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Mathematical Reasoning Ability of Junior High School Students Through Problem Based Learning Model with Ethnomathematical Nuances

Erni Maidiyah[1*], Nadia Anwar[1], Mailizar[1], Bintang Zaura[1], Suryawati[1] and Fahlida Harnita[1]

[1]Jurusan Pendidikan Matematika, FKIP, Universitas Syiah Kuala
Corresponding Author: ernimaidiyah@unsyiah.ac.id[1*]

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Abstract
The use of ethnomathematics which is part of learning with a contextual approach is expected to maximize students' mathematical reasoning abilities. Knowing the increase in students' mathematical reasoning abilities who are taught using the PBL model with ethnomathematical nuances is the purpose of this study. Through experimental research and pre-test-post-test control group design, the instrument used is a mathematical reasoning ability test. A T-test was performed to analyze the data. It was found that there was an increase in mathematical reasoning ability that was better in the experimental class than the control class based on the average N-Gain value of the experimental class of 0.54 with moderate criteria but 0.24 for the control class with low criteria. Based on the results of hypothesis testing, H1 was accepted, namely the increase in the mathematical reasoning ability of students who received learning with an ethnomathematical PBL model better than students who received conventional learning.

Abstrak
Pemanfaatan etnomatematika yang merupakan bagian dari pembelajaran dengan pendekatan kontekstual diharapkan dapat memaksimalkan kemampuan penalaran matematis siswa. Mengetahui peningkatan kemampuan penalaran matematis siswa yang diajarkan menggunakan model PBL bernuansa etnomatematika merupakan tujuan penelitian ini. Melalui penelitian eksperimen dan desain control group pre-test-post-test, instrumen yang digunakan yaitu tes kemampuan penalaran matematis. Uji-t dilakukan untuk menganalisis data. Diperoleh bahwa terjadi peningkatan kemampuan penalaran matematis yang lebih baik pada kelas eksperimen dibandingkan kelas kontrol berdasarkan nilai rata-rata N-Gain kelas eksperimen 0,54 dengan kriteria sedang tetapi kelas kontrol 0,24 dengan kriteria rendah. Berdasarkan hasil pengujian hipotesis, H1 diterima yaitu peningkatan kemampuan penalaran matematis siswa yang mendapat pembelajaran dengan model PBL bernuansa etnomatematika lebih baik dari siswa yang mendapat pembelajaran konvensional.

***Keywords**: Problem Based Learning (PBL); Mathematical Reasoning Ability; Ethnomathematics.*

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INTRODUCTION

One of the subjects taught at all levels of education is mathematics. This science is structured and integrated, about patterns of relationships and how to think to understand the world around. Good mathematical mastery will equip humans to have a logical, creative, critical mindset and be able to solve problems that exist in life (Agustyaningrum, 2014).

Mathematics as a structured and integrated science requires reasoning abilities. This is because students need reasoning in learning mathematics which includes thinking activities. Thinking activities as a form of reasoning activities affect a person's ability to conclude various premises logically, systematically, and critically. The existence of reasoning abilities in students will make it easier for these students to learn mathematics. Therefore, reasoning abilities are important and expected, especially in mathematics (Ramdani, 2012).

There are five mathematical abilities in the implementation of mathematics learning, such as 1) connection, that is the ability to connect mathematical ideas, mathematical ideas with other branches of knowledge, or mathematical ideas with the concept of life; 2) communication, that is the ability to convey mathematical ideas in various ways; 3) problem solving, that is the ability to obtain a solution to a problem whose solution is not yet clear; 4) representation, that is the ability to present mathematical ideas in various forms of presentation; and 5) reasoning, that is the ability to make conclusions, analyze patterns, explain various interpretations and predict solutions (NCTM, 2000). Therefore, the teacher's role is very crucial in developing reasoning abilities in students both through teaching and evaluation methods, that is supporting questions. Teachers need to anticipate the suitability of the material or method used to direct students to achieve learning objectives (Wahyudin, 2008).

The apparent fact is that mathematics learning in Indonesia is more focused on basic skills, and rarely emphasizes the application of mathematics and mathematical thinking in life (Saleh, Prahmana, & Isa, 2018). Indonesian students have a low level of reasoning, especially in the cognitive domain with an average percentage of 17% (Rosnawati, 2013). Reasoning ability is one of the goals of school mathematics, such as the mindset to conclude, cultivate problem-solving abilities, and foster communication abilities with oral, written, picture, and graphic.

Then, how about the facts on the ground? The mathematics teacher of SMP Negeri 10 Banda Aceh when interviewed revealed that the aspect of mathematical reasoning because of learning mathematics was still not optimal. When students were asked to solve problems with mathematical reasoning indicators, students were confused and found it difficult to solve them. Students more often got questions with standard procedures without interpreting the problems given. Research on reasoning ability also showed the low mathematical reasoning ability of students, namely with a percentage of 25% (low criteria) (Izzah & Azizah, 2019), and the dominant was in poor criteria (Rismen, Mardiyah, & Puspita, 2020). Reasoning questions are still new to students, so students are overwhelmed in reasoning activities. In addition, the low mathematical reasoning ability is also caused by the lack of student participation in the learning process and the learning that does not involve problems (Putri, Sulianto, & Azizah, 2019).

Mathematical reasoning is a habit

of thinking that can be improved by utilizing mental resources including integrating various contexts in mathematics (Miliyawati, 2014). Familiarizing reasoning activities in learning mathematics by applying practical problems is very important (Saleh, Prahmana, & Isa, 2018). Mathematical reasoning ability using everyday context aims to foster students' habits of applying a mathematical procedure in solving problems in new contexts. The reasoning process using real contexts will increase curiosity about mathematical concepts, as a result, students will be interested and challenged to solve the problems given. (Romdoni, 2021; Jacobsen, Eggen, & Kauchak, 2002).

One of the ways to improve mathematical reasoning abilities can be done through the provision of mathematics learning that is associated with contextual problems, because mathematics is a lesson that is close to the real environment of students and even becomes an indispensable part of living life. So that its use is always needed by the community. It has even become a tradition passed down from generation to generation. Without realizing it, they understand mathematical concepts correctly. This can be seen in the culture in the form of handicrafts and the mention of the size of the scales they usually use. Mathematics in culture was known as ethnomathematics.

Ethnomathematics was often found in the surrounding community, both in the form of historical relics, as well as community habits that have been passed on from generation to generation that contain elements of mathematics and mathematics learning materials (Martyanti & Suhartini, 2018). Ethnomathematical nuanced learning not only introduces mathematical elements to culture but can also remind students of the importance of preserving a culture that has been eroded by the progress of the times.

Aceh is an area that has an interesting cultural diversity. This province, which is located at the western end of Sumatra, has its uniqueness in terms of traditional houses, regional traditions, dances, crafts, food, traditional games, and so on. This uniqueness can be explored as a context in learning. Among the cultural objects found in Aceh are the wedding aisle, there are various forms on the aisle decoration according to the local wisdom of various ethnic groups in Aceh which indirectly contain mathematical values (Usnul, Johar, & Sofyan, 2019). At the aisle in Aceh, there are various forms of quadrilaterals contained in the mathematics material as shown in Figure 1, Figure 2, and Figure 3. This makes the quadrilateral material can be taught with ethnomathematical nuances.

Figure 1. Aceh Halua Breuh Traditional Cake in the form of Parallelogram

Figure 2. Tilam Pandak in the form of Square

Figure 3. One of the Various Kipah Shaped Kites

A learning model that is centered on practical problems is the Problem Based Learning (PBL) model. PBL involves various mathematical abilities including problem-solving abilities to construct fundamental concepts in mathematics. PBL is also formulated to lead students to develop thinking abilities, solve problems, and use their intellect to design various solutions to problems (Surya & Syahputra, 2017). PBL learning makes students work independently in constructing knowledge. Thus, the teacher acts as a facilitator who directs the learning flow. The PBL model encourages the development of problem-solving ideas. Students are required to reason with the concepts they already have.

The PBL model cannot be separated from problem-solving activities. Students in learning are guided to solve a problem to help students understand the material. Students learn to analyze incoming information, find problems, determine solutions, and find solutions according to the hypothesis of Arends (2004) which states that PBL can improve mathematical reasoning abilities.

Ethnomathematical PBL is the application of learning using problems related to the culture where students live. The use of ethnomathematics which is part and one of the learnings with a contextual approach is expected to maximize mathematical reasoning abilities through PBL models that use real-life problems at the beginning of their learning.

Previous research on increasing mathematical reasoning abilities had been widely studied. Research that had been carried out discusses students' representational abilities in terms of mathematical reasoning through PBL learning (Nurfitriyanti, Kusumawardani, & Lestari, 2020), as well as developing mathematical reasoning abilities and student learning independence through the PBL model (Putra & Ikhsan, 2019). Rakhmawati, (2016) implemented culture-based learning to improve the quality of education, a form of integrating cultural values in learning, and transforming culture through learning mathematics. However, research that discusses the culture of Aceh as a context for learning mathematics had not been carried out. The cultural context of Aceh is a learning component that should be integrated with mathematics. This integration is then expected to be learning that not only instills the concept of knowledge but also expands the reasoning capacity of students' mathematical reasoning.

Based on the explanation above, the purpose of this research is to find out whether the improvement of students' mathematical reasoning abilities who are taught using Problem Based Learning model with ethnomathematical nuances is better than students who are taught using conventional learning on quadrilateral material in class VII SMP 10 Negeri Banda Aceh. The hypothesis used is "the increase in students' mathematical reasoning abilities taught using PBL model with ethnomathematical nuances is better than that taught with conventional learning".

METHOD

The purpose of this study can be achieved by looking at the consequences of treatment through calculations. These activities were in the form of collecting data, interpreting the data, and presenting the results. By considering the activities carried out during the research, this research was quantitative research with an experimental approach (Arikunto, 2010). The type of design used is a true experimental design with the type of control group pre-test-post-test. The research population is the seventh-grade students of SMP Negeri 10 Banda Aceh. Sampling was done randomly. The experimental class is the class VII_A and the control class that is class VII_B.

This study involved instruments in the form of three mathematical reasoning questions on the rectangular material for each test (pre-test and post-test). The questions were obtained from various sources and content validated by lecturers and teachers in the field of mathematics education based on basic competencies, learning indicators, and measured reasoning indicators. The contents of the test had been declared valid. The pre-test questions with indicators of mathematical reasoning ability, namely explaining by using pictures, facts, properties, existing relationships, can be seen in Figure 4. While the post-test questions with indicators of mathematical reasoning ability are using relationship patterns to analyze, make analogies, generalize, and construct conjectures, are presented in Figure 5.

3. Tilam Pandak

Tilam pandak adalah singgasana kehormatan para pengantin yang disandingkan di pelaminan. Singgasana itu berupa sepasang bantal dengan ketebalan 7-10 cm dilengkapi sulaman kasab. Di bagian atas juga diberi atas kasab pula. Khusus motif yang dipilih untuk hiasan alas duduk. Motif tumbuhan dapat dijadikan pilihan. (*sumber: symbol dan makna kasab di Aceh Selatan*)

Bu Meurah membutuhkan kain beludru untuk membuat *tilam pandak* berukuran 35 cm x 35 cm. Pada pinggiran *tilam pandak* diberi pita berwarna cerah. Misalnya seperti gambar diberi warna kunig dan hijau dengan kain beludru warna merah.

Harga kain tersedia sebagai berikut:

Kain beludru Rp. 20.000/m

Kain beludru star Rp. 30.000/m

Harga pita :

Pita satin Rp. 3.000/m

Pita biasa Rp. 2.500/m

a. jika jenis kain yang tersedia masing-masing 3 m, berapa banyak *tilam pandak* yang dapat dibuat?

b. jelaskan kemungkinan jenis kain dan pita yang dapat dibeli bu Meurah, agar ia dapat mengeluarkan uang seminimal mungkin.

Figure 4. Pre-test Number 3 Problem

1. kaligrafi

Kaligrafi Islam masa Aceh Darussalam adalah merupakan sarana penyaluran refleksi kreatifitas seni dari senimannya. Para kaligrafer Aceh dengan kreatif berhasil memadukan seni kaligrafi Islam dengan unsur-unsur seni lokal. Sehingga muncul karya kaligrafi beridentitas Aceh. Pola hias tradisional yang sudah berkembang sebelumnya dipertahankan sedemikian rupa sehingga menghasilkan karya kaligrafis yang indah tanpa menghilangkan karakter tulisannya.

Amir ingin membuat bingkai kaligrafi dengan ukuran 45 cm x 45 cm. bagian pinggir pigura terbuat dari kayu dengan lebar 5 cm dan bagian dalam bingkai diberi pinggiran ornament di cat dengan warna hitam. Sisanya ditutupi kaca. Perkiarakan luas kayu yang dibutuhkan untuk pinggir pigura, panjang pingggiran yang dicat hitam dan luas kaca yang harus disediakan Amir.

Figure 5. Post-test Number 1 Problem

The data of this study were collected by using a test technique. Data on students' initial abilities were collected through a pre-test given to each group. As for getting information related to increasing mathematical reasoning abilities, a final test was given to each group. Mathematical reasoning ability data was obtained by scoring the answers to each question from the student test. The scoring criteria used a rubric adapted from Rahmah (2019) with mathematical reasoning indicators as shown in table 1.

Table 1. Mathematical Reasoning Scoring Criteria

Mathematical reasoning indicator	Student Response	Score
Give an explanation using pictures, facts, characteristics, and existing relationships	1. Did not give an answer	0
	2. Did not give explanations by using pictures, facts, properties, and relationships and did wrong calculations	1
	3. Did not give explanations by using pictures, facts, properties, and relationships but did the correct calculations	2
	4. Explained by using pictures, facts, properties, and existing relationships but did the wrong calculations	3
	5. Explained by utilizing pictures, facts, properties, and existing relationships and provide calculations correctly	4
Estimating the answer and the solution process	1. Did not give an answer	0
	2. Did not estimate answers and solution processes and did wrong calculations	1
	3. Did not estimate the answer and solution processes but provided the correct calculation	2
	4. Estimated the answer and solution processes but did the wrong calculation	3
	5. Estimated the answer as well as solution processes and provided the correct calculation	4
Using relationship patterns to analyze, make	1. Did not give an answer	0
	2. Did not use relationship patterns to analyze, analogize, generalize and	1

analogies, generalize and construct conjectures	construct conjectures and gave incorrect calculations	
	3. Did not use relationship patterns to analyze, analogize, generalize and construct conjectures but provided correct calculations	2
	4. Used relationship patterns to analyze, analogize, generalize and construct conjectures but gave wrong calculations	3
	5. Used relationship patterns to analyze, analogize, generalize and construct conjectures and provided correct calculations	4

This study used statistical tests as a procedure to analyze the data. The statistical tests used are: ***N-Gain* Test,** This test was conducted to determine the increase (gain) that occurred after learning in each group. This test is done by comparing the pre-test and post-test scores. According to Hake (Meltzer, 2002), the formula used is the normalized gain formula, that is:

$$Gain\ index(g)\ \frac{posttest\ scores - pretest\ scores}{maximum\ score - pretest\ scores}$$

The results of the normalized gain calculation were categorized into three (see Table 2).

Table 2. Gain Index Criteria

N-Gain	**Category**
g ≥ 0,7	High
0,3 ≤ g ≤ 0,7	Medium
g < 0,3	Low

***T-Test*,** this test was conducted to test the hypothesis after given that the N-Gain value is normally distributed and homogeneous. This test used a one-sided test, namely the right side to compare the two conditions. If the test results are obtained $t_{count}>t_{table}$, then Ho is rejected and H1 is accepted, and vice versa.

RESULTS AND DISCUSSIONS

Research Results

After completing the stages of data collection through pre-test and post-test, the mathematical reasoning ability scores of 25 students about quadrilaterals were obtained. The scores are presented in Table 3.

Table 3. List of Scores for Experiment Class and Control Class

No	Experimental Class		Control Class	
	Pre-test Scores	Post-test Scores	Pre-test Scores	Post-test Scores
1	25	58	25	42
2	42	71	42	54
3	25	58	38	46
4	38	67	38	50
5	46	75	33	46
6	42	71	29	50
7	54	85	29	46
8	29	58	33	54
9	33	62	29	50
10	38	67	33	58
11	42	75	38	62
12	46	75	38	58
13	46	75	46	71
14	50	83	25	42
15	38	67	25	38
16	33	62	38	50
17	42	63	42	54
18	42	75	29	54
19	25	75	33	42
20	25	58	25	46
21	33	62	25	38
22	38	71	38	50
23	29	62	29	46
24	46	75	21	33
25	50	83	21	29

Based on the pre-test scores, the data of class VII_A students who learned using the PBL model with ethnomathematical nuances (experimental class) had a variance s_1^2 = 72,33 and standard deviation s_1 = 8,50, while the data of class VII_B students who learned using conventional methods (control class) had a variance s_2^2 = 56,83 and standard deviation s_2 = 7,54. Normality test in the experimental class was obtained $x^2 < x^2_{(1-\propto)(k-3)}$ or $4{,}51 < 7{,}82$ and the control class was obtained $x^2 < x^2_{(1-\propto)(k-3)}$ or $5{,}24 < 7{,}82$ so it can be seen that the data in both classes were normally distributed.

The value of the increase that occurs after learning in each class was obtained by comparing the pre-test and post-test scores with the normalized Gain formula (N-Gain) so that the presentation of the N-Gain score data was obtained as shown in Table 4.

Table 4. N-Gain Score for Experimental Class and Control Class

No	N-Gain for Experimental Class	N-Gain for Control Class
1	0.44	0.23
2	0.50	0.21
3	0.56	0.13
4	0.39	0.19
5	0.46	0.19
6	0.79	0.30
7	0.67	0.24
8	0.48	0.31
9	0.37	0.30
10	0.60	0.37
11	0.50	0.39
12	0.54	0.32
13	0.54	0.46
14	0.84	0.23
15	0.47	0.17
16	0.43	0.19
17	0.43	0.21
18	0.57	0.35
19	0.50	0.13
20	0.44	0.28
21	0.37	0.17
22	0.47	0.19
23	0.46	0.24
24	0.54	0.15
25	0.66	0.10

Based on the N-gain scores data, the average N-Gain score of the experimental class is 0,54 (medium criteria) and the control class is 0,24 (low criteria). Experimental class had variance s_1^2 = 0,12 and standard deviation s_1 = 0,12, while control class had variance s_2^2 = 0,008 and standard deviation s_2 = 0,09. Based on the normality test for the distribution of N-Gain data in the experimental class, it was obtained $x^2 < x^2_{(1-\propto)(k-3)}$ or $5,50 < 7,82$ and control class was obtained $x^2 < x^2_{(1-\propto)(k-3)}$ or $2,24 < 7,82$ so that the data in both classes were normally distributed. The N-Gain variance homogeneity test showed that $F_{hitung} < F_{tabel}$ or $1,75 < 2,27$ so H_o is accepted. The conclusion obtained is that the N-Gain score data in both classes had a homogeneous variance.

If given that the two classes had homogeneous N-Gain scores, then the combined variance calculation was carried out. Then, a comparison of the two results was also carried out through the t-test. The data needed to calculate the variance are: $n_1 = 25$, $\overline{x_1} = 0,53$, $s_1^2 = 0,014$, $s_1 = 0,12$, $n_2 = 25$, $\overline{x_2} = 0,25$, $s_2^2 = 0,008$, dan $s_2 = 0,09$. So that the combined variance score can be calculated as follows:

$$s_{comb} = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}}$$

$$s_{comb} = \sqrt{\frac{(25-1)(0,014) + (25-1)(0,008)}{25+25-2}}$$

$$s_{comb} = \sqrt{\frac{0,336 + 0,192}{48}}$$

$$s_{comb} = \sqrt{\frac{0,528}{48}}$$

$$s_{comb} = 0,11$$

Hypothesis testing is done by calculating the value of t_{count} by the formula:

$$t = \frac{\overline{x_1} - \overline{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$t = \frac{0,53 - 0,25}{0,11\sqrt{\frac{1}{25} + \frac{1}{25}}}$$

$$t = \frac{0,28}{(0,11)(0,28)}$$

$$t = \frac{0,28}{0,0297}$$

$$t = 9,44$$

Based on the t distribution table, with $\alpha = 0{,}05$ and $dk = n_1 + n_2 - 2 = 25 + 25 - 2 = 48$, it is obtained $t_{(0{,}95)(48)} = 1{,}68$. Statistical analysis results obtained $_{count}$ = 9,44 and $_{table}$ = 1,68 or $t_{count} > t_{table}$. Thus, H_0 is rejected and H_1 is accepted. This means that the increase in students' mathematical reasoning abilities in the experimental class is better than in the control class.

Discussions

The results showed that there was an increase in the students' mathematical reasoning ability who studied in the experimental class before and after learning. The increase in mathematical reasoning ability in the experimental class is better than in the control class. The interpretation is based on the average N-Gain scores of the experimental class 0.54 (medium criteria) and the control class 0.24 (low criteria). This showed the effective role of the PBL model with ethnomathematical nuances in improving students' mathematical reasoning abilities because the PBL model ethnomathematical nuances made real problems with ethnomathematical nuances as the beginning of learning. The same thing was found by Huda, Kharisma, Qoma, and Jermsittiparsert (2020) where the PBL learning model had a positive and significant effect on improving students' mathematical reasoning abilities.

The PBL learning model is known as a learning model that makes problems as the center of learning. Problems that need to be solved become the subject of discussion in PBL learning. The PBL model requires students to actively participate in problem-solving. Students solve problems by analyzing problems individually and in groups. The problem posed to students is in the form of contextual problems, meaning that the problem contains conditions that have been studied and are familiar to students. Students can use the concept of knowledge they have to solve problems. In addition, the questions are packaged in the context of the local culture so that students are more interested in working on them.

This study emphasizes the application of problems to the cultural context in Aceh at each meeting. The cultural context presented at the first meeting relates to *Rumoh Krong Bade* or more known as *Rumoh Aceh* that is the traditional house of the Acehnese people. Students get information about the privileges of *Rumoh Aceh*, such as (1) *Rumoh Aceh* is in the form of a stilt house built from seumantok wood and (2) the construction of *Rumoh Aceh* strong even though only using palm fiber rope, pegs, and wedges to replace nails. In addition, students are also introduced to parts of *Rumoh Aceh*, such as *seramai* (porch). *Seramai* is a front room that functions as a place to receive male guests if there is a wedding or feast, as a place for children's recitations, as a place to sleep for single boys, and as a place for family meetings that only involve men. The *seramai* area is approximately 3 m x 7 m until 3 m x 12 m. *Rumoh Aceh* Building and *seramai* which are in the Aceh Museum can be seen in Figure 6 and Figure 7. This information is used to provide a stimulus to students in determining the perimeter and area of quadrilaterals, such as rectangles and squares.

Figure 6. Rumoh Aceh

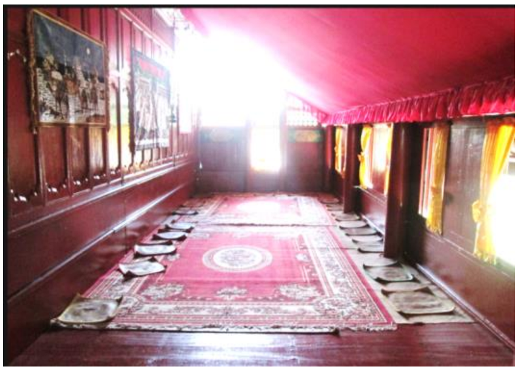

Figure 7. Seramai Rumoh Aceh

The second meeting introduces students to *bubong*, namely the roof of *Rumoh Aceh* which is *a* trapezoidal shape. *Bubong* is made of wicker *on meuria* (leaves of thatch) which are tied with rattan that has been cut into small pieces. The wicker of sago palm leaves was attached to a bubong bone made from split areca nut or bamboo stalks 4 cubits long (± 2 meters). Each sheet used spends approximately 10 m of rattan. *Peudap* (roofing) process is done by arranging each sheet in such a way and tied with rattan on the *beuleubah* (rafter). The difference between the longest and shortest sides of the roof is approximately 3-5 meters. *Bubong Rumoh Aceh* is presented in Figure 8. In addition, students were also asked to observe *halua breuh* that is Acehnese traditional cake cut in the shape of a parallelogram. B*ubong* and *halua breuh* contexts are used to assist students in studying the perimeter and area of quadrilaterals, such as parallelograms and trapezoids.

Figure 8. Bubong Rumoh Aceh

At the last meeting, students were invited to get to know *Kasab* which is a traditional Acehnese craft. *Kasab* is a craft of gold thread that forms the aisle. Its use is for decorating the aisle in traditional ceremonies such as seven months, birth, marriage, circumcision, and death. Each shape, motif, and color that makes up the aisle has its meaning. Now *kasab* is no longer devoted to the aisle but as the interior of the room. One type of *kasab* is *kaniang* (tongues) which is shaped like a kite and a rhombus. *Kasab* as the room interior and *kaniang* are presented in Figure 9 and Figure 10. This information is used by the teacher to guide students to determine the perimeter and area of a quadrilateral, such as parallelograms and trapezoids.

Figure 9. Kasab as pillow decoration

Figure 10. Kaniang

The cultural context of Aceh presented in the problem on the quadrilateral material is not only as decoration material. Through these ethnomathematics, students realize the urgency of mathematics in life. Learning mathematics is not in vain, even mathematics facilitates human activities. Students are interested in learning where students still talk about their curiosity about objects in Acehnese culture after class ends. Ethnomathematical nuanced mathematics learning is in line with the realm of school mathematics, including mathematics as an activity to find patterns and relationships between one another as well as creativity that requires business imagination in solving problems. (Marsigit, Condromukti, Setiana & Hardiarti, 2018). The potential of students can be directed optimally, including the desire of students to learn if accompanied by the provision of motivation, a unique way of learning (not routine), the existence of cooperation and collaboration, as well as a different atmosphere in learning. (Ebbutt & Straker, 1995).

Contextual problems accompanied by the presentation of non-routine problems require students to apply higher order thinking skills in solving problems. Students will get used to predicting appropriate solutions, analyzing various patterns, and summarizing the information obtained. This is part of the indicators of mathematical reasoning which is also the goal of the PBL model. Students will also collaborate and negotiate on their hypotheses so that student activity during learning increases. Through this experience, it is hoped that there will be an increase in students' reasoning abilities (Arends, 2004).

Lack of students' mathematical reasoning ability does not just happen. Various factors that influence them include students having very little practice in solving reasoning problems at school, so they do not train students to have good reasoning abilities. This is caused by learning that has become routine, that is the teacher teaches mathematics by explaining concepts, presenting examples of questions, and directing students to solve problems like the questions that have been explained by the teacher without demands to develop thinking skills.

In accordance with this study, students in the experimental class showed a good response. The ability to re-explain the material, problems given, and solve problems with nuances of local culture is developed. Students are more active in solving problems obtained and discussing ideas with friends or teachers. According to the students, the problems with the cultural context in Aceh helped them in interpreting the learning materials. Students also consider the problem important to be solved. While students in the control class were not very active in learning, students listened to the delivery of material and followed the teacher's instructions without maximum curiosity, then in groups worked on the assigned tasks.

From several discussions, it was concluded that the PBL model with ethnomathematical nuances has a role to maximize student activity and creativity in learning and obtain a learning experience that is long remembered by students. This is a result of activities during learning where students and their groups investigate and determine problem-solving independently. Students are trained to work together to solve problems. The PBL model with ethnomathematics nuances provides real problems with the nuances of Acehnese culture. This makes students develop curiosity and are more interested in the culture that exists in Aceh. In line with Ausubel's theory of meaningful learning theory, where learning has meaning for students if the process is associated with everything that is in the student's environment (Vallori, 2014).

CONCLUSIONS

This study concludes that the improvement of students' mathematical reasoning abilities who are taught using PBL models with ethnomathematical nuances is better than students who are taught using conventional learning on quadrilateral material at SMP Negeri 10 Banda Aceh.

Based on the explanation above, the following can be suggested: (1) Teachers can use the PBL model with ethnomathematical nuances to other materials in appropriate mathematics learning. (2) Ethnomathematics is an acquired science and human habit, which without realizing it has a mathematical element. Indirectly, they know mathematics itself. Through this research, it is hoped that it can be a guardian for further research in recognizing ethnomathematics in their respective regions. Further research needs to be done to test the effectiveness of the PBL model with ethnomathematical nuances at the elementary and high school levels. (3) The research that has been done only examines the improvement of mathematical reasoning abilities in general, so those future researchers are expected to consider students' initial abilities as the basis for increasing mathematical reasoning abilities.

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