literacy. Other factors contributing to students' mathematical literacy development also need to be intensively studied, such as self-confidence, prior mathematical knowledge, math anxiety, attitude and belief toward mathematics, teacher teaching practices, and teacher knowledge.

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