

ETHNOMATHEMATICS: OPTIMIZATION OF STUDENTS' MATHEMATICAL REASONING THROUGH THE TRADITIONAL CEREMONY OF SEREN TAUN AND THE BANTEN BENDRONG LESUNG DANCE

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Abstract. The fundamental problem that causes this study is that the low mathematical reasoning ability of students and culture in Banten has not been explored optimally for classroom learning. This study aims to compare the mathematical reasoning ability of students who use ethnomathematics-based learning with conventional learning, as well as mathematical elements contained in Banten culture. The target is junior high school students with transformation materials. The approach used by the researcher is quantitative research. The research method used is a quasi-experiment with a pre-post control group design. The population in this study is grade IX students of SMP PGRI 1 Tangerang with a sample of 72 students. Researchers used independent sample t-tests to analyze the data. The results obtained by the researcher were the average post-test score of the experimental class of 72.56 and the control class of 54.11, which means that ethnomathematics-based learning is better than conventional learning in optimizing students' mathematical reasoning skills. Creativity is needed to find the elements of mathematics contained in Banten culture, and then it is necessary to conduct further research whether ethnomathematics-based learning can improve students' abilities other than reasoning.

Keywords: Ethnomathematics, Seren Taun Traditional Ceremony, Bendrong Dance Lesung, Mathematical Reasoning Ability

Abstrak. Permasalahan mendasar yang menyebabkan penelitian ini adalah rendahnya kemampuan penalaran matematis siswa dan budaya di Banten belum tereksplorasi secara maksimal untuk pembelajaran di kelas. Penelitian ini bertujuan untuk membandingkan kemampuan penalaran matematis siswa yang menggunakan pembelajaran berbasis etnomatematika dengan pembelajaran konvensional, serta unsur-unsur matematika yang terkandung dalam budaya Banten. Sasarannya adalah siswa SMP dengan materi transformasi. Pendekatan yang digunakan peneliti adalah penelitian kuantitatif. Metode penelitian yang digunakan adalah quasi eksperimen dengan *pre-post control group design*. Populasi dalam penelitian ini adalah siswa kelas IX SMP PGRI 1 Tangerang dengan sampel sebanyak 72 siswa. Peneliti menggunakan uji-t sampel independen untuk menganalisis data. Hasil yang diperoleh peneliti adalah rata-rata nilai post-test kelas eksperimen sebesar 72,56 dan kelas kontrol sebesar 54,11 yang berarti pembelajaran berbasis etnomatematika lebih baik dibandingkan pembelajaran konvensional dalam mengoptimalkan kemampuan penalaran matematis siswa. Diperlukan kreativitas untuk menemukan unsur-unsur matematika yang terkandung dalam budaya Banten, dan kemudian perlu dilakukan penelitian lebih lanjut apakah pembelajaran berbasis etnomatematika dapat meningkatkan kemampuan siswa selain penalaran.

Kata Kunci: Etnomatematika, Upacara Adat Seren Taun, Tari Bendrong Lesung, Kemampuan Penalaran Matematika

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INTRODUCTION

Education is an essential factor for all humanity, and those who follow the development of Education have a broad view of themselves and their surroundings. According to Shavkidinova, et al. (2023), Education can improve human life and the country's development with individual success, job opportunities, and an increased understanding of the environment and people's rights. Mathematics is an abstract and sophisticated topic, so starting when they enter the school world, it will be difficult to learn in school. Many students think math is tedious and challenging to learn, even though mathematics has become an essential skill for everyone, especially students. The ability to analyze data, understand algorithms, and think critically is highly appreciated daily, especially when facing various challenges in the digital era. According to Hoshino (2018), mathematics develops critical thinking, creativity, and oral and written communication with data that other subjects cannot.

A more innovative approach is needed to increase students' interest in learning mathematics so that students can be more active and interested in the learning process, one of which can be applied using an ethnomathematics-based approach. According to Fouze & Miriam (2019), combining ethnomathematics with a formal mathematics curriculum can improve students' academic achievement by strengthening their self-image and motivation to learn mathematics. This approach offers a different learning experience by introducing new nuances in math learning. Not only that, this approach is more than just learning in the classroom; it is an ethnomathematics-based approach that invites students to explore their surroundings, visit historical places, or interact with local cultures. Ethnomathematics opens opportunities to relate mathematics learning to everyday life and understand the role of culture in the context of mathematics, primarily through the traditional ceremony of the year seren taun and the bendrong mortar dance in the Banten area.

The traditional ceremony of seren taun and the bendrong lesung dance is one part of several customs and arts from Banten Province. Banten Province, the owner of agrarian areas, has immensely benefited from abundant natural resources (SDA), such as rice and corn, which are staples of the Indonesian people. Due to the gratitude of the Banten, they held the Seren Taun Traditional Ceremony to welcome the arrival of the harvest season and the Bendrong Lesung Dance, which has dance movements like the people of Banten when planting rice. The content of the meaning is exciting in the traditional ceremony of seren taun, and the bendrong lesung dance and several mathematical concepts can be applied in mathematics learning, like the concept of translation in the traditional ceremony of seren taun when adult men flock to the center by carrying a rengkong while moving to the right and left. There is also the concept of

dilation on the umbrella that is carried because the umbrella has the same shape but a different size, such as experiencing an enlargement. Then, the mortar dance also has a rotation concept, where all dancers pound rice using a mortar and pestle in a circular position at one point.

According to Widada et al. (2018), mathematics learning based on realistic and ethnomathematical approaches has improved students' understanding of mathematical concepts compared to conventional learning methods. With this approach, students learn about mathematical concepts in the abstract and see how mathematics is applied in real-life contexts relevant to their culture and daily life. According to the National Council of Teachers of Mathematics (NCTM) (2000), students must master the five primary abilities of mathematics learning. These essential skills include problem-solving, connection, reasoning, communication, and mathematical representation. Reasoning itself has been explained by Keraf (Marfu'ah et al., 2022), who states that reasoning is a person's thought process that connects several known facts to a conclusion. Based on the observation of grade IX students at SMP PGRI 1 Tangerang, which is the school that was studied, using four student mathematical reasoning questions, the results obtained are that there are several students whose mathematical reasoning skills are still low, it can be said that students' mathematical reasoning skills in learning are not optimal. So, researchers try to change the learning model to be ethnomathematics-based to optimize students' mathematical reasoning skills. Students familiar with mathematical and cultural problems can help them continuously get used to proving a problem in mathematical form.

The following are the average results of the mathematical reasoning ability test in both classes, with question 1 with an average of 2 points obtained from the highest point of 5, question 2 with an average score of 2, question 3 with an average score of 1, and question 4 with an average score of 0. This shows that students' mathematical reasoning skills are still relatively low. According to Fitria et al. (2024), in their research, ethnomathematics-based learning can produce better students' mathematical reasoning skills compared to direct learning. So that students can solve problems using mathematical reasoning and actively respond to questions asked by teachers or classmates. With this, it is hoped that ethnomathematics-based learning can optimize students' mathematical reasoning skills.

METHOD

This research is quantitative; according to Sujarweni (2016), quantitative research is a type of research that produces discoveries that can be achieved (obtained) using statistical procedures or other methods of quantification (measurement). The quantitative approach

focuses on phenomena with specific characteristics in human life, which are named variables. In the quantitative approach, the nature of the relationship between variables is analyzed using objective theory.

In this study, the researcher used a pre-post control group design research design. In this study, the researcher wanted to determine whether students' mathematical reasoning skills could be optimal after being given ethnomathematics-based learning compared to conventional learning. This research was carried out at SMP PGRI 1 Tangerang starting from July 2024 for 1 month with a schedule of class IX.6 as an experimental class and IX.3 as a control class. The instruments in the study consist of two, namely: (a) learning tool instruments in the form of Learning Implementation Plans (RPP) and Student Worksheets (LKPD); (b) supervision instruments in the form of an interview test to the head of the Banten Provincial Cultural Office and a written test of 5 description questions to measure students' mathematical reasoning skills.

Data analysis theory includes a). Description of the pre-test and post-test analysis results in the experimental and control classes on the transformation material, b). The prerequisite analysis consisted of normality and homogeneity in the normality test using Shapiro-Wilk and the homogeneity test using the Levene test, c). The hypothesis test using the t-test with the H_0 criterion showed there was no difference in the mathematical reasoning ability of students who used ethnomathematics-based learning with conventional learning, and H_1 , there was a difference in the mathematical reasoning ability of students who used ethnomathematics-based learning and conventional learning.

RESULTS AND DISCUSSION

This study was conducted to test how optimal students' mathematical reasoning skills were through the traditional ceremony of *seren taun* and ethnomathematics-based *mortar dance* in grade IX students of SMP PGRI 1 Tangerang. The research sample consists of two classes: an experimental class that uses ethnomathematics-based learning and a control class that uses conventional learning methods. This research took place from the beginning of July 2024 for 1 month with an experimental class (IX.6) and a control class (IX.3).

Description of Mathematical Reasoning Ability Results

Table 1. Results of pretest and posttest descriptive analysis

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Posttest-Eksperimen	36	40	100	72.56	17.082
Pretest-Eksperimen	36	8	72	30.56	18.196
Pretest-Kontrol	36	4	64	22.11	14.981
Posttest-Kontrol	36	4	96	54.11	27.372
Valid N (listwise)	36				

The table shows that the average score of the student's mathematical reasoning ability test before being given the *pretest* in the control class was 22.11, with the highest score of 64 and the lowest score of 4. Meanwhile, the average score of the student's reasoning ability test after being given a post-test was 54.11, with the highest score being 100 and the lowest score being 40. The average results of students' mathematical reasoning ability test before being given the *pretest* in the experimental class were 30.56, with the highest score being 72 and the lowest being 8. Meanwhile, the average score of the student's mathematical reasoning ability test after being given the post-test in the experimental class was 72.56, with the highest score of 100 and the lowest score of 40. Thus, after being treated in the experimental and control classes, the results show that students' mathematical reasoning skills can be optimal using ethnomathematics-based learning compared to conventional learning.

Normality and Homogeneity Test

The Shapiro-Wilk normality test showed that the *control class and the experiment's pre/post-test data* were normally distributed, with a significance value of > 0.05 each. The homogeneity test using *the Levene Test* also showed that the data variance of the two samples was homogeneous, with the value of $F_{cal} < F_{tabel}$ and the significance value of *the Levene Test* > 0.05 . This suggests that the data can be further analyzed using hypotheses.

Uji Hipotesis

Hypothesis testing was conducted to test whether ethnomathematics-based learning in the traditional ceremony of *seren taun* and the *bendrong mortar* dance can optimize students' mathematical reasoning ability. The hypotheses tested were:

- H₀: There is no difference in the mathematical reasoning ability of students using ethnomathematics-based and conventional learning.

- H1: There is a difference in the mathematical reasoning ability of students who use ethnomathematics-based learning and conventional learning.

Table 2. Results of students' mathematical reasoning ability hypothesis test

		Independent Samples Test									
		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
N gain	Equal variances assumed	9.248	.003	2.110	70	.019	.038	10.000	4.740	.547	19.453
	Equal variances not assumed			2.110	57.942	.020	.039	10.000	4.740	.513	19.487

Based on the independent *samples test output table*, the Sig. (2-sided p) value was obtained of 0.038, which means $P < 0.05$. Thus, it can be concluded that H_0 was rejected and H1 was accepted, so there was a difference in the experimental or control classes before and after treatment. This means that students' mathematical reasoning skills can be optimal after being given treatment.

Ethnomathematics Discovery Results

Ethnomathematical research on mathematical elements contained in the *traditional ceremony of seren taun* and the *bendrong mortar* dance on geometric transformation materials that can be used as learning media include:

Concept of Translation



Figure 1. Men walking with boards

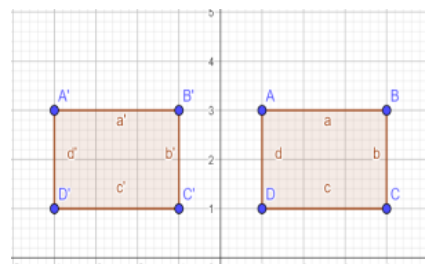


Figure 2. Translation in the coordinate plane

In the traditional *ceremony of the year*, when the men walk while carrying a board, as shown in Figure 1, the board will shift its position if applied to the coordinate plane. Figure 2 shows the change in position in the coordinate plane



Figure 3. Leuit
Cisungsang

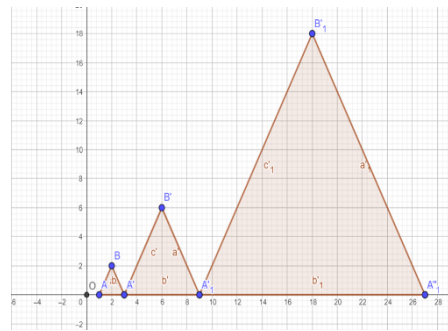


Figure 4. Dilatation in the
coordinate plane

Dilatation Concept

In Figure 3, if we pay attention to the roof, the rice storage area (legit) at the traditional ceremony of the year seems to have been enlarged, where the leftmost part looks smaller, then medium, and the right part is the largest so if it is depicted in the coordinate plane like the dilatation concept in figure 4.



Figure 5. Dancer movements at
the traditional ceremony of the
year

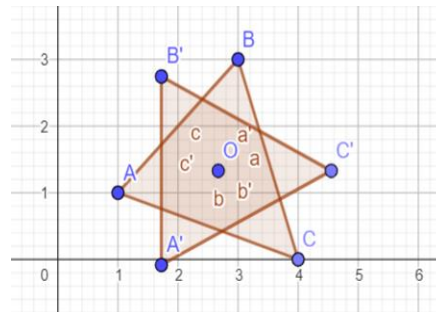


Figure 6. Rotation in the
coordinate plane

Rotation Concept

Figure 5 shows three dancers in the traditional ceremony of *seren taun*. If we draw a straight line like a triangle, the dancers rotate each other's positions. So, if we draw it in the coordinate plane, it will look like Figure 6.



Figure 7. Movements in the mortar dance

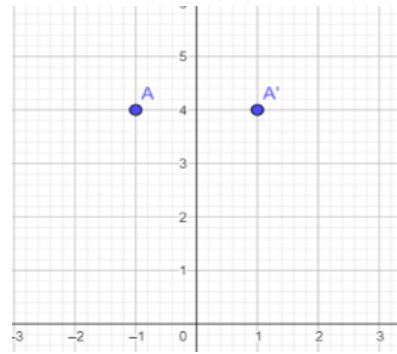


Figure 8. Reflection on the coordinate plane

Concept of Reflection

Figure 7 shows the movement in the *mortal dance* with the left and right dancers facing each other. If we draw a field of coordinate planes like a reflection, where the left dancer reflects against the y-axis, the right dancer will be at the opposite point, as shown in Figure 8. Many findings can be used as material for learning media from these four examples.

Optimizing Students' Mathematical Reasoning Skills Through the Seren Taun Traditional Ceremony and the Banten Bendrong Lesung Dance

Based on the results of the data processing that the researcher has carried out, it can be concluded that ethnomathematics-based learning through the traditional ceremony of *seren taun* and the Banten *mortal dance* affects the mathematical reasoning ability of grade IX students.6. The average result of *the post-test* of students in the experimental class is greater than the average result of *the post-test of students in the control class or conventional learning*. Ethnomathematics-based learning, primarily through the traditional ceremony of *the year seren taun* and the *bendrong mortal* dance, has the potential to optimize students' mathematical reasoning skills because, through ethnomathematics-based learning using the *connected mathematics project* learning model, students will learn to identify, explore, prove to conclude or determine the pattern of a mathematical form by observing a cultural problem.

Based on the results of previous research, it can be concluded that mathematical reasoning ability using the *Connected Mathematics Project (CMP)* learning model with a contextual approach is better than the direct learning model (Febrianti et al., 2021). Meanwhile, the development of ethnomathematics-based teaching materials has also been proven to improve students' mathematical reasoning skills using *the Auditory, Intellectually, Repetition (AIR)*

learning model (Yandita & Nuriana, 2022). Thus, the researcher uses the *Connected Mathematics Project* (CMP) learning model with an ethnomathematical approach to improve students' mathematical reasoning skills.

Data was obtained through the learning process and then analyzed by researchers. It was found that students' mathematical reasoning skills could be optimal after being given ethnomathematics-based learning, where students were invited to explore and conclude a problem. This can be seen in Appendix 13. The post-test results in the experimental class are better than those in the control class, with the most oversized score item of 5 points, which means that the answers to the student's test results meet the indicators of mathematical reasoning ability. The following is an example of the answer result from one of the students after being given a post-test in the experimental class:

Level 1 (Suspected)

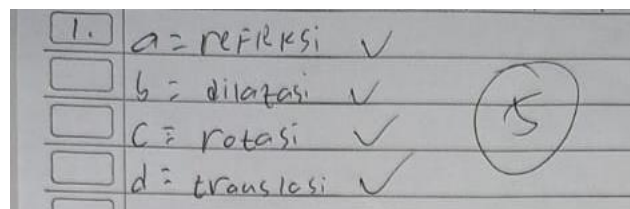


Figure 9. Post-test answer results for student number 1 level 1 (expected)

Figure 9 shows the results of the work of high-category students who can answer with 5 points; number 1 can guess the shadow of a building that has undergone a similar transformation and give the transformation category correctly.

Level 2 (Manipulation)

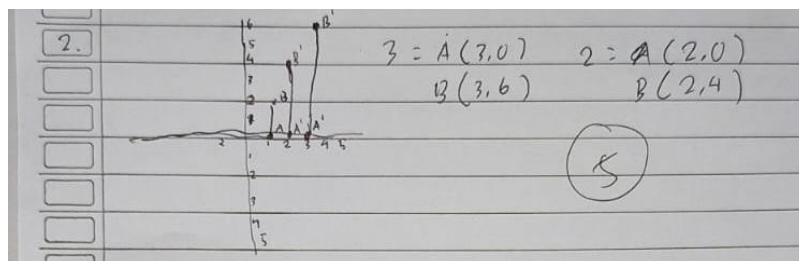


Figure 10. Post-test answer results for student number 2 level 2 (manipulation)

Figure 10 shows the level of manipulation answers by students with a high category of determining a problem's coordinate points and correctly showing them in the coordinate field.

Level 2 (Manipulation)

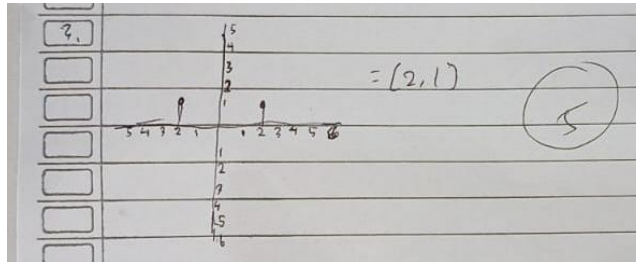


Figure 11. Post-test Answer Results for Student Number 3 Level 2 (Manipulation)

Figure 11 shows the level of manipulation answers by students with a high category of determining a problem's coordinate points and correctly showing them in the coordinate field.

Level 3 (Analyze)

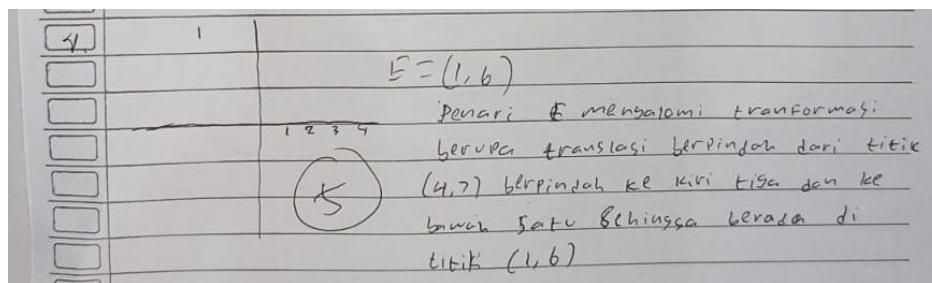


Figure 12. Post-test answer results for student number 4 level 3 (analyze)

Figure 12 shows the answers of the manipulation level by students with a high category can correctly give the conclusion of a problem and show the evidence correctly on the coordinate field.

Level 4 (Finding patterns)

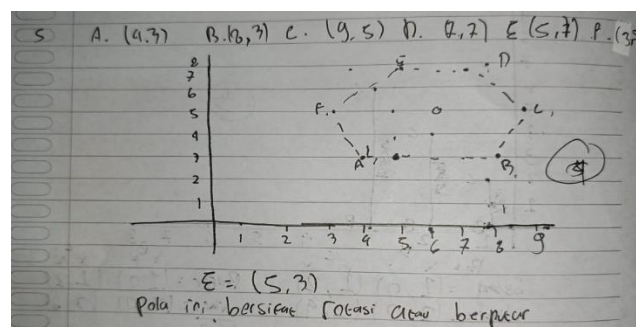


Figure 13. Post-test answer results for student number 5 level 4 (manipulating)

Figure 13 displays the level of manipulation answers by students with a high category of determining the shadow of a building after being given a transformation and the pattern or properties of a transformation correctly and then proving it in the field of coordinates. Based on the results of *the post-test* answers of the students above, the numbers 1 to 5 are included in the high category. It is just that not all students get 5 points; some still get one or even 0 points.

CONCLUSION

The results showed that ethnomathematical learning that integrated mathematical elements from the seren taun ceremony and the mortar bendrong dance significantly improved students' mathematical reasoning skills compared to conventional learning. By connecting abstract mathematical concepts with cultural contexts familiar to students, ethnomathematics learning not only makes the material more interesting, but also helps students build a deeper and more thorough understanding of mathematical concepts. The project method used in this study, in which students are actively involved in finding, confirming, and deducing mathematical problems, has been shown to be effective in developing students' critical thinking and problem-solving skills. Through mathematical projects designed based on the mathematical elements contained in both cultures, students are invited to observe, analyze, and evaluate various mathematical patterns, relationships, and concepts. This process gradually trains students to think logically, systematically, and critically, which is an essential component of mathematical reasoning abilities. These findings indicate that ethnomathematics can be an interesting alternative to overcome various challenges in mathematics learning, such as low learning motivation and difficulty understanding abstract concepts.

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