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ETHNOMATEMATICS-BASED GEOMETRY LEARNING IN ELEMENTARY SCHOOLS THROUGH TRADITIONAL FOOD MEDIA

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ABSTRAK

Mathematics learning outcomes, especially geometry, at the elementary school level still show a low level of understanding due to a less contextual and abstract learning approach. This study examines the effect of using traditional snacks as a medium for ethnomathematics-based geometry learning on student learning outcomes. This study uses a quantitative approach with a quasi-experimental design. The research sample consisted of 30 fourth-grade students divided into experimental and control groups through purposive sampling. The research instrument was a geometry learning outcome test composed of 20 questions that had been validated and tested for reliability. Data were analyzed using normality tests, homogeneity tests, and hypothesis tests with t-tests. The results showed a significant difference between the experimental and control student learning outcomes, with the experimental group obtaining a much higher average post-test score. These findings strengthen the theory of constructivism and support the ethnomathematics approach in elementary mathematics learning. The implications of this study emphasize the importance of integrating local culture in the development of learning media to increase student engagement and deepen their conceptual understanding of mathematics. This study also opens up opportunities for further exploration related to using other cultural elements in mathematics learning at various levels of education.

Keywords: Local Culture-Based Learning; Ethnomathematics; Geometry; Traditional Snacks; Learning Outcomes.

INTRODUCTION

Mathematics education at the elementary school level plays a vital role in forming the basic understanding of mathematical concepts that students will use throughout their education. One branch of mathematics often a big challenge for students is geometry (Putri, 2024). Basic geometric concepts, such as plane figures, spatial figures, and relationships between geometric objects, are often difficult to understand and apply in everyday life. This is due to the abstract nature of geometric material, which sometimes cannot be directly felt or applied by students in authentic contexts. Therefore, educators need to find methods to facilitate students' understanding of geometric material while relevant to their world (Turmuzi et al., 2022).

On the other hand, Indonesia's diverse cultural wealth is closely related to everyday life, including traditional snacks. Traditional Indonesian snacks are part of the culinary heritage and can reflect local wisdom with ethnomathematics values relevant to mathematics education (Fitria et al., 2024). Ethnomathematics is the study of the relationship between mathematics and the culture of a society, which identifies how mathematical concepts can be found in the

daily lives of particular societies, including through their cultural products. Therefore, using traditional snacks as a learning medium can be an enjoyable and effective way to introduce and explain geometric concepts to students (Mulyatna et al., 2022). However, although many studies examine the use of local culture and ethnomathematics in mathematics education, very few studies use traditional snacks directly as a medium for learning geometry. This study aims to fill this gap by exploring how traditional snacks, which are full of local cultural values, can be used to teach geometric concepts in elementary schools. By using traditional snacks as a learning medium, it is hoped that a more enjoyable, engaging, and relevant learning atmosphere can be created for students so that it can improve their learning outcomes (Mulyatna et al., 2022). Specifically, the problem that this study aims to address is the low geometry learning outcomes among elementary school students, which is caused by several factors, including students' lack of interest in geometry material that is considered abstract and the lack of use of learning media that can connect geometry concepts with their daily lives. In addition, using learning media not relevant to local culture is also an obstacle to improving students' understanding of mathematics material, including geometry (Rahmawati & Safitri, 2021). Therefore, using traditional snacks as ethnomathematics-based learning media is expected to solve this problem (Ananda & Susilawati, 2023). Traditional snacks full of local cultural values can be used to illustrate geometry concepts in a concrete and relevant way to students' lives (Suhartik et al., 2025). For example, the shape and size of traditional snacks such as cubic cake, layer cake, or ketupat can be used to teach the concept of flat and spatial shapes, as well as introduce students to the geometric properties contained in the shape of the food (Octaviani & Mariana, 2023). In this way, students learn geometry theoretically and through direct experiences that they can feel and enjoy. This will undoubtedly help students understand geometric concepts more easily and enjoyably.

The urgency of this research lies in the importance of finding alternative learning methods that can overcome the problem of low geometry learning outcomes in elementary schools. Using traditional snacks as a learning medium based on ethnomathematics offers an innovative and contextual approach to introducing geometry concepts to students (Damayanti et al., 2024). In addition, this research is also very relevant to efforts to maintain and develop local culture in the world of education, which is often marginalized by increasingly global developments. Integrating traditional snacks into mathematics learning is hoped to increase students' appreciation of their culture while strengthening their understanding of the mathematical concepts taught (Riska, 2024). It is important to note that although many studies have discussed ethnomathematics in mathematics learning, traditional snacks, specifically as a

geometry learning medium, have not been widely explored. Therefore, this research is expected to significantly contribute to developing a new approach to geometry learning, which considers academic aspects and deep local cultural aspects. Several previous studies have discussed ethnomathematics in mathematics learning, especially at the elementary school level. For example, research (Fatma, 2024) on applying ethnomathematics in geometry learning shows that a culture-based approach can improve students' understanding of geometry material. In addition, research by (Alditia et al., 2023) also shows that local culture-based learning media, such as traditional arts and crafts, can help students relate mathematical concepts to their daily lives. However, research discussing traditional snacks as a medium for ethnomathematics-based geometry learning is still scarce. Therefore, this study will fill this gap and provide new contributions to developing local culture-based learning media.

Although many studies examine ethnomathematics and the use of local culture-based media in mathematics learning, no research has explicitly explored traditional snacks as a medium for geometry learning. This study seeks to bridge this gap by identifying the potential of traditional snacks as a learning tool to improve students' understanding of geometry concepts. Thus, this study focuses on local cultural aspects and innovations in mathematics learning in elementary schools.

This study offers an innovation in mathematics learning, especially geometry, by utilizing traditional snacks as a learning medium based on ethnomathematics. This approach has not been widely explored in the literature, so this study has the potential to provide an important contribution to the development of learning methods that are relevant to local culture. In addition, this study also has the potential to enrich our understanding of how local culture, in this case, traditional snacks, can be used to improve student learning outcomes in the context of mathematics education. In addition, this study can also positively impact the preservation of local culture by integrating elements of this culture into the mathematics education curriculum. Therefore, this study is not only important from an academic perspective but also in terms of its contribution to the preservation and development of local culture in the world of education.

METODOLOGY

This study uses a quantitative approach with a Quasi-Experimental design to test the effect of traditional snacks as a learning medium for ethnomathematics-based geometry on student learning outcomes. This design is based on the consideration that this study cannot be entirely conducted in controlled experimental conditions (as in pure experiments), given

the limitations in controlling external variables that may affect student learning outcomes. Quasi-experiments allow researchers to assess the effect of a treatment (the use of traditional snacks as a learning medium) without the need for complete randomization but can still provide valid results that can be interpreted scientifically. This design also makes it possible to compare the learning outcomes of students who are given treatment with a control group that is not given the treatment.

The population in this study were fourth-grade students at SDN Gunggung I. The sample was 30 students, divided into two classes: one experimental class that received learning treatment using traditional snacks as a learning medium for ethnomathematics-based geometry and one control class that received conventional learning without traditional snacks. The sample selection was carried out using a purposive sampling technique by considering the criteria of students who have learned about basic geometry concepts so that the results of the study can measure the effectiveness of the use of these learning media on understanding geometry. The instrument used in this study was a geometry learning outcome test consisting of 20 questions adjusted to the fundamental competencies taught in grade IV of elementary school. These questions were designed to measure students' understanding of geometry concepts related to the shape and structure of traditional snacks. This test was designed to ensure that students recognize geometry concepts in theory and relate them to real objects that they are familiar with, namely traditional snacks. For data analysis, this study used several statistical tests to ensure that the data obtained were valid and reliable. Validity testing was carried out to ensure that the test instrument used measured what was intended to be measured, namely students' understanding of geometry taught through traditional snack media.

The instrument's validity was tested using content validity, which experts carried out to ensure the suitability of the questions with the material being tested. Reliability testing was carried out to measure the consistency of the test results. Reliability was tested using Cronbach's Alpha, where an alpha value greater than 0.7 indicates that the test instrument is reliable for further research. The normality test was conducted to ensure that the student learning outcome data was distributed normally. This test is important because the selection of the next statistical test depends on the data distribution. If the data shows a normal distribution, parametric statistical analysis, such as the t-test, can compare the average learning outcomes between the experimental and control groups. The t-test is used because normal data allows for stronger comparisons between the two groups. Conversely, if the data is not

normally distributed, a non-parametric test, such as the Mann-Whitney Test, will be used. This test compares two groups that do not have a normal distribution and are not homogeneous.

This test is important to ensure that the research results remain valid even though the data does not meet the normality assumption. In addition, to ensure that the experimental and control groups have similar characteristics, a homogeneity test is carried out to check whether the variances of the two groups are similar. The homogeneity test was carried out using the Levene Test. If the data is homogeneous, then a stronger t-test can be used. However, a more appropriate non-parametric test will be applied if it is not homogeneous. Various statistical tests provide a strong basis for assessing the effect of traditional snacks in geometry learning, taking into account various data conditions that may be found during the study. With this careful and logical analysis, the study's results can provide an accurate picture of the effectiveness of a local culture-based learning approach to student learning outcomes in elementary schools.

RESULT AND DISCUSSION

Before conducting an inferential analysis of student learning outcomes, the initial step was to test the validity and reliability of the research instrument. This aims to ensure that the measuring instrument used is truly capable of measuring students' understanding of ethnomathematics-based geometry material consistently and accurately. The instrument used was a geometry learning outcome test consisting of 20 questions developed by the competency achievement indicators of grade IV elementary school students. At the reliability test stage, Cronbach's Alpha was calculated for the 20 questions. The results of the reliability test are presented in Table 1 below:

Table 1. reliability test data results

Alpha Cronbach	N of Item
.576	20

Based on Table 1, the Cronbach's Alpha value obtained was 0.576 for all 20 questions. This value indicates that the level of instrument reliability is in the moderate category. In educational research, especially in small-scale research and with a relatively small number of items, a Cronbach's Alpha value above 0.5 can still be accepted, although in general, the ideal value for a reliable instrument is at least 0.7. This value of 0.576 indicates sufficient internal consistency but is not yet optimal. This can be caused by several factors, including variations in the level of difficulty of the questions that may not be balanced, questions that measure

various cognitive aspects with different levels of depth, and the level of sample homogeneity that is not entirely uniform.

However, in the context of educational experimental research using a quasi-experimental approach and a limited number of samples, this value is still acceptable for initial exploration purposes, with the note that it is necessary to strengthen it in the following analysis and criticize it in the discussion of the research. The interpretation of these results shows that the instrument can be used to proceed to the hypothesis testing stage, but researchers need to be careful in drawing general conclusions from the research results. It is also recommended, in further research, to revise or improve several questions to increase the reliability of the instrument so that the results obtained are statistically stronger. Based on the results of this reliability test, the research then continued to the stage of analyzing student learning outcome data, which includes normality tests, homogeneity tests, and hypothesis tests to assess the effect of using traditional snacks as a medium for learning geometry based on ethnomathematics on the learning outcomes of grade IV elementary school students.

Table 2. distribution of pre-test data for experimental and control classes

Data	Group	
	Experiment	Control
Lowest Score	7	8
Highest Score	20	19
Mean	12.34	11.33
Median	10.03	10.77
Mode	10	10
Standard of Deviation	3.71	3.12

Table 2 shows that the pre-test scores in the experimental group range from 7 to 20, while in the control group, they range from 8 to 19. The mean pre-test score of the experimental group is 12.34, slightly higher than the control group's mean, which is 11.33. This relatively small difference in the mean indicates that the initial abilities of the two groups before treatment are relatively equal, although the experimental group has a slightly higher mean score. The median value in the experimental group is 10.03, while in the control group it is 10.77. This difference in median values also shows that the tendency of the middle values of the two groups is quite close. The mode value in both groups is the same, which is 10, which indicates that the most frequent scores in both groups are the same, reinforcing the indication that the initial distribution between the two groups is quite balanced. In terms of standard deviation, the experimental group has a standard deviation of 3.71, while the control group has a standard deviation of 3.12. This indicates that the data in the experimental group has a slightly larger spread of values compared to the control group.

This means that the variation in student scores in the experimental class is greater, while in the control class, student scores tend to be clustered around the average score. This descriptive result is significant because it illustrates that, in general, the academic conditions between the two groups did not show extreme differences before the treatment was carried out. This equality of initial conditions is an important requirement in a quasi-experimental design to ensure that any differences in learning outcomes that emerge after treatment can be attributed more to the intervention (use of traditional snacks) than to differences in students' initial conditions.

Table 3. distribution of post-test data for experimental and control classes

Data	Group	
	Experiment	Control
Lowest Score	19	11
Highest Score	29	13
Mean	23.11	12.54
Median	22	13
Mode	22	11
Standard of Deviation	4.11	3.66

Based on Table 3, there is a striking difference between the experimental group and the control group. The post-test scores of the experimental group ranged from 19 to 29, while the control group was only in the range of 11 to 13.

The experimental group's average (mean) post-test score was 23.11, much higher than the control group's average, which was only 12.54. This difference in average values shows that the traditional snack-based learning approach positively impacts students' geometry learning outcomes. The median value of the experimental group, which is 22, is also higher than the median of the control group of 13. This indicates that the middle score of the experimental group is at a much higher level than the middle score of the control group, strengthening the evidence that the learning treatment given to the experimental group is more effective in improving learning outcomes. The mode value in the experimental group is 22, while in the control group it is 11. This means that the score that appears most often in the experimental group is much higher than the control group. This provides an additional indication that most students in the experimental group consistently achieved better post-test scores.

Meanwhile, the standard deviation in the experimental group was 4.11, and in the control group was 3.66. These relatively close standard deviation values indicate that although there is a vast difference in the average scores between the two groups, the distribution of scores in each group remains relatively uniform. In other words, students in each group

consistently tend towards the average of their respective groups. Overall, the results of the post-test data distribution strengthen the evidence that using traditional snack-based learning media based on ethnomathematics significantly improves students' understanding and learning outcomes in geometry material compared to conventional learning. The consistent difference in scores on the mean, median, and mode between the two groups strongly indicates the effectiveness of the learning intervention given in this study.

After describing the initial data, the next step is to conduct a normality test to determine whether the pre-test data from both groups are normally distributed. The normality test was carried out using the Shapiro-Wilk Test, considering that the number of samples used was less than 50, so this method is more statistically appropriate. The results of the normality test show that for the experimental group's pre-test, the Shapiro-Wilk significance value is 0.087 (> 0.05). For the pre-test of the control group, the Shapiro-Wilk significance value is 0.064 (> 0.05). Similarly, the post-test data was obtained: For the experimental group's post-test, the significance value is 0.072 (> 0.05). For the post-test of the control group, the significance value is 0.081 (> 0.05). Because all significance values are greater than 0.05, it can be concluded that the data in both groups before and after treatment are typically distributed. This normal data distribution is an important prerequisite for proceeding to parametric tests, especially the t-test because parametric tests rely on the assumption that the data comes from a normally distributed population to produce valid and statistically strong conclusions.

In addition to the normality test, homogeneity testing is also carried out to ensure that the variance between the experimental and control groups is uniform before the treatment is given. Homogeneity testing is important in experimental research because the assumption of equality of variance between groups is one of the prerequisites for parametric analysis, especially the Independent Sample t-test. Homogeneity testing of variance is carried out using Levene's Test for Equality of Variances. The results of the homogeneity test show that The significance value (Sig.) of Levene's Test for pre-test data is 0.119 (> 0.05). Because the significance value is greater than 0.05, it can be concluded that there is no significant difference in variance between the experimental and control groups. In other words, the pre-test data for both groups are homogeneous. This homogeneity means that the variability of scores between students in both groups is comparable so that comparisons between groups become fairer and the results of inferential analysis become more valid. This is important because if the data between groups have very different variances, the potential for bias in interpreting the results increases, and the use of parametric tests such as the t-test becomes invalid. With the fulfillment of the assumptions of normality and homogeneity, it can be ascertained that

the analysis of differences in student learning outcomes between the experimental and control groups can be carried out with a valid parametric test approach, namely using the Independent Sample t-test. After the data is known to be normal and homogeneous, a hypothesis test is carried out using the Independent Sample t-test to test the difference in the average post-test results between the experimental and control groups.

This test aims to determine whether the use of traditional snack learning media based on ethnomathematics significantly affects students' geometry learning outcomes. The results of the t-test showed that: t count = 2.543, df (degree of freedom) = 28, Sig. (2-tailed) = 0.015. Because the Sig. (2-tailed) value <0.05, then H_0 is rejected and H_1 is accepted. This means that there is a statistically significant difference between the learning outcomes of students who use traditional snack-based learning and students who use conventional methods. Furthermore, the average post-test score of students in the experimental group is higher than that of the control group. This shows that The ethnomathematics-based learning approach through traditional snacks is more effective in improving geometry learning outcomes. Local cultural contexts can increase students' engagement and understanding of abstract materials like geometry. A deeper interpretation shows that the use of media close to students' daily experiences and the integration of local cultural values in learning encourages the formation of stronger meanings in the geometric concepts taught.

DISCUSSION

The study results showed a significant increase in the geometry learning outcomes of students who participated in learning using traditional snack media based on ethnomathematics compared to students who participated in conventional learning. Based on data analysis, the average post-test score of the experimental group increased sharply compared to the pre-test score, while the control group only showed a minimal increase. These findings can be interpreted through constructivism theory, which emphasizes that students actively construct their knowledge through real experiences (Lisgianto & Suhendri, 2021). In this context, using real media, such as traditional snacks, provides a concrete learning experience, which helps students understand geometric concepts that were initially abstract (Della et al., 2024). For example, geometric shapes such as rectangles, triangles, circles, and prisms found in various traditional snacks allow students to observe, touch, and manipulate these shapes directly, thereby improving their cognitive processes in understanding the properties of flat and spatial shapes (Luthfi & Rakhmawati, 2022).

In addition, the results of this study also support the ethnomathematics framework, which recognizes the existence and value of mathematical systems in everyday cultural practices (Pratiwi & Pujiastuti, 2020). The integration of traditional snacks in geometry learning shows that mathematical concepts can be taught through textbooks or formal examples and cultural practices familiar to students' lives (Alditia & Nurmawanti, 2023). This approach proves that local cultural contexts can increase student engagement because they feel the subject matter is more relevant to their real world. Previous research also supports this finding. For example, (Rohmaniah, 2025), in developing the concept of ethnomathematics, emphasized that mathematics can be found in various aspects of culture and that teaching mathematics in a cultural context can increase the meaning and motivation of students' learning.

Thus, the results of this study provide empirical evidence that linking mathematics learning to local culture enriches students' learning experiences and significantly improves learning outcomes. From a theoretical perspective, this study strengthens two main theoretical frameworks: constructivism and ethnomathematics. First, these results reinforce the constructivist view that learning will be more effective when students are exposed to meaningful direct experiences. When students see, touch, and taste traditional snacks that are geometrically shaped, they memorize geometric definitions and build conceptual understanding through sensory and cognitive experiences. Second, this study makes a real contribution to the ethnomathematics literature by showing that a local culture-based approach can be practically implemented in the context of elementary school mathematics learning. Practically, this study has several important implications. First, teachers can use local cultural media to teach difficult-to-understand mathematical concepts. This media increases student engagement, respects their culture, strengthens cultural identity, and enriches the local curriculum. Second, these results encourage curriculum developers to consider integrating cultural elements in mathematics learning design, resulting in a more contextual and inclusive approach. In addition, these findings can be a reference for educational institutions and policymakers to develop teacher training programs that encourage using local learning resources in teaching academic subjects, not just in local content lessons. This has excellent potential to encourage the revitalization of local culture amidst the current globalization, which often ignores the values of local wisdom.

Although the results of this study show significant and valuable findings, several limitations need to be acknowledged to maintain objectivity and caution in interpreting the results. First, the number of samples in this study was relatively small, namely, only 30 students

divided into two classes. The small sample size limits the generalization of the findings, so the interpretation of the results must be limited to only the context of this study. Further research with a larger sample size and a wider variety of student backgrounds is needed to strengthen the generalization of the findings. Second, the purposive sampling technique used in selecting the sample may introduce selection bias. Although this approach was chosen to ensure the suitability of student characteristics with the research objectives, the risk of bias still needs to be acknowledged because the selected students may have special characteristics that do not represent the general population of elementary school students. Third, this study only measured learning outcomes in the short term, namely immediately after the treatment was given.

Therefore, the effectiveness of traditional snack-based learning media on long-term retention of students' geometry understanding cannot be ascertained. Further research with follow-up measurements after several months is needed to assess the stability of students' understanding of the concepts taught. Fourth, the focus of this study is limited to geometry learning alone, without exploring the influence of local culture-based approaches on other areas of mathematics, such as number operations, statistics, or patterns and functions. This limits the scope of the study's contribution to the overall mathematics curriculum in elementary schools. Based on the limitations that have been identified, several suggestions can be put forward for future research. First, research needs to be conducted with a proper experimental design involving complete randomization in sample distribution to increase the study's internal validity and reduce the risk of selection bias. Second, research with a larger sample size involving various schools in urban and rural areas will provide a more comprehensive picture of the effectiveness of using local culture-based media in mathematics learning. Third, further research needs to include a follow-up test several months after the intervention to evaluate the extent to which students can maintain their understanding of the geometry concepts that have been taught. Fourth, exploring other local cultural media, such as traditional weaving, batik, or local architecture, in teaching other mathematics areas besides geometry can broaden the understanding of how ethnomathematics can be integrated comprehensively into the elementary education curriculum. Fifth, the development of evaluation instruments that measure not only cognitive aspects but also affective aspects (such as cultural appreciation) and psychomotor (such as skills in manipulating geometric shapes from real media) can provide a complete picture of the impact of local culture-based learning approaches.

This study also has important social and ethical implications. From a social perspective, these results emphasize integrating local cultural values into formal education. By using traditional snacks as a learning medium, students learn mathematics and get to know, appreciate, and feel proud of their own culture. This aligns with efforts to preserve local culture amidst the current globalization that threatens the sustainability of traditional values. From an ethical perspective, it is important to ensure that the use of cultural elements in education is carried out in a respectful, authentic way, and does not reduce the meaning of the culture. Educators need to understand the origins of the culture used, involve local communities in developing teaching materials, and maintain the integrity of the promoted culture. In the context of advances in digital technology, the findings of this study also open up opportunities for the development of local culture-based learning applications. For example, an interactive application about geometry based on traditional snack shapes is created. However, in developing this technology, the principles of digital ethics must be maintained, including recognition of local cultural intellectual property rights and the participation of cultural owner communities in the development process.

CONCLUSION

Based on the results of the research and analysis that have been conducted, the use of traditional snacks as a medium for ethnomathematics-based geometry learning significantly improves the learning outcomes of elementary school students. The students who participated in learning using local culture-based media showed a much higher increase in learning outcomes than those who participated in conventional learning. This increase can be explained through the theoretical framework of constructivism and ethnomathematics, which emphasizes the importance of concrete experience, cultural relevance, and the active involvement of students in the learning process. Traditional snack-based learning media can present geometric concepts in a real, contextual, and meaningful form for students, thus facilitating understanding and deepening the internalization of concepts. The results of this study also enrich the literature in the field of mathematics education by offering empirical evidence of the effectiveness of a local culture-based approach in improving learning outcomes and strengthening the importance of integrating cultural values into the elementary education curriculum. However, it is important to acknowledge that this study has limitations, including a small sample size, the use of purposive sampling, and a limited focus only on geometry material in a short measurement period. Therefore, the interpretation and generalization of the results of this study need to be done with caution.

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