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Enhancing elementary student's numeracy skills through ethnomathematics-based learning: An analysis of minimum competency assessment results

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Abstract

The persistent issue of low numeracy skills among elementary school students remains a critical challenge in mathematics education, particularly in contexts where conventional pedagogical approaches fail to connect mathematical concepts to students' lived experiences. Despite growing advocacy for culturally responsive teaching, limited empirical evidence exists regarding the integration of ethnomathematics within the Mathematics Contextual Approach (MCA) to address this gap. This study introduces a novel instructional strategy by embedding ethnomathematics-based learning into the MCA framework to enhance numeracy skills through culturally and contextually relevant mathematics instruction. The research aimed to examine the effectiveness of this integrated approach at SD Negeri 04 Temuireng using a quasi-experimental one-group pretest-posttest design involving 30 fifth-grade students. Data were collected through test and non-test instruments, with numeracy assessments based on the government-developed MCA test. Statistical analysis utilizing a paired sample t-test revealed a significant improvement in students' numeracy skills, with mean scores increasing from 27.83 (pretest) to 56.17 (posttest), a Sig. (2-tailed) value of 0.000, and an average N-gain of 0.3696. These findings underscore the potential of ethnomathematics-based learning to foster a deeper understanding of mathematical concepts by leveraging students' cultural knowledge and real-world experiences. The results contribute to the discourse on curriculum innovation by highlighting the role of ethnomathematics in developing meaningful, contextualized, and equitable mathematics education practices.

Keywords: cultural knowledge, elementary students, ethnomathematics, minimum competency assessment, numeracy skills

Introduction

Mathematics education at the elementary level plays a critical role in establishing students' foundational numeracy skills, which are essential for future academic success and real-life problem-solving. In the context of Indonesian basic education, numeracy remains a pressing concern. Data from the 2021 National Assessment indicate that over half of Indonesian elementary students fail to meet minimum numeracy competencies, particularly in tasks requiring logical reasoning and number sense (Safari & Khasanah, 2023). Corroborating this, findings from the Indonesian Ministry of Education reveal that poor numeracy proficiency hampers students' ability to comprehend advanced mathematical concepts and adversely affects their problem-solving abilities in everyday life. These challenges underscore the urgent need for innovative and contextualized pedagogical approaches such as those grounded in ethnomathematics to strengthen students' numeracy from an early age.

Numeracy encompasses more than basic arithmetic; it involves the ability to interpret numerical relationships, analyze quantitative data, and apply mathematical understanding to various real-world contexts (Wahyuti et al., 2023; Nuraida, 2023). As a fundamental component of mathematical literacy, numeracy supports informed decision-making and adaptive thinking. However, a significant number of elementary students perceive mathematics as abstract, formulaic, and disconnected from their lived experiences (Anggraeni et al., 2024). A 2020 survey by the Indonesian Ministry of Education and Culture revealed that 62% of elementary students find mathematics difficult and irrelevant to daily life (Prahmana et al., 2020). These perceptions contribute to math anxiety and disengagement, which are exacerbated by traditional, non-contextual teaching methods.

International assessments also reflect this trend. The 2022 PISA study reported that over 30% of 15-year-olds in OECD countries performed below the basic proficiency level in mathmatics, with the U.S. National Assessment of Educational Progress (NAEP) indicating that fewer than 40% of students reached "proficient" status. In Indonesia, PISA results placed the country 68th out of 79 participating nations, with a mean mathematics score of 379, well below the OECD average (Ate & Lede, 2022; Hewi & Shaleh, 2020). Only about 30% of Indonesian students demonstrated sufficient numeracy skills, pointing to systemic issues in instructional quality and teacher professional development (Mariamah et al., 2021).

Numeracy indicators, as defined by Winata et al. (2021), include: (1) utilizing numbers and mathematical symbols in everyday problem-solving; (2) interpreting data from graphs, tables, and diagrams; and (3) making predictions based on data analysis. Similarly, Nasoha et al. (2022) emphasize the application of symbols in mathematical literacy, data analysis, and deriving conclusions. Although framed differently, both perspectives converge on the importance of applied mathematics and data interpretation as core components of numeracy.

Effective numeracy assessment provides insight into students' mastery of mathematical concepts and their capacity to apply these concepts across contexts (Wulandari et al., 2024; Tyas et al., 2024). Consequently, mathematics instruction must move beyond procedural knowledge to cultivate critical thinking, communication, and life skills aligned with 21st-century demands. Unfortunately, teacher-related factors continue to hinder this progress.

Studies have shown that many Indonesian elementary school teachers struggle to implement student-centered instruction due to limited pedagogical content knowledge, often defaulting to rote-based approaches. The 2021 National Assessment similarly found a correlation between low teacher training scores and poor student numeracy outcomes.

One promising avenue to address these issues is the integration of ethnomathematics-based learning. Ethnomathematics, as an educational paradigm, connects formal mathematical concepts with students' cultural contexts and everyday experiences (Hardiyansyah et al., 2024; Rahmawati et al., 2024; Rizky & Nasution, 2024). It emphasizes the mathematical practices embedded in cultural traditions, thereby fostering meaningful learning and bridging the gap between abstract content and students' lived realities (Setiani et al., 2023; Lestari et al., 2024). Ethnomathematics has been shown to enhance student motivation and engagement by making mathematics more relevant and accessible (Febriani et al., 2019; Sarwoedi et al., 2018).

Moreover, this culturally responsive approach enriches numeracy development by embedding mathematics in familiar socio-cultural settings, thereby promoting deeper conceptual understanding and retention (Mukwambo et al., 2023). It also supports interdisciplinary learning, encouraging students to draw connections between mathematics and other domains such as science, art, and social studies (Fadillah, 2024; Aini et al., 2023). Beyond cognitive gains, ethnomathematics facilitates affective and social development by fostering collaboration, communication, and cultural appreciation within the classroom (Serepinah & Nurhasanah, 2023). Students are more inclined to participate actively in learning when they recognize the cultural relevance of mathematical tasks.

Empirical studies affirm the effectiveness of ethnomathematics-based instruction in improving students' numeracy performance, particularly as measured by the Minimum Competency Assessment (MCA) (Nst & Batubara, 2024; Cahyadi et al., 2020; Tampubolon et al., 2023). Learning grounded in local cultural contexts enhances mathematical understanding while simultaneously contributing to students' identity development and cultural pride (Sarwoedi et al., 2018). However, despite growing interest in this approach, limited research has directly examined the impact of ethnomathematics-based learning on primary students' numeracy outcomes as assessed through standardized national evaluations like the MCA.

Existing studies primarily emphasize cultural relevance and engagement (Ibrahim & Wahid, 2024; Arion, 2024) with insufficient attention given to its measurable effects on numeracy proficiency. This gap calls for further empirical inquiry to evaluate the pedagogical effectiveness of ethnomathematics in improving numeracy performance. Thus, the present study aims to investigate the influence of ethnomathematics-based learning on elementary students' numeracy skills, with specific reference to outcomes on the Minimum Competency Assessment.

Building on this foundation, the research seeks to contribute to the development of contextually relevant and culturally grounded mathematics education practices. By evaluating the effectiveness of ethnomathematics in improving numeracy performance, this study aims to offer evidence-based recommendations for curriculum design and instructional strategies. The results are expected to inform educational policy and practice, promoting mathematics learning

that not only fosters cognitive competence but also nurtures critical thinking, creativity, and cultural awareness. Through the adoption of ethnomathematics-based approaches, mathematics education can become a transformative experience that prepares students for academic success and meaningful participation in an increasingly complex, multicultural world (Asyiah et al., 2022).

Methods

This study adopts a quantitative research approach utilizing a quasi-experimental design, specifically the one-group pretest-posttest model. Although the inclusion of a control group is generally preferred to enhance the internal validity of intervention studies, the one-group design remains an appropriate alternative in settings where implementing a control group is impractical. This design facilitates the examination of changes in students' numeracy proficiency by comparing performance before and after the intervention within the same cohort. Despite its limitation in controlling for extraneous variables, this design offers a foundational understanding of the intervention's potential impact and is particularly suitable for exploratory studies.

Following Junaedi (2015), the research procedure involved administering an initial assessment (pretest) prior to the intervention, followed by a final assessment (posttest) after the treatment. The intervention in this study was the application of ethnomathematics-based instruction aimed at enhancing students' numeracy skills. The research was conducted at SD Negeri 04 Temuireng, with the target population comprising all fifth-grade students. A sample of 30 students was selected through simple random sampling (Sugiyono, 2016), ensuring that each individual had an equal probability of selection (Firmansyah & Dede, 2022). The sampling procedure involved listing all eligible students, assigning each a unique identifier, and conducting a randomized draw akin to a lottery system. A sample size of 30 meets the minimum criteria for conducting inferential statistical procedures such as the paired samples t-test, assuming the data distribution approximates normality.

The independent variable (X) in this study is the ethnomathematics-based instructional intervention, while the dependent variable (Y) is students' performance on the Minimum Competency Assessment (MCA), specifically focusing on numeracy outcomes. The MCA scores were analyzed not only in aggregate but also according to specific numeracy indicators, which included: (1) the application of mathematical operations and concepts in real-world contexts; (2) the ability to interpret and analyze quantitative data from tables, graphs, or diagrams; and (3) the capacity to make logical inferences and predictions from numerical information. These indicators provided a multidimensional assessment of students' numeracy competencies following the intervention.

The research was executed in three stages. First, the Preparatory Stage included administrative coordination with the school, the development of research instruments such as interview guides and observation sheets, the determination of sample and experimental classes, and the preparation of instructional materials, including lesson plans. Second, the Implementation Stage began with the administration of a 20-item pretest to assess baseline

numeracy proficiency. The intervention was then delivered using an ethnomathematics-based learning model, followed by a 20-item posttest comprising different items from the pretest to mitigate memorization effects. Although the test items differed in form and content, they were aligned in complexity and learning objectives to ensure comparability. The design minimized potential threats such as testing effects through the temporal separation of assessments and the emphasis on reasoning-based rather than recall-based questions. Third, the Final Stage involved systematic data processing and statistical analysis to draw research conclusions.

Data analysis was conducted using inferential statistics to test the research hypotheses. Prior to hypothesis testing, tests for normality and homogeneity were conducted using the Shapiro-Wilk and Levene tests, respectively, via SPSS version 23. The effectiveness of the intervention was evaluated using the normalized gain (N-gain) metric. Data collection employed both test-based and non-test-based instruments. The test component consisted of multiple-choice questions aligned with the MCA framework and administered during both the pretest and posttest phases. Non-test data were collected through classroom observations, semi-structured interviews, and document analysis. The qualitative data obtained were subjected to thematic analysis to identify patterns in student engagement, responses, and behavior during the learning process. These qualitative insights served to enrich the interpretation of the quantitative findings and provided contextual understanding of the observed improvements in numeracy skills. As the MCA instruments were developed by the national education authority, they were used in their original form without modification.

Results and Discussion

This study was conducted at SD Negeri 04 Temuireng to examine the effectiveness of an ethnomathematics-based instructional approach in improving students' numeracy competencies, as measured by their performance on the Minimum Competency Assessment (MCA). The findings revealed a substantial enhancement in students' MCA scores following the intervention, suggesting that integrating local cultural contexts into mathematics instruction positively influences numeracy outcomes. Qualitative observations further supported this improvement, highlighting heightened student engagement during group activities and collaborative discussions hallmarks of effective and meaningful learning. Notably, during tasks involving traditional measurement practices, students actively participated, posed questions, and articulated their mathematical reasoning to peers, signifying a deeper conceptual understanding and strengthened mathematical communication.

Active student participation is instrumental in developing higher-order thinking skills such as critical and creative reasoning, which are essential for addressing real-world mathematical problems (Rachmantika & Wardono, 2019). This was evident during classroom discussions related to the traditional game congklak, where students engaged in strategic thinking to determine optimal seed distributions for maximizing scores. Such interactions cultivated peer-to-peer ideation, promoted critical discourse, and encouraged innovative problem-solving strategies. Furthermore, collaborative learning environments enhanced students' interpersonal and communication competencies skills that extend beyond academic

contexts and hold long-term relevance in professional and social settings (Agusniatih & Manopa, 2019). These findings underscore that fostering culturally responsive and interactive mathematics learning environments not only supports cognitive development but also contributes to students' holistic growth. The efficacy of ethnomathematics-based learning was substantiated through both qualitative indicators such as enthusiasm, cooperative learning behavior, and cultural contextualization and quantitative data, with the average MCA scores increasing from 27.83 (pretest) to 56.17 (posttest).

The initial diagnostic assessment revealed that most students scored below the minimum competency benchmark, prompting the implementation of ethnomathematics-based instruction as a pedagogical intervention. This approach incorporated culturally embedded mathematical knowledge derived from the local traditions of the SD Negeri 04 Temuireng community to contextualize and enhance students' understanding of fundamental numeracy concepts. Following the intervention, posttest results demonstrated a marked improvement in students' numeracy performance. While the study primarily focused on cognitive outcomes, observational data also suggested the development of non-cognitive attributes such as cooperation, discipline, and cultural appreciation. However, as no specific instruments were employed to measure character or life skills, these observations are considered anecdotal and serve as qualitative insights rather than empirically measured outcomes.

A key component of the learning intervention involved the integration of traditional games such as engklek, congklak, and marbles to contextualize abstract mathematical concepts and foster learner engagement. The game engklek, which involves sequential hopping across drawn rectangular grids, serves as a practical representation of geometric reasoning (Sholihah et al., 2024; Afghohani et al., 2024). This game provided an intuitive and embodied context for exploring spatial and numerical relationships, including shape recognition, estimation of distance, and arithmetic operations.

Observational data and student responses to follow-up questions and worksheets indicated that learners were able to transfer these experiences to formal mathematical content, particularly in geometry and measurement. For instance, students identified geometric shapes (e.g., rectangles, circles) within the playing field, estimated lengths, and computed scores through basic addition. These activities bridged the gap between conceptual understanding and applied mathematics, thereby contributing to improvements in students' numeracy proficiency as reflected in their MCA results. Moreover, physical engagement through engklek facilitated both cognitive stimulation and motor skill development, emphasizing the multifaceted benefits of culturally contextualized mathematics instruction.

Figure 1. Engklek game

Congklak is a traditional Indonesian game that integrates strategic thinking and numerical skills (Tusolihah et al., 2022; Ayuningrum et al., 2024; Hariyadi et al., 2024; Permatasari et al., 2023). The game is played by two participants using a congklak board, which consists of 14 small compartments and two larger end compartments, known as rumah-rumahan. Each player populates the small compartments with seeds, which may include shells, pebbles, or grains. Congklak can be leveraged as an educational tool to introduce various counting concepts, including foundational operations such as addition, subtraction, and multiplication (Matulessy et al., 2022).

Similarly, other traditional games such as engklek contribute to the development of numerical sequences, spatial reasoning, and basic arithmetic skills as players jump across numerically ordered patterns. These games, including engklek and marbles, also facilitate the recognition of patterns, the counting of steps, and the application of strategic thinking. To assess students' mathematical understanding and engagement, it is essential to use structured observation tools, such as observation sheets, to record students' performance, strategies, and problem-solving approaches during the games. Figure 2 presents documentation of the congklak game.

Figure 2. Congklak game

The game of marbles, or Gundu, is another widely played traditional game in Indonesia. It involves the use of small balls, typically made of glass, with an approximate diameter of 1.25 cm. Gundu has significant connections to ethnomathematics, which integrates mathematical concepts with local cultural practices (Oktarina, 2022; Sarah et al., 2022). The game is often played by drawing a circle on the ground, which serves as a practical example of flat geometry, while the spherical marbles provide a tangible opportunity to introduce concepts related to spatial figures and the properties of spheres in geometry. Therefore, as outlined, the traditional game of Gundu offers a valuable and effective medium for learning mathematical concepts (Sarah et al., 2022). Figure 3 documents the Gundu game.

Figure 3. Marbles Game

The following presents the results of the data analysis for the pretest and posttest scores of students who received ethnomathematics-based learning treatments. The analysis was conducted in several stages, starting with tests for normality and homogeneity, followed by hypothesis testing.

Analysis Requirement Testing

Before conducting hypothesis testing, normality and homogeneity tests were performed on the collected data. The following outlines the results of these tests:

Normality Test

The normality of the data was tested using the Shapiro-Wilk test via SPSS version 23. The results are presented in Table 1.

Table 1. Normality test results using shapiro wilk

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pretest MCA	.100	30	.200	.959	30	.294
Posttest MCA	.148	30	.092	.958	30	.276

The results show that both the pretest and posttest data, based on the MCA instruments, are normally distributed. Specifically, the significance values for both the pretest (0.294) and posttest (0.276) are greater than the 0.05 threshold, confirming that the data follow a normal distribution. Therefore, the normality assumption required for performing a t-test has been met.

Homogeneity Test

The homogeneity of variances between the pretest and posttest data was assessed using Levene's Test, conducted through SPSS version 23. The results are summarized in Table 2.

Table 2. Results of homogeneity testing using levene's test

Levene statistic	df1	df2	Sig.
2.284	1	58	.136

The Levene test yielded a significance value of 0.136, which is greater than the 0.05 threshold. This indicates that the variances of the pretest and posttest data are homogeneous, satisfying the assumption necessary for the validity of the paired sample t-test. Homogeneity of variances ensures the reliability of the statistical comparison, strengthening the validity of the results.

Hypothesis Testing

The following sections summarize the results of the paired sample t-test analysis, which assesses the differences between the pretest and posttest scores.

Table 3. T test results using paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest MCA	27.83	30	12.573	2.295
	Posttest MCA	56.17	30	16.225	2.962

As shown in Table 3, the mean pretest score for MCA was 27.83 with a standard deviation of 12.573, while the posttest mean increased to 56.17 with a standard deviation of 16.225. These results, derived from a numeracy test instrument aligned with MCA indicators, demonstrate a substantial improvement in students' numeracy and problem-solving skills following the ethnomathematics-based learning intervention.

The increase in the standard deviation from 12.573 in the pretest to 16.225 in the posttest indicates a greater variability in student performance post-treatment. This finding aligns with research by Dwianjani et al. (2022), who noted that ethnomathematics-based learning not only enhances average student performance but also provides opportunities for learners from diverse backgrounds to engage and progress in the learning process.

Furthermore, Fauzan et al. (2024) emphasized the significance of culturally relevant learning materials in fostering student motivation and engagement, as it enables learners to connect mathematical concepts with real-life contexts. The substantial improvement in students'

posttest scores confirms the effectiveness of ethnomathematics-based learning in enhancing students' mathematical abilities.

Table 4. T test results using paired samples test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest AKM -Postest AKM	-28.333	21.186	3.868	-36.244	-20.422	- 7.325	29	.000

The paired t-test analysis revealed a significant difference between the pretest and posttest MCA scores, with a mean difference of -28.333. This negative value indicates that the posttest scores were significantly higher than the pretest scores. The t-test statistic was -7.325, with a p-value of 0.000, which is below the 0.05 significance threshold. Thus, it can be concluded that ethnomathematics-based learning had a statistically significant positive effect on students' MCA skills.

Table 5. N-gain test results

	N	Minimum	Maximum	Mean	Std. Deviation
N-gain	30	-.20	.87	.3696	.26784
Valid N (listwise)	30				

The N-gain test presented in Table 5 was conducted to measure the effectiveness of the ethnomathematics-based learning intervention. The average N-gain was 0.3696, which falls within the medium effectiveness category. This result suggests that the intervention had a moderate effect on students' learning outcomes. Furthermore, these findings also collectively support the hypothesis that ethnomathematics-based learning can significantly enhance students' mathematical achievements. The results indicate that this approach not only improves students' scores but also encourages engagement with mathematical concepts through culturally relevant content.

The results of this study indicate that ethnomathematics-based learning significantly enhances students' numeracy skills at SD Negeri 04 Temuireng. The increase in scores from the pretest to the posttest demonstrates that students have not only improved their ability to perform basic calculations but have also developed a deeper understanding of mathematical concepts within their cultural context. Incorporating elements of local culture into learning strengthens students' comprehension of mathematics. Moreover, when mathematical content is

contextualized within students' daily experiences, it becomes more meaningful and relevant, thereby improving engagement and learning outcomes.

The integration of cultural relevance into the curriculum is crucial for enhancing students' ability to understand and apply mathematical concepts effectively. As noted by Tampubolon et al. (2023), ethnomathematics plays a key role in improving numeracy skills by embedding cultural practices into mathematics education. This approach not only makes the learning process more relatable but also fosters a greater understanding of abstract mathematical ideas. Ethnomathematics links culture and education, thereby enhancing numeracy through the application of local cultural practices in the teaching of mathematics (Permana, 2023). Furthermore, ethnomathematics has been shown to promote better learning outcomes, stimulate creative thinking, and cultivate an appreciation for cultural values within the domain of mathematics education (Arion, 2024).

The effectiveness of ethnomathematics-based learning can be attributed to its ability to connect students with the material in a way that is both relevant and engaging. By linking mathematical concepts with real-life applications and local cultural practices, students become more engaged and gain a better understanding of the subject matter. This approach has been corroborated by Widana & Diartiani (2021), who argue that ethnomathematics increases student participation by providing contextualized learning experiences. When students recognize the practical applications of mathematics in traditions, arts, and daily life, they not only grasp mathematical concepts but also develop a deeper appreciation for the cultural heritage embedded in these practices.

Moreover, the ethnomathematics approach fosters critical and creative thinking skills. Students were observed applying these skills through their participation in group discussions, responding to open-ended questions, and solving problems embedded within traditional games. Observational notes and student worksheets revealed students' ability to analyze problems, propose multiple strategies, and justify their reasoning. These activities served as indirect indicators of their development in critical and creative thinking. For instance, when examining geometric patterns in local handicrafts or calculating ingredients for traditional recipes, students could immediately see the practical relevance of mathematics in familiar contexts.

In addition to enhancing cognitive skills, ethnomathematics learning also contributes to boosting students' confidence. By validating their lived experiences and cultural knowledge within the learning process, students feel more valued and motivated (Nur et al., 2019). Thus, ethnomathematics serves not only as a vehicle for teaching mathematical concepts but also as a bridge that connects students with their cultural identity, improving both their motivation and learning outcomes.

Overall, the findings from this study contribute valuable insights into the development of more effective mathematics learning methods that are culturally relevant to students. Ethnomathematics offers an engaging and meaningful approach for educators seeking to enhance students' numeracy skills while simultaneously fostering cultural awareness. These findings also provide significant implications for policymakers, emphasizing the need for culturally responsive approaches in mathematics education across Indonesia.

However, for more comprehensive policy recommendations, further research is needed, including multisite studies and longitudinal data, to evaluate the long-term impacts of ethnomathematics-based learning and its applicability across diverse educational contexts. This would provide a more robust foundation for generalizing the results and ensuring that educational policies address the varied needs of students nationwide. Future studies should also investigate additional factors that may influence learning outcomes, as well as explore strategies to further improve the effectiveness of ethnomathematics-based learning in different educational settings.

Conclusion

The results of this study demonstrate that the integration of ethnomathematics-based instruction has a statistically significant impact on enhancing students' numeracy performance in the Minimum Competency Assessment (MCA) at SD Negeri 04 Temuireng. Historically, student achievement in the MCA at this school has consistently fallen below the national average. However, the application of a culturally contextualized learning approach resulted in a marked improvement in students' numeracy outcomes, as evidenced by the increase in the mean score from 27.83 (SD = 12.573) on the pretest to 56.17 (SD = 16.225) on the posttest. The mean gain of 28.33 points was statistically significant, with a paired samples t-test yielding a p-value of 0.000 (Sig. 2-tailed), affirming the effectiveness of the ethnomathematics intervention. Beyond quantitative results, qualitative observations during classroom activities revealed increased student engagement, active participation in group discussions, and enhanced problem-solving abilities particularly when mathematical concepts were embedded in traditional games and cultural narratives. These findings underscore the pedagogical value of ethnomathematics in creating a meaningful, relevant, and cognitively stimulating learning environment that not only enhances numeracy but also aligns mathematical instruction with learners' socio-cultural contexts.

Despite these promising outcomes, several limitations should be acknowledged. The scope of the study was confined to a single school with a relatively small sample, which may affect the generalizability of the findings. Additionally, although traditional games were used as a medium for contextual learning, the assessment of students' mathematical thinking within these games was not fully explored, suggesting an avenue for further investigation. Future research should consider expanding the study across diverse educational settings and student populations to evaluate the broader applicability and scalability of the ethnomathematics-based model. Moreover, it is recommended that future studies incorporate more rigorous tools to assess higher-order mathematical thinking, creativity, and metacognition fostered by culturally relevant pedagogies. Continued professional development and structured collaboration among educators, community leaders, and cultural practitioners are essential to sustaining and enriching ethnomathematics-based instruction. Ultimately, embracing ethnomathematics as a core pedagogical strategy holds significant potential for transforming mathematics education into a more inclusive, equitable, and contextually grounded discipline.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript.

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