



INTEGRATING THINK-PAIR-SHARE AND ETHNOMATHEMATICS: LEARNING PLANE AND SOLID GEOMETRY THROUGH EXPLORATION OF SUMENEP GRAND MOSQUE

Adin Lazuardy Firdiansyah^{*1}, Sitti Karimah Sulfiah², Dewi Rosikhoh³, Fatimatuz Zahroh⁴, Nur Hasanah⁵

^{1,2,3,4,5} Islamic State University of Madura

Article Info

Article history:

Received Apr 25, 2026

Revised Mei 01, 2026

Accepted Mei 26 2026

Keywords:

Cooperative learning

Ethnomathematics

Grand mosque of Sumenep

Think-Pair-Share

ABSTRACT

This study aims to analyze the implementation, effectiveness, and student responses to the Think-Pair-Share (TPS) learning model based on ethnomathematics through exploration of the Grand Mosque of Sumenep. This study used mixed methods with a Sequential Explanatory design. The subjects were 32 10th grade students at MAN 2 Pamekasan. Quantitative data were obtained through pre-tests and post-tests to measure conceptual understanding, as well as questionnaires to measure student responses. Qualitative data were obtained through observation, interviews, and documentation to explore the implementation process and explain quantitative findings. Quantitative data analysis used Paired T-test, while qualitative data analysis used Miles & Huberman interactive model. The results of the quantitative study showed a statistically significant increase in students' understanding of geometric concepts, with an average score increasing from 49.03 to 83.81. Qualitative findings explained that this success was supported by main factor, namely the TPS structure, especially the "Pair" stage (discussion in small groups), proved to be a very effective safe zone for students to do peer tutoring and overcome fears experienced by students. It was concluded that the implementation of the ethnomathematics-based TPS model was effective and positive in significantly improving students' understanding of geometric concepts.

This is an open access article under the [CC BY](#) license.



Corresponding Author:

Adin Lazuardy Firdiansyah,
Departement of Mathematics Education,
Islamic State University of Madura, Pamekasan, Indonesia
Email: adin.lazuardy@iainmadura.ac.id

How to Cite:

Firdiansyah, A., Lazuardy., Sulfiah, S., Karimah., Rosikhoh, D., Zahroh, F., & Hasanah, N. (2026). Integrating Think-Pair-Share and Ethnomathematics: Learning Plane and Solid Geometry Through Exploration of Sumenep Grand Mosque. *JME: Journal of Mathematics Education*, 11(1), 129-140

1. INTRODUCTION

The development of high-quality human resources in the 21st century is closely linked to the quality of education, particularly mathematics education, which plays a strategic role in fostering logical, analytical, critical, and creative thinking skills. Mathematics is not only a body of knowledge but also a tool for understanding and solving problems encountered in daily life (Juita et al., 2024). However, despite its importance, mathematics is still widely perceived by students as an abstract and difficult subject, resulting in low motivation and unsatisfactory learning outcomes. This condition is particularly evident in geometry learning, where students are required to visualize objects, understand spatial relationships, and connect mathematical formulas with real-world representations (Lestari et al., 2024). As a result, many students struggle to understand both plane and solid geometry concepts, which ultimately affects their overall mathematical understanding.

Geometry is a fundamental component of mathematics that requires strong visualization and spatial reasoning abilities. Learning about plane and solid shapes involves recognizing structures, identifying properties, and connecting these properties to formulas and measurements (Kyaw & Vidákovich, 2025). However, in many classroom practices, geometry is still taught using conventional approaches where teachers emphasize memorization of formulas and procedural problem solving without providing meaningful contextual experiences. This approach limits students' opportunities to construct their own understanding of geometric concepts. Consequently, students often fail to relate mathematical concepts to real objects in their surroundings, which leads to superficial understanding and low retention of knowledge (Sahara & Nurfauziah, 2021). Therefore, an instructional innovation is needed to bridge abstract mathematical ideas with students' real-life experiences, especially in geometry learning.

One promising approach to making mathematics more meaningful is ethnomathematics-based learning. Ethnomathematics integrates cultural values, local wisdom, and environmental contexts into mathematics instruction, allowing students to discover mathematical concepts embedded in cultural practices and artifacts (Aulia et al., 2019). Through this approach, mathematics becomes more relevant and meaningful because students learn concepts through familiar contexts. Ethnomathematics also encourages students to appreciate local culture while simultaneously developing mathematical understanding. Previous studies have shown that learning based on cultural objects can improve students' engagement and conceptual understanding because mathematical ideas are presented in concrete and observable forms (Gbormittah et al., 2025). Therefore, ethnomathematics provides a suitable framework for contextual geometry learning.

Within the context of Madurese local culture, the Sumenep Grand Mosque represents a cultural heritage site rich in historical and architectural value. The structure of the mosque contains various geometric elements that can be explored in mathematics learning. For instance, rectangular shapes appear in doors and windows, cylindrical and rectangular prisms can be identified in pillars, and the main dome and minarets represent hemispherical, conical, and pyramidal shapes. These architectural components provide authentic learning resources for understanding plane and solid geometry concepts (Firdiansyah et al., 2024). The use of the Sumenep Grand Mosque as a learning context allows students to observe geometric shapes directly, measure dimensions, and connect formulas to real objects. Additionally, integrating local cultural heritage into mathematics learning can increase students' cultural awareness and foster appreciation for historical buildings (Jannah et al., 2025). Therefore, the exploration of the Sumenep Grand Mosque offers a meaningful context for geometry learning.

Although ethnomathematics provides a contextual learning environment, effective implementation also requires an instructional model that encourages active student participation. One cooperative learning model that supports active engagement is Think-Pair-Share (TPS). The TPS model provides structured learning stages consisting of thinking individually, discussing ideas with peers, and sharing results with the whole class. This learning structure encourages students to actively construct knowledge, communicate ideas, and collaborate in solving problems (Irma et al., 2020). Through TPS, students are not only passive recipients of information but also active participants in the learning process. Moreover, TPS learning promotes deeper conceptual understanding because students have opportunities to reflect individually, refine their ideas through discussion, and validate understanding during class presentations.

Several previous studies support the effectiveness of TPS and contextual learning in mathematics education. Research by Najichah et al. (2025) revealed that the TPS model effectively improves students' communication and collaboration skills during mathematics learning. Similarly, a case study conducted by Amaliyah et al. (2022) identified that one of the main difficulties in learning plane and solid geometry is students' inability to connect formulas with real three-dimensional objects. The study recommended the use of contextual learning to bridge abstract concepts with real-world representations. Furthermore, Yuwana et al. (2025) reported that the implementation of the TPS model assisted by learning media significantly improved students' problem-solving abilities. The TPS structure helped students identify problems, discuss solutions, and present results systematically.

In addition to TPS-based learning, ethnomathematics research also shows promising results. Avitasari and Mulyatna (2024) found that exploring local cultural elements, such as East Javanese batik, significantly increased students' learning motivation. Students demonstrated higher engagement when mathematical concepts were connected to their cultural environment. Similarly, Situmorang et al. (2025) utilized the Toba Batak traditional house as a learning medium for spatial geometry and found that direct observation of cultural objects helped students visualize complex geometric structures. Qudsyah et al. (2024) also confirmed that the TPS cooperative learning model improves both learning outcomes and communication skills. Additionally, Hanifah Fitriyani and Putri (2024) identified that students' difficulties in spatial geometry mainly stem from the inability to connect geometric shapes with formulas, and the study recommended contextual learning approaches as a solution.

Although previous studies demonstrate the effectiveness of TPS learning and ethnomathematics separately, research integrating the TPS cooperative learning model with ethnomathematics-based exploration of cultural heritage objects remains limited. In particular, studies that utilize the Sumenep Grand Mosque as a contextual learning resource for understanding plane and solid geometry concepts have not been widely conducted. This gap highlights the need for research that combines cooperative learning strategies with culturally relevant contexts to enhance students' conceptual understanding in geometry.

Therefore, this study aims to investigate the implementation of the Think-Pair-Share (TPS) cooperative learning model integrated with ethnomathematics through the exploration of the Sumenep Grand Mosque in learning plane and solid geometry concepts. This study is expected to contribute to mathematics education by providing a contextual and collaborative learning model that connects cultural heritage with geometric concepts. Furthermore, the findings of this research are expected to improve students' conceptual understanding, enhance learning motivation, and promote appreciation of local cultural heritage through meaningful mathematics learning experiences.

2. METHOD

This study employed a mixed-methods approach using a sequential explanatory design to obtain a comprehensive understanding of the implementation of ethnomathematics-based Think-Pair-Share (TPS) learning in geometry instruction. The sequential explanatory design prioritizes quantitative data collection and analysis in the first phase, followed by qualitative data collection to explain and deepen the quantitative findings (Creswell & Creswell, 2018; Susanto et al., 2024). The quantitative phase aimed to examine the effect of ethnomathematics-based TPS learning on students' conceptual understanding of plane and solid geometry. Meanwhile, the qualitative phase was conducted to explore students' learning experiences, responses, and obstacles during the implementation of the model. The integration of quantitative and qualitative findings was carried out at the interpretation stage.

This research was conducted at Madrasah Aliyah Negeri (MAN) 2 Pamekasan, Indonesia. The research site was selected purposively because students were studying geometry topics relevant to the research objectives, and they were familiar with the Sumenep Grand Mosque as a local cultural heritage object. This familiarity enabled students to directly observe and analyze geometric elements during the learning process.

The population of this study consisted of all tenth-grade science students at MAN 2 Pamekasan, totaling 32 students. Total sampling was applied in the quantitative phase, meaning that all students participated in the pre-test and post-test. For the qualitative phase, purposive sampling was employed by selecting four students representing different levels of mathematical ability (high, medium, and low) and gender representation (two males and two females). These informants were chosen to provide in-depth insights into students' learning experiences.

Data were collected using multiple instruments, including tests, questionnaires, observations, interviews, and documentation. The test instrument consisted of pre-test and post-test items designed to measure students' conceptual understanding of plane and solid geometry. The questionnaire used a Likert scale ranging from strongly disagree to strongly agree to assess students' responses to the implementation of ethnomathematics-based TPS learning. Observation sheets were used to document student activities and teacher performance during the learning process. Semi-structured interview guidelines were used to explore students' experiences and difficulties. Documentation, such as photographs, lesson plans, and student work, was used to support the findings. Data validity was ensured through source triangulation and technique triangulation.

All research instruments were validated using expert judgment. Three validators, who were mathematics education lecturers, evaluated the instruments in terms of content relevance, clarity, and alignment with research objectives. The validation results were calculated using a Likert scale, and the average validation score of 4.9 indicated that all instruments were valid and appropriate for use.

The research procedure followed the sequential explanatory design. In the quantitative phase, students were first given a pre-test to measure their initial understanding. Then, ethnomathematics-based TPS learning was implemented through three stages: (1) Think, where students individually observed geometric elements in the Sumenep Grand Mosque and identified plane and solid shapes; (2) Pair, where students discussed their findings with peers or small group and solved related problems; and (3) Share, where students presented their results and received feedback. After the learning process, students were given a post-test and questionnaire. In the qualitative phase, observations and interviews were conducted to explain the quantitative results.

Quantitative data were analyzed using inferential and descriptive statistics. The difference between pre-test and post-test scores was analyzed using a paired sample t-test to determine whether there was a significant improvement in students' conceptual understanding. Prior to hypothesis testing, the normality assumption was tested using the Shapiro–Wilk test applied to the difference scores (post-test minus pre-test). Testing the normality of difference scores is appropriate in paired data analysis because the paired t-test assumes that the distribution of the differences between paired observations is approximately normal (Field, 2012).

To determine the magnitude of the treatment effect, effect size was calculated using Cohen's *d*. The effect size was computed by dividing the mean difference between post-test and pre-test scores by the pooled standard deviation. The interpretation of Cohen's *d* followed the criteria proposed by Cohen (2009), where 0.20 indicates a small effect, 0.50 indicates a medium effect, and 0.80 indicates a large effect.

Questionnaire data were analyzed using descriptive statistics by calculating mean scores and categorizing students' responses. Qualitative data obtained from interviews, observations, and documentation were analyzed using the Miles and Huberman interactive model, which includes data condensation, data display, and conclusion drawing (Miles & Huberman, 1992). Finally, the quantitative and qualitative findings were integrated at the interpretation stage to provide a comprehensive understanding of the implementation of ethnomathematics-based TPS learning.

3. RESULTS AND DISCUSSION

3.1. Results of Improving Students' Comprehension Abilities

The purpose of this study is to examine the development of mathematical concept learning abilities after the implementation of the TPS learning model based on ethnomathematics at the Grand Mosque of Sumenep. This study is conducted at MAN 2 Pamekasan with 32 students as respondents. The population come from all 10th grade Science students.

After the test was conducted, the students' pre-test and post-test scores were obtained. The scores were then analyzed using descriptive statistics, resulting in **Table 1**. Based on the data in **Table 1**, the average pre-test and post-test scores are 49.03 and 83.81, respectively. The difference between the pre-test and post-test averages is quite significant. Thus, it can be concluded that there is a difference in students' understanding of mathematical concepts before and after the treatment.

Table 1. Description of Students' Pre-Test and Post-Test Results

Test	Number	Minimum Score	Maksimum Score	Average	Variance	Standard Deviation
Pre-Test	32	42	73	49.03	13.773	3.711
Post-Test	32	56	95	83.81	32.222	5.676

An inferential test is then conducted. The data used are the results of the pre-test and post-test. This data is used to test the hypothesis, namely to evaluate whether there is an increase in students' understanding of mathematical concepts after the implementation of the ethnomathematics-based TPS learning paradigm. Previously, a normality test is conducted on the difference between pre-test and post-test data to determine the normal distribution of the data. In the test, a hypothesis is first formulated so that a conclusion could be easily

drawn. The normality test hypotheses are as follows: 1) H_0 : the data is normally distributed and 2) H_1 : the data is not normally distributed. The Shapiro-Wilk test is used in this test because the population is 32 students or less than 50. Using the Shapiro-Wilk test, **table 2** is obtained.

Table 2. Normality Test Results for the Difference Between Pre-Test and Post-Test Data

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
POST - PRE	,084	32	,200*	,968	32	,450

Based on **table 2**, it is determined that the significance value for the difference between pre-test and post-test is 0.450. Since the significance value for both data is greater than 0.05 ($Sig > 0.05$) (Firdiansyah & Rosikhoh, 2024), H_0 is accepted. This shows that the pre-test and post-test data are normally distributed data.

Hypothesis testing is then conducted. The hypothesis test used in this study is a Paired t-test for one sample. This test is used because the data used is data for one class. The goal is to see whether students' understanding of mathematical concepts improved after the treatment. The hypotheses formulated are 1) H_0 : there is no difference between the two data sets, and 2) H_1 : there is a difference between the two sets. The results of the paired t-test for one sample are given below.

Table 3. Paired T-Test Results for One Sample

		Std. Mean Deviat ion	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	POST - PRE	- 34,78 9,269	1,639	-38,123	-31,439	-21,226	31	,000	

Table 3 shows that the degrees of freedom are 31 and the significance value is 0.000 less than 0.05 or < 0.05 , so H_0 is rejected and H_1 is accepted. Thus, it can be stated that the TPS learning paradigm based on ethnomathematics can improve students' ability to understand mathematical concepts.

Using Cohen's d formula (Cohen, 2009), it's obtained that the value of Cohen's d is 7.3. This Cohen's d is greater than 0.8. This indicates the ethnomathematics-based TPS learning model has a significant impact.

3.2. Descriptive Results of Student Activities and Responses to Learning

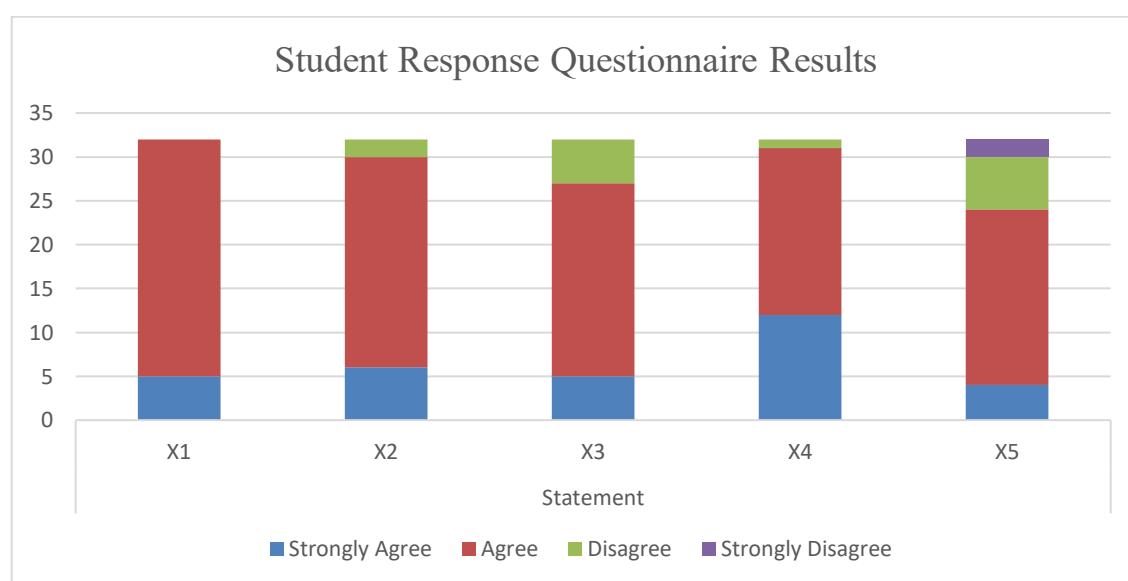
This study aims to know the student activity and response to learning. The questionnaire contained 5 statements regarding the context of ethnomathematics, the benefits of the think, pair, and share stages, and the learning atmosphere.

Table 4. Data of 10th Grade Science Students of MAN 2 Pamekasan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	5	15,6	15,6	15,6
	Female	27	84,4	84,4	100,0
	Total	32	100,0	100,0	

Based on **table 4**, the number of male students in class 10th is 5 students, or 15.6%, and the number of female students is 27 students, or 84.6%. This indicates that the number of female students dominates the class.

The results of the student response questionnaire regarding learning are presented in the following diagram.

**Figure 1.** Questionnaire Results Regarding Student Activities and Responses to Learning

The results of the questionnaire on student activities and responses to ethnomathematics-based TPS learning are displayed based on figure 1. First, statement X1 describes students' enthusiasm for ethnomathematics-based TPS learning. Based on figure 1, five students state "strongly agree", and 27 students state "agree". Second, students' interest in the TPS model is the subject of statement X2. From figure 1, 24 students chose "agree", 6 students chose "strongly agree", and 2 students chose "disagree". Third, statement X3 refers to the stages of thinking undertaken by students. From the responses collected, 22 students answered "agree", 5 students answered "strongly agree", and 5 students answered "disagree". Fourth, students are divided into small groups at the pair stage, this is stated in proposition X4. It is obtained that 19 students state "agree", 12 students state "strongly agree", and 1 student state "disagree". Fifth, students' courage in explaining the results of the discussion is stated in proposition X5. A total of 20 students answered "agree", 4 students answered "strongly agree", 6 students answered "disagree", and 2 students answered "strongly disagree". Based on the questionnaire results, many students respond "agree" and "strongly agree." Thus, it can be concluded that students are interested in learning that involves

concrete elements such as the architecture of the Sumenep Grand Mosque, and they respond positively to ethnomathematics-based TPS learning.

3.3. Description of the Implementation Process of Ethnomathematics-Based TPS learning

Based on observations, interviews, and documentation, the implementation of the ethnomathematics-based TPS cooperative learning model at the Sumenep Grand Mosque is active and engaging for students. The following findings are obtained.

First, the ethnomathematics-based TPS learning environment provides students with opportunities to observe their surroundings and engage in small group discussions, thus increasing their motivation. Students actively record, calculate, and redraw the geometric shapes they encounter. This indicates that an ethnomathematics approach within a cultural context can foster interest in learning mathematics.

Second, students are encouraged to think independently about the concepts of plane and spatial shapes during the "think" stage. They are given time to observe geometric objects at the Grand Mosque of Sumenep and adapt them to the mathematical concepts they have learned.

Third, students discuss in pairs or small groups during the "pair" stage. They exchange opinions about the geometric shapes they encounter and simultaneously align their understanding of the concepts. In this session, students revealed that discussing with peers boosted their confidence because they could compare answers and correct mistakes.

Fourth, the "share" stage helps students become more confident in expressing their opinions in front of the class. Furthermore, they can reinforce concepts through peer correction and clarification, and help students hone their skills in explaining and providing contextual examples. Consequently, it can foster interactive and collaborative learning.

3.4. Description of Student Obstacles to Ethnomathematics-Based TPS Learning

Based on interviews, observations, and documentation, one obstacle is identified in implementing ethnomathematics-based TPS cooperative learning through an exploration of the Sumenep Grand Mosque. The obstacle experienced by students during the learning process is difficulty applying abstract concepts to concrete objects. This obstacle is felt when students carried out the "think" stage.

The research results revealed that students' difficulty applying abstract concepts to concrete objects is due to two factors. First, students have limited memory for mathematical formulas. Second, students are unable to distinguish abstract geometric concepts from the concrete objects found inside the Grand Mosque of Sumenep.

3.4. Discussion

This study has presented data on the implementation of ethnomathematics-based TPS learning through the exploration of the Grand Mosque of Sumenep to determine the concept of flat and solid shapes. The researcher will discuss several findings regarding the improvement of students' understanding abilities after the implementation of ethnomathematics-based TPS learning, students' activities and responses to the ethnomathematics-based TPS learning model, the implementation process of ethnomathematics-based TPS learning, and students' obstacles during the learning implementation process. The researcher first discusses the improvement of students' abilities after TPS learning. This study find that ethnomathematics-based TPS learning can significantly improve students' understanding abilities.

The first finding is an increase in students' comprehension ability after the implementation of ethnomathematics-based TPS learning. The quantitative findings of this study show a highly statistically significant increase ($sig = 0.000 < 0.05$) in students' understanding of geometric concepts with the class average score increasing from 49.03 to 83.81. In addition, the value of Cohen's d is 7.3, namely $7.3 > 0.8$. The qualitative findings indicate that there are at least two main factors that strengthen the quantitative findings, namely the strength of the ethnomathematics context as a student attraction and the effectiveness of the TPS learning structure as a problem-solving mechanism. Therefore, students are interested in participating in the learning process that enables students to provide solutions systematically. As a result, students are able to improve their mathematical comprehension. This discussion aligns with the basic principles of ethnomathematics proposed by D'Ambrosio (D'Ambrosio, 1985). This approach seeks to bridge formal mathematics with the mathematics inherent in students' cultures. By using the Sumenep Grand Mosque as the object of learning, this learning transforms mathematics from an abstract concept into something that exists within the students' environment. This is also in line with the findings of Sulthoni and Handayani who found that the use of local architectural context significantly increased the relevance of the material and students' learning motivation (Sulthoni & Handayani, 2025).

The second finding is the students' activities and responses to the ethnomathematics-based TPS learning model. Quantitatively, the researchers found several points, namely 1) students' interest in the ethnomathematics context, 2) the usefulness of the TPS learning process, and 3) students' acceptance of the learning. This shows that students are interested in the ethnomathematics context provided so they can easily accept the learning mechanism. From here, students can feel the benefits of the ethnomathematics-based TPS learning model. Meanwhile, based on qualitative results, the ethnomathematics-based TPS learning model can provide students with opportunities to interact directly with the environment and discuss in small groups, so it makes students more motivated. Therefore, motivated students can follow the entire learning well. Through discussions, students can help each other and exchange ideas in understanding mathematical concepts. This is in line with the theory of the Zone of Proximal Development developed by Vygotsky, where students can successfully achieve conceptual understanding with the help of other people, in this case, it is their group mates (Wardani et al., 2023). This is also in line with Slavin's theory in Mukhlis, where peer tutoring interactions have been proven to be effective in improving students' understanding abilities (Mukhlis, 2016).

The third finding is the process of implementing ethnomathematics-based TPS learning through an exploration of the Grand Mosque of Sumenep. There are several findings obtained by the researcher, namely student interest and the effectiveness of the TPS learning structure. Student interest shows that students are interested in ethnomathematics-based TPS learning. They enjoy in following the TPS learning mechanism starting from the "think" stage, the "pair" stage, to the "share" stage. In the "think" stage, students are encouraged to think independently about geometric concepts. Students are given time to observe geometric objects in the Grand Mosque of Sumenep, then adapt them to mathematical concepts. In the "pair" stage, students are formed into several small groups, then they discuss together the geometric shapes found, while at the same time equalizing concepts with other friends. In this session, they are more confident because they can discuss among their group members so they can compare answers and correct mistakes. In the "share" stage, students are more confident in explaining mathematical concepts in front of the class. In addition, they can strengthen mathematical concepts through corrections and clarifications between students and teachers. From here, it can create interactive and collaborative learning. Based on the quantitative results of the questionnaire, it can be explained that students gave a positive

response to ethnomathematics-based TPS learning. This proves the theory explained by Arends (Arends, 2012) and Lyman in Yamaoka, et al. (Yamaoka et al., 2019) regarding the strength of the TPS learning structure. This model provides a safe zone for students so they can solve their problems without fear.

The fourth finding explains the obstacles experienced by students in implementing ethnomathematics-based TPS learning. This study find that there are obstacles in memory of mathematical formulas and abstractions experienced by students. This obstacle is a substantial obstacle faced by students, namely in the form of abstraction or modeling. They must translate complex real-world shapes into ideal geometric shapes. This is a core challenge of reality-based learning, including ethnomathematics. As stated by Kurniawan and Hidayati, students are often confused when real objects do not resemble the images in books (Kurniawan & Hidayati, 2020). Therefore, the teacher as a facilitator is crucial, especially at the “share” stage. Students will be guided by the teacher to understand mathematical concepts (Yildizhan & Cezik Turk, 2022).

4. CONCLUSION

This study has explained the implementation of ethnomathematics-based TPS cooperative learning through the exploration of the Grand Mosque of Sumenep in determining the concept of flat and spatial shapes. Based on the analysis and discussion conducted, several conclusions are obtained as follows. First, the implementation of the ethnomathematics-based TPS model is effective and proven to be statistically significant in improving the mathematical understanding ability of 10th grade students of MAN 2 Pamekasan. This is indicated by the increase in the average test score from 49.03 (pre-test) to 83.81 (post-test). Second, students show a very positive response and interest in the entire learning process. This means that ethnomathematics-based TPS learning is interesting, easier to understand, and helps students be more confident. Third, the implementation of learning is very dynamic and effective. This success is supported by two factors. First, the ethnomathematics context successfully acts as a strong motivational hook for students and makes abstract geometric concepts feel relevant and interesting. Second, the structure of the TPS model, particularly the “pair” stage, proved to be the primary mechanism for knowledge construction. Fourth, the main obstacle students faced is difficulty in abstraction, namely translating the complex architectural form of the Grand Mosque of Sumenep into ideal geometric shapes. This difficulty arises due to two factors: poor memory and difficulty distinguishing between abstract concepts and concrete objects.

REFERENCES

- Amaliyah, A., Uyun, N., Fitri, R. D., & Rahmawati, S. (2022). Analisis Kesulitan Belajar Siswa pada Materi Geometri. *SOSTECH: Jurnal Sosial dan Teknologi*, 2(7), 659–664. <https://doi.org/10.59188/jurnalsostech.v2i7.377>
- Arends, R. (2012). *Learning to teach* (9th ed). McGraw-Hill.
- Aulia, F., Dianti, S. P., Utami, W. B., & Sina, I. (2019). Ethnomathematics-Based Contextual Learning with Interactive Media to Improve Mathematics Problem Solving. *Jurnal Pendidikan MIPA*, 20(2), 39–45. <https://doi.org/10.23960/jpmipa/v20i2.pp39-45>
- Avitasari, E. D., & Mulyatna, F. (2024). Systematic Literature Review: Eksplorasi Etnomatematika pada Motif Batik Jawa Timur. *Himpunan: Jurnal Ilmiah Mahasiswa Pendidikan Matematika*, 4(2), 337–346.
- Cohen, J. (2009). *Statistical Power Analysis for the Behavioral Sciences* (2. ed.). Psychology Press.

- Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.
- D'Ambrosio, U. (1985). Ethnomathematics and its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics*, 5(1), 44–48.
- Field, A. (2012). *Discovering statistics using SPSS* (3. ed., repr). Sage.
- Firdiansyah, A. L., Fausi, M., & Hidayati, A. L. (2024). Artifacts Exploration of the Sumenep Great Mosque Through Ethnomathematics for Mathematics and Social Learning. *Indonesian Journal of Science and Mathematics Education*, 7(2), 194. <https://doi.org/10.24042/ijsme.v7i2.18584>
- Firdiansyah, A. L., & Rosikhoh, D. (2024). The Effect of Student Adversity Quotient on Mathematics Test Scores Using PISA Questions. *Jambura Journal of Mathematics Education*, 5(1), 29–38. <https://doi.org/10.37905/jmathedu.v5i1.21022>
- Gbormittah, D., Yarkwah, C., Osiakwan, J. K., & Adom, G. (2025). Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices Among Ghanaian Teachers. *Social Sciences & Humanities Open*, 12, 102036. <https://doi.org/10.1016/j.ssaho.2025.102036>
- Hanifah Fitriyani, & Putri, A. D. (2024). Analisis Kesulitan Belajar Matematika Materi Geometri pada Siswa Kelas 4 Sekolah Dasar. *Jurnal Pendidikan Matematika*, 2(1), 1–8. <https://doi.org/10.47134/ppm.v2i1.1112>
- Irma, A., Juandi, D., Dahlan, J. A., & Nirawati, R. (2020). The Effect of Think-Pair-Share Cooperative Learning on Student Mathematical Communication Skills. *Journal of Physics: Conference Series*, 1521(3), 032033. <https://doi.org/10.1088/1742-6596/1521/3/032033>
- Jannah, Y. M., Wati, I. F., & Wulanningtyas, M. E. (2025). Eksplorasi Etnomatematika Pada Cagar Budaya Indonesia. *Pedagogik Journal of Islamic Elementary School*, 8(1), 407–424. <https://doi.org/10.24256/pijies.v8i1.6899>
- Juita, D. P., Priya, P., Azwardi, M., & Amra, A. (2024). Pentingnya Pengembangan Sumber Daya Manusia pada Lembaga Pendidikan. *Indo-MathEdu Intellectuals Journal*, 5(3), 3068–3077. <https://doi.org/10.54373/imeij.v5i3.1243>
- Kurniawan, W., & Hidayati, T. (2020). Ethnomathematics in Borobudur Temple and Its Relevance in Mathematics Education. *Jurnal Pendidikan Progresif*, 10(1), 91–104. <https://doi.org/10.23960/jpp.v10.i1.202011>
- Kyaw, K. M., & Vidákovich, T. (2025). The Relationship Between Spatial Reasoning and Geometric Reasoning in Teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(8), em2684. <https://doi.org/10.29333/ejmste/16718>
- Lestari, R., Habibi, & Bastari, S. (2024). Persepsi Siswa Terhadap Mata Pelajaran Matematika (Studi Kasus Siswa Kelas VI SD Negeri 03 Gumay Ulu). *Jurnal Ilmu Kependidikan*, 3(1), 21–28. <https://doi.org/10.58222/jurip.v3i1.777>
- Miles, M. B., & Huberman, A. M. (1992). *Analisis Data Kualitatif*. UI Press.
- Mukhlis, A. (2016). Pembelajaran Tutor Sebaya: Solusi Praktis dalam Rangka Menyongsong Pembelajaran Sastra yang Menyenangkan Bagi Siswa SMP. *JP-BSI (Jurnal Pendidikan Bahasa dan Sastra Indonesia)*, 1(2), 68. <https://doi.org/10.26737/jp-bsi.v1i2.93>
- Najichah, Z., Maulida, Q., Inayah, N., & Amiliyah, A. (2025). Effectiveness Of TPS (Thinking, Pairing, and Sharing) Learning Model Assisted By Quizizz to Train Critical Thinking and Collaboration Skills. *JPPIPA: Jurnal Penelitian Pendidikan IPA*, 10(1), 69–79. <https://doi.org/10.26740/jppipa.v10n1.p69-79>
- Qudsya, H., Yantoro, Y., & Risdalina, R. (2024). Penerapan Model Pembelajaran Kooperatif Tipe Think Pair Share Meningkatkan Keterampilan Berkomunikasi Siswa pada

- Pembelajaran Matematika Kelas V Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 9(3), 273–283. <https://doi.org/10.23969/jp.v9i3.16934>
- Sahara, R. I. A., & Nurfauziah, P. (2021). Analisis Kesulitan Siswa Materi Bangun Ruang Sisi Datar Berdasarkan Tahap Berpikir Van Hiele. *Jurnal Pembelajaran Matematika Inovatif*, 4(4), 911–920. <https://doi.org/10.22460/jpmi.v4i4.911-920>
- Situmorang, P. R. A., Tambunan, H., & Simanjuntak, R. M. (2025). Eksplorasi Rumah Adat Batak Toba Terhadap Konsep Bangun Ruang Di Kelas XII SMA Negeri 1 Girsang Sipangan. *AFORE: Jurnal Pendidikan Matematika*, 4(1), 125–140. <https://doi.org/10.57094/afore.v4i1.3119>
- Sulthoni, A. S., & Handayani, U. F. (2025). Eksplorasi Etnomatematika pada Masjid Nurul Anwar untuk Pembelajaran Bangun Datar dan Ruang di MTS Mambaul Ulum Banjarejo. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, 4(1), 59–74. <https://doi.org/10.31980/pme.v4i1.2655>
- Susanto, P. C., Arini, D. U., Marlita, D., & Yuntina, L. (2024). Mixed Methods Research Design Concepts: Quantitative, Qualitative, Exploratory Sequential, Exploratory Sequential, Embedded and Parallel Convergent. *IJAM: International Journal of Advanced Multidisciplinary*, 3(3), 471–485. <https://doi.org/10.38035/ijam.v3i3>
- Wardani, I. R., Zuani, M. I. P., & Kholis, N. (2023). Teori Belajar Perkembangan Kognitif Lev Vygotsky dan Implikasinya dalam Pembelajaran. *Dimar: Jurnal Pendidikan Islam*, 4(2), 332–346. <https://doi.org/10.58577/dimar.v4i2.92>
- Yamaoka, T., Okino, S., Takeno, K., Yamamoto, T., & Matsumoto, S. (2019). Think-Pair-Share Strategy Enhances the Understanding of High School Students in Physics: The Case of Japanese Stem Educators. *American Journal of Educational Research*, 7(3), 244–248. <https://doi.org/10.12691/education-7-3-9>
- Yildizhan, B., & Cezikturk, O. (2022). The Effect of the Art-themed Activities on Mathematics Achievement and Student Views. *IRJE: Indonesian Research Journal in Education*, 6(2), 274–291. <https://doi.org/10.22437/irje.v6i2.17433>
- Yuwana, Y., Imswatama, A., & Lukman, H. S. (2025). Implementasi Model Pembelajaran Kooperatif Tipe Think Pair Share Berbantuan Photomath Terhadap Kemampuan Pemecahan Masalah Matematika Siswa. *JP2M: Jurnal Pendidikan dan Pembelajaran Matematika*, 11(2), 1194–1205. <https://doi.org/10.29100/jp2m.v11i2.7470>