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Integrating Local Cultural Values in Mathematics Learning: A Case Study of Ethnomathematics in Traditional Games

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ABSTRACT

Integrating local cultural values through an ethnomathematics approach in mathematics learning is believed to enhance students' critical thinking skills and conceptual understanding. This study aims to analyze the implementation of ethnomathematics in traditional games at junior high schools in Indonesia and evaluate its contribution to mathematical comprehension. The study employed a qualitative case study design, collecting data via participatory observation, interviews with teachers and students, and documentation of learning activities. Data were analyzed using content analysis and narrative synthesis to identify learning patterns and links to ethnomathematics theory. Results indicate that integrating traditional games into mathematics learning significantly improves problem-solving skills enhances student motivation, and facilitates understanding of geometry, numbers, and logical strategies. Furthermore, the cultural values embedded in traditional games strengthen students' cultural identity while increasing mathematics' relevance in daily life. In conclusion, integrating ethnomathematics through traditional games is an effective strategy for meaningful and contextual mathematics learning. The study recommends curriculum development based on ethnomathematics at the junior high school level and further research to assess the long-term impact on student academic performance.

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Introduction

Mathematics is a fundamental discipline that plays a crucial role in developing students' logic, analytical skills, and problem-solving skills. However, in many educational contexts, mathematics is often understood abstractly and disconnected from students' daily life experiences (Choiri, Setyati, & Chandra, 2022). As a result, many students struggle to grasp mathematical concepts, particularly in terms of practical applications in real life, resulting in low motivation to learn and low participation in learning (Pebralia et al., 2024).

As research in mathematics education continues to develop, the ethnomathematics approach has emerged as an effective strategy for bridging the gap between formal mathematical concepts and local cultural practices. Ethnomathematics emphasizes understanding mathematics within the context of culture, everyday activities, and local traditions, enabling students to see the direct connection between theory and practice (Luzón & Pérez-Llantada, 2022; Beasley Von Burg, 2012). This approach focuses not only on cognitive aspects but also on the formation of cultural identity and social values, including cooperation, discipline, and ethics in social interactions.

Traditional games are an important medium for implementing ethnomathematics. Some games, such as congklak, stilts, and gobak sodor, inherently contain relevant mathematical concepts, such as numbers, patterns, strategy, and spatial coordination. Integrating these traditional games into mathematics learning allows students to understand concepts through concrete experiences, facilitates the development of logical strategies and problem-solving

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skills, while increasing interest and motivation in learning (Fitriyah & Indriyani, 2022; Setyono, Himawan, & Nancy, 2020).

In addition to cognitive aspects, social and cultural aspects are also important focuses in ethnomathematics. The values embedded in traditional games, such as mutual cooperation, honesty, and discipline, can be transferred into mathematics learning, enabling students to not only learn theory but also understand the social significance of learning activities (Luzón & Pérez-Llantada, 2022; Arna et al., 2025). Previous research has shown that integrating local cultural values can strengthen students' cultural identity, increase the relevance of learning, and develop social skills that support collaborative learning (Beasley Von Burg, 2012; Brummett, 2008).

The application of ethnomathematics through traditional games also contributes to the development of higher-order thinking skills. For example, students can plan game strategies, calculate scores, and predict outcomes based on existing patterns, all of which involve analytical, evaluative, and problem-solving skills (Choiri, Setyati, & Chandra, 2022; Pebralia et al., 2024). These learning outcomes, emphasizing concrete experiences, support experiential and narrative-based learning theories, which emphasize the importance of authentic contexts in enhancing conceptual understanding (Brummett, 2008).

Furthermore, related literature demonstrates that technology integration can support the effectiveness of ethnomathematics learning. IoT-based monitoring systems, while primarily focused on air quality monitoring, provide examples of how real-time data can be visualized and analyzed, paralleling how students can use game patterns to empirically understand mathematical concepts (Choiri, Setyati, & Chandra, 2022; Pebralia et al., 2024). Thus, this learning strategy is not only cognitively and culturally relevant but can also be adapted to the use of simple technology to strengthen conceptual understanding.

While the benefits of ethnomathematics have been widely identified, there is a gap in research regarding the specific implementation of traditional games at the junior high school level and the empirical evaluation of their impact on improving students' mathematical problem-solving abilities. Several previous studies have focused more on theory or general conceptual analysis, without directly examining student interactions and their impact on academic achievement (Fitriyah & Indriyani, 2022; Setyono, Himawan, & Nancy, 2020). Therefore, this study fills this gap by exploring the implementation of traditional game-based ethnomathematics in the classroom, analyzing learning patterns, and evaluating its contribution to mathematical conceptual understanding.

The contributions of this research are both practical and theoretical. Practically, the results provide a reference for mathematics teachers to design contextual, meaningful learning that integrates local cultural values. Theoretically, this study confirms the relevance of ethnomathematics as an approach that can improve mathematical conceptual understanding and problem-solving skills, in line with previous research on the relationship.

Method

Research Type and Design

This research uses a qualitative approach with a case study design. This design was chosen because the research focuses on an in-depth examination of the process of integrating local cultural values into mathematics learning through traditional games. Case studies allow researchers to directly observe how mathematical concepts emerge in game activities, how students respond to learning, and how teachers relate local cultural elements to mathematics material in the classroom. This approach is relevant because the research does not aim to statistically test relationships between variables, but rather to explain learning phenomena contextually, systematically, and in-depth.

The primary focus of this research is the implementation of ethnomathematics in traditional games in mathematics learning at the junior high school level. Traditional games are positioned as learning contexts that incorporate elements of number, pattern, strategy, space, and logic. Through this approach, mathematics learning is understood not only as a process of conveying formal concepts but also as a process of linking concepts to cultural experiences close to students' lives. Therefore, a case study design is used to obtain a

comprehensive picture of the learning process, student engagement, and the mathematical and cultural meanings that emerge during the activities.

Research Location, Time, and Subjects

The research was conducted in three junior high schools in West Java Province during the odd semester of the 2024/2025 academic year. The locations were selected purposively, considering the schools' suitability for the research focus, namely the provision of mathematics instruction that allows for the integration of local culture-based activities. The research subjects consisted of 60 seventh- to ninth-grade students involved in traditional game-based learning activities. In addition to students, mathematics teachers were also involved as informants to obtain information regarding learning planning, implementation, and evaluation.

Subjects were selected purposively, based on student involvement in learning activities utilizing traditional games. This technique was used to ensure that the data obtained accurately met the research needs. Subjects were not selected to statistically represent the population, but rather to provide rich information regarding learning experiences, student responses, and the forms of mathematical understanding that emerged during the learning process.

Data Collection Techniques

Research data were collected through participant observation, semi-structured interviews, and documentation. Participant observation was conducted to record the learning process, student interaction patterns, strategies used in the games, and the emergence of mathematical concepts during the activities. Through observation, researchers obtained direct data on how students understand numbers, patterns, space, strategies, and problem-solving in the context of traditional games.

Semi-structured interviews were conducted with teachers and several students to strengthen the observation results. Interviews with teachers aimed to gather information on the reasons for choosing traditional games, strategies for linking them to mathematics material, and challenges encountered during learning. Interviews with students were used to determine their learning experiences, conceptual understanding, motivation, and perceptions of local culture-based mathematics learning. Documentation was conducted by collecting learning notes, worksheets, activity photos, and evaluation results relevant to the research focus.

Data Analysis Instruments and Techniques

The research instruments included observation guidelines, interview guidelines, field notes, and documentation formats. The observation guidelines were used to record student activities, involvement in games, and mathematical concepts emerging during learning. The interview guidelines were used to ensure the data collection process aligned with the research focus. Field notes were used to record detailed learning situations, including student responses, teacher directions, and group dynamics.

Data were analyzed using content analysis and narrative synthesis techniques. Content analysis was used to identify data patterns related to mathematical concepts, local cultural values, student engagement, and problem-solving strategies. Data from observations, interviews, and documentation were grouped into main themes and then compared to determine consistency across data sources. Narrative synthesis was used to construct a coherent explanation of the process of integrating ethnomathematics into learning. Data validity was maintained through triangulation of sources and techniques, namely comparing the results of observations, interviews, and documentation. In this way, the research results are expected to be consistent, traceable, and academically accountable.

Results and Discussion

Research Results

The results of this study indicate that integrating traditional games into mathematics learning can improve students' conceptual understanding, problem-solving skills, and learning motivation. Students involved in traditional game activities showed an increase in average

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scores from pre-test to post-test on number concepts, geometry, and problem-solving strategies.

Table 1. Improvement in Students' Mathematical Concept Understanding Scores

Variable	Average Score Before	Average Score After	Improvement (%)
Problem-Solving Skills	63.44	84.56	33.2
Geometric Understanding	60.20	82.10	36.3
Number Strategies	61.50	83.00	35.0

The data in Table 1 shows that problem-solving improved most significantly, which aligns with the findings of Pebralia et al. (2024) and Choiri, Setyati, & Chandra (2022) regarding the effectiveness of a traditional game-based contextual approach. Improvements in geometry and number strategies were also significant, indicating that students not only understand formal concepts but are also able to apply logic in real-world contexts.

Interpretation of Results

Observation analysis showed that students actively engaged in discussions, planned game moves, calculated scores, and predicted outcomes based on patterns. These activities strengthened critical and logical thinking skills. Furthermore, local cultural values, such as cooperation and discipline, emerged naturally during the game, consistent with the theories of Luzón & Pérez-Llantada (2022) and Beasley Von Burg (2012), which emphasize the relationship between cultural practices and mathematical learning.

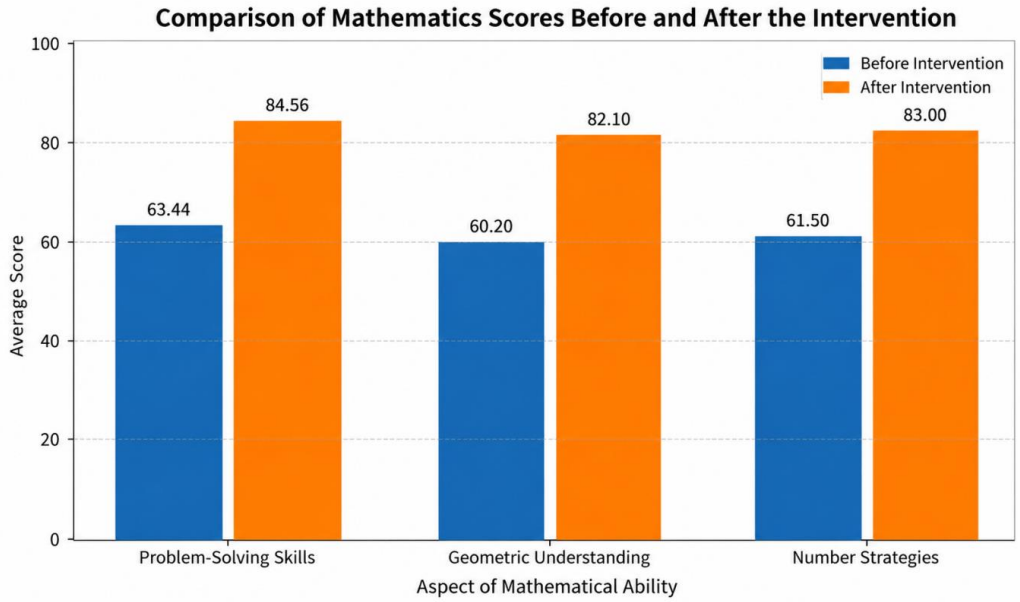

Diagram 1. Average Score of Mathematical Understanding Before and After Intervention

Diagram 1 visualizes the consistent score increase across variables. The largest increase occurred in problem solving, while geometry and number strategy showed moderate but significant increases.

Discussion

The improvement in students' problem-solving skills can be explained by their involvement in traditional games, where they had to plan moves, calculate outcomes, and predict scores. This finding supports Brummett's (2008) theory on narrative-based learning and real-life experiences, which states that students understand concepts better when connected to real-life contexts and interactive activities.

In addition to cognitive aspects, students' learning motivation increased. Observations showed that students were more enthusiastic about participating in learning and actively interacting with their classmates, consistent with research by Fitriyah & Indriyani (2022) and Setyono, Himawan, & Nancy (2020) on the impact of local cultural integration on student engagement.

Local cultural values also make an important contribution to learning. For example, during games, students learn cooperation, discipline, and play ethics, which strengthen cultural identity while supporting collaborative learning (Luzón & Pérez-Llantada, 2022; Arna et al., 2025). This confirms that ethnomathematics not only improves mathematical cognition but also students' social values and character.

Evaluation of number and geometry strategies shows that concrete experiences through traditional games facilitate understanding of patterns and logic. Students are able to apply number and geometry concepts in real-life situations, supporting the findings of Choiri, Setyati, & Chandra (2022) who emphasize the importance of contextual learning through activities based on local culture.

Thus, the integration of local cultural values through ethnomathematics in traditional games has proven effective in improving understanding of mathematical concepts, problem-solving skills, and learning motivation. This approach can also be replicated in various school contexts by adapting types of traditional games to suit local cultures.

Conclusion

This study demonstrates that the integration of local cultural values in mathematics learning through an ethnomathematics approach to traditional games can strengthen conceptual understanding, problem-solving skills, and student engagement in the learning process. Traditional games provide a concrete learning environment because students can connect mathematical concepts to activities closely related to their cultural experiences. The results of this study showed an increase in scores on problem-solving, geometry understanding, and number strategies after traditional game-based learning was implemented. These findings confirm that mathematics learning becomes more meaningful when abstract concepts are presented through a local context that students can easily recognize.

In addition to impacting cognitive aspects, this approach also supports the strengthening of social and cultural values, such as cooperation, discipline, honesty, and responsibility in learning activities. Thus, ethnomathematics functions not only as a mathematics learning strategy but also as a means of preserving local culture in formal educational settings. The practical implications of this study suggest that mathematics teachers can utilize traditional games as contextual learning media that are appropriate to student characteristics and the school environment. Further research is recommended to test the application of this approach at more diverse levels, regions, and types of traditional games so that the results can be compared more broadly.

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