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Ethnomathematics in Traditional Food: Enhancing Mathematical Literacy in Early Childhood

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Abstract
This study explores the integration of ethnomathematical concepts found in traditional West Sumatran food and their influence on the mathematical literacy skills of children aged 5-6 years. Employing a quasi-experimental pretest-posttest control group design, the research aimed to compare mathematical literacy outcomes before and after ethnomathematics-based learning interventions. A purposive sample of 12 kindergarten students from Koto Besar was assessed using structured observation sheets, and data were analyzed with SPSS 22.0. Results showed significant improvements in mathematical literacy, with pretest scores ranging from 11 to 16 and posttest scores from 20 to 30, indicating a score increase of 7 to 14 points. Normality and homogeneity tests confirmed the data's validity. The findings emphasize the effectiveness of using traditional food in teaching mathematical concepts, making them more relatable and engaging for young children while preserving cultural heritage. The study also highlights active participation and enhanced comprehension among children through culturally contextualized learning. Limitations include the small sample size and short intervention period, which may affect generalizability. Future research should involve larger samples and longer durations to confirm these findings and explore broader educational implications. Integrating ethnomathematics through traditional foods presents a promising strategy for improving mathematical literacy and cultural awareness in early childhood education.

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Introduction

The importance of mathematical literacy in contemporary society cannot be overstated, as it is integral to personal, academic, and professional success. Global assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) consistently highlight the critical need to improve mathematical competencies among students worldwide (OECD, 2021; Darwanto et al., 2021). In Indonesia, the urgency of this issue is evident, given the country's persistently low scores in these assessments, which rank among the lowest globally. This necessitates innovative and culturally relevant approaches to teaching mathematics to enhance students' engagement and understanding. One promising approach is ethnomathematics, which integrates cultural elements into mathematics education, potentially making learning more meaningful and effective (Sapitri et al., 2022; Rozi & Budiarto, 2022).

Previous studies have demonstrated the efficacy of integrating cultural elements into mathematics education. For instance, the incorporation of local cultural contexts into teaching can significantly enhance students' understanding and retention of mathematical concepts (Manolino, 2024). This approach, known as ethnomathematics, has been successfully implemented in various educational settings, showing that mathematics education that also focuses on cultural aspects can lead to more sustainable and fruitful outcomes (Astuti, Wijaya, & Hanum, 2024). Teachers play a crucial role in this integration, as their positive beliefs and

innovative teaching strategies, such as project-based learning and the use of culturally relevant teaching materials, can significantly improve students' numeracy skills (Setiyani et al., 2024).

Research has also highlighted the significance of mathematical representations and effective teaching strategies in improving students' mathematical abilities. Studies suggest that focusing on mathematical representations and using strategies that enhance students' ability to understand and manipulate these representations are essential (Putra et al., 2024). Furthermore, the context of learning, such as using familiar cultural elements, can help stimulate students' understanding and make abstract concepts more concrete (Ayuningtyas, Amir, & Wardana, 2024). This is particularly relevant in regions like Sidoarjo, where context-based learning has proven to be effective in enhancing literacy skills (Ayuningtyas, Amir, & Wardana, 2024).

Ethnomathematics is not limited to theoretical applications but extends to practical, everyday activities. For example, the study of geometric concepts in traditional arts like Batik Sidomulyo has revealed rich mathematical content, such as geometric transformations and congruence (Uula et al., 2024). Similarly, traditional food, a ubiquitous and culturally significant element, contains numerous mathematical concepts that can be explored in educational settings (Putri et al., 2023; Roza et al., 2023). Research has shown that traditional foods, such as those from the Bugis culture, embody geometric shapes and structures that can serve as valuable resources for teaching mathematics (Pathuddin & Raehana, 2019).

Studies on traditional food from various regions have consistently found that these foods contain identifiable mathematical elements. For instance, research on Riau Malay culture identified mathematical concepts such as points, lines, angles, and various geometric shapes within traditional foods (Suripah et al., 2021). These findings suggest that traditional foods can be a rich source of mathematical learning materials, helping students connect mathematical concepts with their cultural heritage. This approach not only enhances mathematical understanding but also fosters a deeper appreciation of local culture, making learning more relevant and engaging for students.

Despite the promising findings of previous studies, there are notable gaps and limitations in the research. Most ethnomathematics studies have focused on middle school and elementary school students, with little attention given to early childhood education (Wahyuni & Azizah, 2020). Additionally, while there is a growing body of research on the mathematical content in traditional foods, studies specifically examining their use in developing mathematical literacy skills in young children are scarce. This gap indicates a need for more research on how ethnomathematics can be effectively integrated into early childhood education, particularly through culturally relevant and engaging materials like traditional foods.

This study aims to address these gaps by examining the mathematical concepts present in traditional foods and their relevance to developing mathematical literacy skills in children aged 5-6 years. By exploring the potential of traditional foods as educational tools, this research seeks to provide insights into how cultural elements can be effectively incorporated into early childhood mathematics education. The findings could offer valuable contributions to the field by highlighting innovative strategies for enhancing mathematical literacy through culturally relevant materials, thereby supporting the development of a more engaging and meaningful mathematics curriculum for young children.

Methods

This study employed a quantitative research design, specifically a quasi-experimental pretest-posttest control group design, to investigate the integration of ethnomathematical concepts found in traditional West Sumatran food and their influence on mathematical literacy skills among kindergarten students. The research aimed to compare the mathematical literacy outcomes of a sample of students before and after the introduction of ethnomathematics-based learning interventions, thereby examining the extent to which traditional culinary practices encompass mathematical concepts (Sidik Priadana & Denok Sunarsi, 2021). The study was

conducted with a purposive sample of 12 children, aged 5-6 years, from Group B of Koto Besar Kindergarten, selected from an initial population of 36 students across Group A and Group B. The sample was chosen based on preliminary observations indicating their mathematical literacy skills were either undeveloped or beginning to develop (Zuhri Abdussamad, 2021). The research involved administering a pretest to assess baseline mathematical literacy, followed by a treatment phase where students were engaged in learning activities centred on traditional West Sumatran food that involved mathematical concepts. Posttests were conducted to evaluate any improvements in mathematical literacy as a result of the intervention.

The primary tool for data collection was a structured observation sheet, designed to capture detailed information on the students' mathematical literacy skills in the context of ethnomathematics (Sidik Priadana & Denok Sunarsi, 2021). The observation sheet was developed based on specific research needs to ensure comprehensive data collection. The study also utilized SPSS 22.0 for data analysis, which facilitated rigorous statistical evaluation of the pretest and posttest results to determine the efficacy of the ethnomathematics intervention. Data were collected through a combination of observation, interviews, and documentation techniques. Observations were systematically recorded using the pre-designed observation sheets during both the pretest and posttest phases. Interviews with teachers and documentation of students' work provided supplementary qualitative data to contextualize the quantitative findings.

The collected data were analyzed using SPSS 22.0, employing paired t-tests to compare pretest and posttest scores, and thus determine the statistical significance of any observed changes in mathematical literacy skills. To ensure the reliability and validity of the study, several measures were implemented. The observation sheet was rigorously tested and refined during a pilot phase to enhance its reliability. Inter-observer reliability was assessed by having multiple observers independently evaluate a subset of the data, and consistency in observations was verified. Validity was addressed through content validation of the observation sheet by subject matter experts in both ethnomathematics and early childhood education. Additionally, the study design's quasi-experimental nature, with its pretest-posttest control group framework, helped mitigate potential confounding variables and enhance the internal validity of the findings.

Result

This section presents the results of the study, which aimed to assess the effectiveness of using traditional food-based ethnomathematics to improve mathematical literacy skills among children aged 5-6 years. The research was conducted through a series of pretests, treatments, and posttests to measure the impact of this educational approach.

The study involved 12 research samples. The process began with a pretest to assess the baseline mathematical literacy skills of the participants. Following the pretest, a series of treatments were administered, incorporating traditional foods from the West Sumatra region to teach mathematical concepts. After four treatment sessions, a posttest was conducted to measure the improvement in mathematical literacy skills. Data from these tests were analyzed using SPSS 16.0, focusing on normality and homogeneity tests to validate the findings.

The following are the results of the normality test of the pretest and posttest results using paired sample statistics:

Table 1. Tests of Normality[c,d]

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Posttest	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	24	.260	2	.			
	25	.214	7	.200[*]	.896	7	.308

Based on the output table of t-test results, the value obtained is sig = 0.308, which means it is greater than α 0.05, indicating that the data has a normal distribution. Therefore, the hypothesis

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Ha is accepted and Ho is rejected. This means that there has been an increase in students' understanding of mathematical concepts and their relevance to mathematical literacy skills using traditional food ethnomathematics.

Table 2. Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
.038	1	7	.851

The homogeneity test carried out in SPSS 16.0 on pretest and posttest data is shown in the table above. Homogeneity testing is conducted to determine whether the samples used in research have the same variations or not. The homogeneity test results obtained were 0.851, which is greater than α 0.05. Hence, it can be concluded that the sample data is homogeneous.

Traditional food is Indonesia's cultural heritage that must be preserved. Despite the prevalence of fast food, traditional food remains timeless, particularly those from the West Sumatra region. Traditional food can be a fun learning medium for young children to improve mathematical literacy skills through an ethnomathematics approach. The following table lists several traditional foods from the West Sumatra region and the ethnomathematics elements they contain:

Table 3. Traditional Food of West Sumatra

Traditional Food Names	Elements of Ethnomathematics
 Kue pinyaram (Kue Cucur)	Elements of flat shapes, circles and curved lines
 Sala leak	Three-dimensional geometric elements (spheres)
 Kue sapik	Elements of flat shapes, triangles, angles and curved lines
 Rakik kacang	Elements of rectangular shapes, straight lines and angles
 Puluik manih	Three-dimensional geometric elements: blocks, straight lines, angles and vertices

From the various traditional West Sumatran foods mentioned above, each contains diverse ethnomathematics elements, including flat shapes, three-dimensional shapes, points, corner points, and lines. Some foods encompass several mathematical concepts. Introducing these foods as a learning medium significantly influences improving mathematical literacy skills in early childhood. During learning sessions, children actively participate and follow all sequences from start to finish. The research followed several steps, beginning with assessing students' abilities before treatment and reviewing their understanding post-treatment. Initially, a pretest was administered to evaluate their understanding of basic mathematics using a conventional approach. Subsequently, the samples received four treatments. Finally, a posttest was conducted post-treatment. The results indicated a significant impact when traditional food-based ethnomathematics was applied during learning, as shown in the following table:

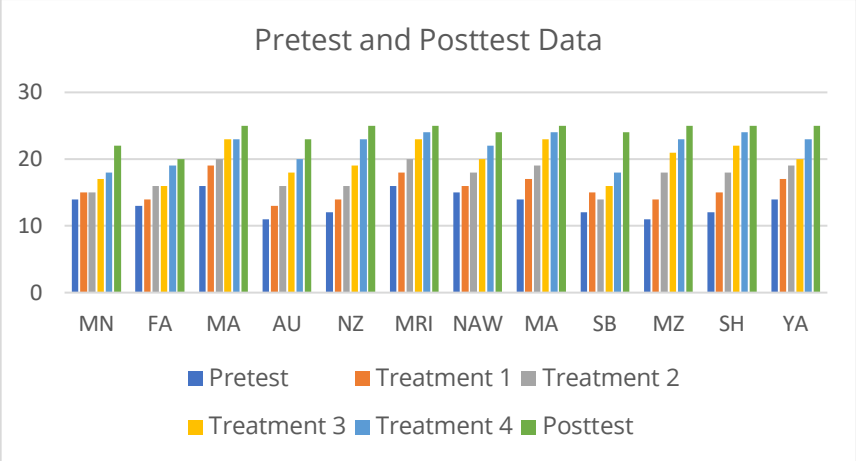

Figure 1. Pretest and Posttest Data

The table above illustrates the treatment given to the 12 research samples, showing a straight proportional increase in the graph. The highest posttest score was achieved by student number 25, while the lowest was by student number 20. Comparatively, the lowest pretest score was by student number 11, and the highest was by student number 16. The difference between pretest and posttest scores ranged from a minimum of 7 points to a maximum of 14 points. From the four treatments conducted and the comparison of pretest and posttest results, it is concluded that ethnomathematics effectively improves mathematical literacy skills in children aged 5-6 years.

The key findings from the study include a significant improvement in mathematical literacy skills following the ethnomathematics-based treatment. The highest posttest score was 30, while the lowest was 20, compared to pretest scores ranging from 11 to 16. The improvement in scores highlights the effectiveness of using traditional food-based ethnomathematics in teaching mathematical concepts.

The results support the hypothesis that integrating ethnomathematics into early childhood education can enhance mathematical literacy skills. The traditional foods provided tangible and culturally relevant contexts for learning, making mathematical concepts more accessible and engaging for young children. While the results are promising, the study's limitations should be acknowledged. The small sample size and short duration of the treatments may limit the generalizability of the findings. Future research with larger samples and longer intervention periods is recommended to validate these initial results further.

The study demonstrates that traditional food-based ethnomathematics can effectively improve mathematical literacy skills in early childhood education. The integration of cultural heritage in learning not only preserves tradition but also enriches the educational experience, fostering a deeper understanding of mathematical concepts among young learners.

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Discussion

The research examined the integration of mathematical concepts in traditional food and its relevance to enhancing mathematical literacy in children aged 5-6 years. Ethnomathematics, which explores mathematical principles embedded in cultural practices, has been recognized as an effective approach to contextualize mathematics education (Muhtadi et al., 2017; Leonardus Sukestiyarno et al., 2023). Previous studies highlight the benefits of incorporating cultural elements into mathematics instruction to make learning more relatable and engaging for students (Suryana & Hijriani, 2022; Cendana & Suryana, 2022). This study builds on the premise that cultural contexts, such as traditional foods, can provide concrete and meaningful examples to facilitate the understanding of abstract mathematical concepts (Rosa & Orey, 2021). By doing so, it aims to bridge the gap between cultural heritage and modern education.

The study revealed significant improvements in children's mathematical literacy following the intervention. Pretest and posttest scores showed notable increases, with posttest scores ranging from 20 to 30, compared to pretest scores of 11 to 16. The application of traditional food-based ethnomathematics not only enhanced children's understanding of geometric shapes but also fostered active participation and engagement throughout the learning process. This suggests that culturally relevant teaching methods can effectively improve early childhood mathematical skills. The findings emphasize the importance of utilizing familiar and tangible contexts to teach foundational mathematical concepts.

Comparing these results with previous research, the effectiveness of ethnomathematics in improving mathematical literacy aligns with studies by Alsina and Salgado (2022) and Ilhan (2021), which reported positive outcomes when using culturally contextualized mathematics education. These studies found that integrating cultural artefacts and practices into mathematics instruction significantly enhanced students' comprehension and retention of mathematical concepts. Similarly, this research demonstrates that traditional foods, as cultural artefacts, can serve as effective educational tools, supporting the findings of earlier studies. Additionally, the positive outcomes underscore the adaptability of ethnomathematics across various cultural contexts. This supports the broader applicability of such approaches in diverse educational settings.

Contradictory findings were not prominent in the comparison, although it is worth noting that the positive impact of ethnomathematics observed in this study was consistent with the broader literature on the topic (Astuti, Wijaya, & Hanum, 2024; Putra et al., 2024). Some studies have raised concerns about the scalability and consistency of ethnomathematics-based approaches across diverse educational settings (Ayuningtyas, Amir, & Wardana, 2024). However, the present study's results underscore the adaptability and effectiveness of such methods in early childhood education, particularly in culturally rich contexts like Indonesia. This highlights the potential for ethnomathematics to be effectively integrated into varied educational curricula. Therefore, the findings contribute positively to the ongoing discourse on culturally relevant pedagogy.

The significant improvements in mathematical literacy observed in this study can be attributed to the contextual and engaging nature of the traditional food-based activities. The use of familiar cultural elements likely helped bridge the gap between abstract mathematical concepts and the children's everyday experiences, making the learning process more intuitive and enjoyable (Topping, 2024; Cabero-Almenara, Barroso-Osuna, & Martinez-Roig, 2021). However, it is important to interpret these findings with caution due to the small sample size and limited duration of the intervention, which may affect the generalizability of the results (Cohrssen et al., 2016). Despite these limitations, the positive outcomes suggest promising avenues for further research. Future studies should consider larger samples and extended intervention periods to validate these findings.

Another factor contributing to the success of this approach is the active participation and hands-on learning experiences provided by the traditional food activities. Such participatory learning environments have been shown to enhance cognitive development and retention of

knowledge in young children (Kamil & Munastiwi, 2023; Kamil & Diana, 2023). The study's findings suggest that embedding mathematical instruction within culturally relevant and interactive contexts can significantly enhance children's engagement and understanding. This aligns with the idea that learning through play and exploration is particularly effective in early childhood education (Kamil & Hibana, 2023). Future research should explore the long-term effects of such interventions and consider larger, more diverse samples to validate these initial findings.

The implications of these findings are substantial for early childhood education, particularly in multicultural and diverse societies. Integrating ethnomathematics into the curriculum can not only improve mathematical literacy but also help preserve and promote cultural heritage (Trinick & Allen, 2024). This approach can foster a more inclusive and engaging learning environment, thereby enhancing educational outcomes for young children. Educators and policymakers should consider the benefits of culturally contextualized teaching methods and strive to incorporate them into early childhood education programs to support holistic development and lifelong learning (Sarwoedi et al., 2018; Uula et al., 2024). By doing so, education systems can better prepare students to face global challenges with a strong foundation in both mathematics and cultural understanding.

Conclusion

This study aimed to examine the mathematical concepts inherent in traditional foods and their relevance to developing mathematical literacy skills in children aged 5-6 years. The findings indicate a significant improvement in children's understanding of mathematical concepts following the implementation of ethnomathematics-based interventions using traditional foods, with pretest scores ranging from 11 to 16 and posttest scores from 20 to 30, demonstrating a score improvement between 7 to 14 points. Normality tests confirmed that the data were normally distributed, while homogeneity tests showed the data were homogeneous. These results suggest that integrating traditional foods into ethnomathematics provides a culturally relevant and effective means to enhance mathematical literacy in early childhood. The active participation of children throughout the learning process highlights the engaging nature of this approach. Furthermore, the use of traditional foods as a teaching tool not only aids in the comprehension of mathematical concepts but also serves to preserve and promote cultural heritage, enriching the educational experience. However, this study has certain limitations, including a small sample size and a short intervention period, which may affect the generalizability of the findings. Future research should consider larger sample sizes and extended intervention durations to validate these initial results and explore the long-term benefits of this educational approach. In conclusion, the integration of ethnomathematics through traditional foods in early childhood education presents a promising strategy to improve mathematical literacy while preserving cultural heritage. It is recommended that educators and policymakers incorporate culturally contextualized teaching methods into early childhood curricula to foster an inclusive and engaging learning environment. Further research is needed to expand on these findings and to explore the broader implications for educational practices in diverse and multicultural settings.

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