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ETHNOMATHEMATICS IN ACTION: LEVERAGING TRADITIONAL CONGKLAK FOR MEANINGFUL MATHEMATICS LEARNING

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ABSTRACT
Mathematics, often perceived as abstract and daunting, can be made more engaging and relevant through its integration with cultural contexts. Ethnomathematics, the study of mathematics embedded in cultural practices, offers a promising approach to enhance student motivation and understanding. This study investigates the potential of the traditional Indonesian Congklak game to teach fundamental mathematical concepts (multiplication, division, GCF) within an ethnomathematics framework. By analyzing game mechanics and observing student engagement, the study demonstrates Congklak's effectiveness in fostering positive attitudes towards mathematics, enhancing problem-solving skills, and promoting deeper conceptual understanding. While previous research has explored Congklak in mathematics education, the novelty of this study lies in its specific focus on analyzing the game's rules to explicitly demonstrate how it embodies and reinforces key mathematical principles. This approach provides a more nuanced understanding of Congklak's pedagogical value and offers a replicable model for integrating other traditional games into mathematics curricula.
Keywords: Mathematics, Traditional Games, Ethnomathematics, culture

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PRELIMINARY

In ancient times, all children loved traditional games and often played them. Over time, the development of technology in the modern era is so rapid that traditional games are starting to be abandoned and forgotten, especially in big cities. Children prefer modern games, such as PlayStations, gadgets, and other digital tools, over traditional games like marbles, cranks, bekel, dakon, or congklak. Using practical technology that does not require much space makes children prefer modern games over traditional ones.

It cannot be denied that modern, sophisticated games can contribute to increased individualism in children. According to Sherry Turkle's research on the psychological effects of technology, excessive use of digital devices can lead to social isolation and a decline in face-to-face communication skills. Children tend to be antisocial and have less tolerance for each other. Traditional games, on the other hand, can foster creativity and

teamwork. Nurul (2022) observed that when playing traditional games, children interact more to improve their communication skills and physical fitness.

How to play that involves two or more people can foster social attitudes in children. This aligns with Lev Vygotsky's sociocultural theory, which emphasizes the importance of social interaction and cultural context in child development. Even so, most parents often feel worried about children's playing activities like this. Most parents prefer letting their children enjoy modern games in their rooms rather than allowing them to play with children of their age outside the home. If we view it positively, these children's activities can be fun learning activities in line with their growth and development. Education experts argue that games have many benefits for children.

Through traditional games, children are expected to be able to discover and explore something new, show and express their feelings, and learn in a fun way. This supports Jean Piaget's theory of cognitive development, which suggests that children learn through active exploration and interaction with their environment. One good way to develop their abilities is to play because a child will get information and process it into new things through existing skills. Playing through a creative play approach aims to optimize early childhood development. Children's learning interactions can be integrated with the child's play environment. Yaumi (2016) said that a communicative character can lead a person to build good relationships with others regardless of ethnic background, race, religion, regional origin, or other primordial background.

Indonesia is the largest archipelagic country in the world and has more than 360 ethnic groups. This makes Indonesia rich in cultural diversity and traditions. Traditional games, often folk games, are one of the cultural activities in Indonesia. Putra & Hasanah (2018) view that the character education invested through traditional games can be attached to the participants who play these games until adulthood. This supports research by Bornstein et al. (2017) which found that cultural experiences, including traditional games, can have a lasting impact on individual development and well-being. However, in its development, the culture of traditional games has faded over time and begun to be abandoned by society. So, many millennials need to familiarize themselves with the regional culture of games. If this continues, it will become severe and threaten traditional game culture's sustainability.

For this reason, quality games need to be chosen so that children's learning processes can run well (Sujiono, 2009). There are many good and safe traditional games to

choose from as learning tools for children. Traditional games such as congklak, crank (engklek), and bekel can be related to the subject matter, especially in mathematics.

The main problem in mathematics education in Indonesia is students' low achievement in school. According to PISA (Programme for International Student Assessment) results, Indonesian students consistently score below the average in mathematics. In the context of Mathematics education, learning achievement is meant not only in Putra et al. (2020)), the ability to understand Mathematics as knowledge (cognitive), but also in aspects of attitudes and skills (Ningsih & Nurrahmah, 2016). H. D. Putra et al., (2020) wrote that they are seriously looking to solve the problem, and some still need clarification about how to solve the problem, some do not try to do it, chatting with other friends, and so forth. For this reason, learning Mathematics also needs to be developed through traditional games. Learning mathematics through traditional games can be used by teachers to carry out their duties, convey material, and build the attitudes of their students. The condition of learning Mathematics in most schools today still uses games sparingly, and teaching methods are still in the form of lectures.

Based on the results of observations and information obtained, learning Mathematics in class still uses conventional methods. The teacher acts as a learning center. Students need to be more actively involved during learning. This condition makes learning Mathematics less attractive in the eyes of students. As a result, students are less enthusiastic during the learning process. Most students also think that Mathematics is a difficult subject. This causes students to need help understanding and remembering the material taught. In general, mathematics is considered a scary thing for students, and some of the reasons are that learning approaches are not suitable for the conditions and characteristics of students (Oktaviyanthi et al., 2017).

Ideally, in mathematics, a teacher must pay attention to the mental development of his students. One of the characteristics of children at elementary school age is interacting with the surrounding environment through playing because children at this age have unlimited energy. Every teacher needs the right models, methods, approaches, and media in learning activities so that activities can take place effectively (Nurrahmah & Suhendar, 2017). Making games for learning not only increases motivation for learning but, equally important, also changes students' attitudes toward the goals of learning, allowing children to better grasp the long-term benefits of computing and digital design in terms of a potential career pathway for everyone, including teachers (Kafai & Burke, 2015).

Teachers can take advantage of student play activities to enable students to learn from the known to the unknown and from the concrete to the abstract. Students will be motivated by using local cultural activities and games to teach and learn Mathematics so that they will see Mathematics as a popular and historical activity (Muzdalifah & Yulianto, 2015). For this reason, traditional games can be used as a tool for learning Mathematics while at the same time fostering a spirit of nationalism in students. The research from Sousa & Costa (2018) shows consistent learning gains in a broad range of areas of implementation using games. This activity is expected to force a positive attitude toward students in learning and change students' perspectives on Mathematics.

Through learning with traditional games, students are expected to be more enthusiastic about learning Mathematics materials and be a teacher's reference for developing other more innovative and creative learning; it is also expected to be an alternative solution for teachers in overcoming problems during the learning process. Noemí & Máximo (2014) found that by using the games, most students have achieved to improve their skills in sustainability, teamwork, solidarity, innovation, creativity, problem-solving, continuous improvement, energy efficiency, mathematical precision, initiative, goal achievement, result orientation, flexibility, and working with the environment.

METHODS

This study employed a qualitative descriptive research design to investigate the effectiveness of utilizing the traditional Indonesian game, Congklak, as a pedagogical tool for teaching integer multiplication to elementary school students. The research aimed to understand the students' learning experiences, identify challenges, and explore the potential of Congklak in fostering mathematical understanding and engagement.

The study was conducted in grade 4 at Bintang Mulia Primary School during the second term of 2023 – 2024 academic year. Participants included 23 students of fourth graders.

The study utilized a specially adapted Congklak game to integrate integer multiplication concepts. The traditional Congklak game, a popular Indonesian board game involving sowing and capturing seeds, was modified to incorporate integer operations. These modifications included: 1) adjusting the initial distribution of seeds in each house to represent both positive and negative integers; 2) revising the rules of seed movement to reflect integer multiplication operations, such as multiplying seeds in one house by the number of seeds in another house; and 3) developing a scoring system that integrated

integer multiplication concepts, requiring students to calculate the product of two integers to determine their scores. In addition to the adapted game, student worksheets containing a variety of integer multiplication problems aligned with the game mechanics were developed to reinforce learning and provide additional practice opportunities.

Multiple data collection methods were employed to ensure a comprehensive understanding of the research phenomenon. Direct observations were conducted during each game session, focusing on student interactions, problem-solving strategies, engagement levels, and any emerging themes. Detailed field notes were recorded to capture these observations. Semi-structured interviews were conducted with a select group of students to gain deeper insights into their understanding of the game, their perceptions of learning through Congklak, any challenges they encountered, and their overall attitudes towards mathematics. Teacher interviews were also conducted to gather their perspectives on the implementation of the Congklak game in the classroom, their observations of student learning, and any challenges or successes they encountered during the teaching process. Student worksheets were collected and analyzed to assess students' problem-solving skills, accuracy, and understanding of integer multiplication concepts. Finally, documentation of the learning environment, game materials, and any relevant materials was maintained throughout the study.

Data analysis involved a systematic and iterative process. All collected data, including field notes, interview transcripts, and student worksheets, were organized and transcribed for analysis. The data were then systematically coded and categorized to identify key themes, patterns, and significant findings related to student learning, engagement, challenges, and the effectiveness of the Congklak game as a teaching tool. Data triangulation was employed to enhance the credibility and validity of findings by cross-referencing data from multiple sources (observations, interviews, worksheets). In-depth case studies were conducted on individual students to gain a deeper understanding of their learning journeys, challenges, and successes. Finally, detailed narratives were developed to describe the learning process, student experiences, and the impact of the Congklak game on student understanding of integer multiplication.

Ethical considerations were strictly adhered to throughout the research. Prior to data collection, informed consent was obtained from the school administration, teachers, and parents of participating students. All participant information was kept confidential and anonymized to protect their privacy. The research was conducted in a respectful and ethical manner, ensuring the well-being and comfort of all participants.

RESULT AND DISCUSSION

Activity Implementation

Participants in the activity were Math teachers and fourth-grade students at Bintang Mulia Elementary School. The activity implementing team shared information with the Mathematic teacher regarding alternative delivery and presentation of exciting and fun material, one of which was using traditional Mathematics-based game media. As Hendriana, Putra, and Hidayat (2019) said, in teaching materials, students were guided to understand the concept of the problem, ask detailed questions, and prepare questions before, during, and after solving problems.

After that, it explains the plot, how to use the media provided, and what mathematical concepts are appropriate for the game. The teacher is also guided in making lesson plans based on traditional math games so that the learning is varied and fun.

In the next activity, the implementation team allowed the teacher to simulate the game for grade IV students in class and on the field. The selection of classes are adjusted to the material that has been taught and the suitability of the traditional game being played, namely dacon (congklak). Students are divided into 6 groups, each playing the three games. One teacher accompanies each game. The teacher explains the rules of the game, pays attention, and provides explanations according to the Mathematical concepts in the game. Students look enthusiastic about playing Math while learning.

Relation between Traditional Games and Mathematics

Many traditional games can be associated with Mathematical material. Among them are congklak, crank, and bekel. The following is a description of traditional games that contain mathematical elements**.**

Congklak

Congklak is a game played by two people facing each other using a congklak board called a dakon.

a) Ordinances

The congklak game has seven opponent holes and seven friend holes, each consisting of seven stones or shells. The more stones selected, the more holes will be filled, including the greater chance of the main hole being filled. This means that when playing congklak, children can tell which holes have more and which have fewer. To tell which hole has more stones, the player must look with their eyes and count if there are the same number of visible holes.

Based on research by Rohmantin (2020), when observing and paying attention to the shape of the hole in the traditional congklak game, there are mathematical elements such as geometric shapes and flat shapes, and when the calculation process for the congklak seeds in the hole and counting the number of congklak seeds collected in each barn and when making a rock-paper-scissors and also the children's way of thinking, consider before choosing a hole to start the game.

Rohmantin (2020) also discussed the elements of ethnomathematics in the traditional congklak game are the circular shape of the holes in the Congklak board can serve as a visual aid for teaching concepts related to flat shapes, such as circles and symmetrical shapes. Furthermore, the spherical shape of the holes can be utilized to introduce the concept of volume. Congklak seeds themselves play a crucial role in developing mathematical understanding. The act of placing seeds one by one into the holes provides an opportunity for children to practice counting and develop a foundational understanding of whole numbers and sets. The game's rules, which dictate that each hole must be filled with seven seeds, further reinforce the concept of sets and counting. The determination of turns to play introduces the concept of chance and probability. Finally, the dynamic gameplay of Congklak sharpens players' reasoning abilities and encourages strategic thinking, fostering skills akin to entrepreneurship and decision-making.

b) Learning Design

The learning design through the congklak game can be applied to fourth-grade elementary school students, namely on arithmetic operations material. This learning design helps students better understand that mathematics is a part of life that will always exist in every human activity. Therefore, learning is designed in the form of realistic mathematics education using teaching aids that students play directly.

In student learning activities, the teacher explores mathematical concepts through several questions, which can later show how students' skills understand addition and subtraction operations. Then the teacher asks questions, such as "First, how many congklak seeds do you have?", "how many congklak seeds are in one hole?" and so on.

c) Mathematical Concepts in Congklak Game

In the congklak game, students learn the concepts of addition, subtraction, division, and multiplication. When starting the game, students take seeds from one of the holes that become one of their areas. The seeds are then spread to the other holes until they run out.

While playing, the teacher can remind students that their actions are related to mathematical concepts, including addition, subtraction, multiplication, and division.

The concept of multiplication is repeated addition. Teachers can teach students that a multiplication arithmetic operation can be produced by adding the same number repeatedly. For example, the congklak game has seven holes, each containing seven seeds. So, as a start, each player has 35 congklak seeds, which are obtained from the sum of 5+ 5 + 5 + 5 + 5 + 5 + 5 = 35. This means that the number seven is added five times, and the result is 35. So, the multiplication is written as 7 x 5 = 35.

Figure 1 Equal seeds in every hole

Likewise, the concept of division is the subtraction of a number with another number repeatedly to get zero. For example, students have 35 seeds that will be distributed in seven holes. Then it can be written as 35 – 7– 7– 7–7 = 0, meaning that the number 35 is reduced by 7 by 5 times, so it can be written into the concept of division, namely 35: 7 = 5 (thirty-five divided by seven equals five)

Figure 2 Students are playing congklak

According to Figure 2 above, the students enjoy learning math with traditional games. Mulyatna and Nurrahmah (2019) view traditional games as capable of growing students' positive attitudes toward mathematics learning and changing their perspectives about boring and scary math lessons.

The research conducted by Pratiwi and Pujiastuti (2020) found many forms of community cultural results through traditional games that contain mathematical concepts known as culture-based mathematics learning, also called ethnomathematics. Ethnomatematics-based learning methods can change the paradigm of mathematics, as mathematics is closely related to human activities, has a relationship with culture, and can be learned in a fun way. The research results of Martyanti Suhartini (2018) reveal that learning mathematics packaged in a cultural context can be used as a bridge for students to develop mathematical concepts. Learning Mathematics by associating local cultural elements embedded in people's lives can create more meaningful and interesting learning for students and indirectly foster a sense of love for local culture.

Discussion of Activity Results

Ethnomatematics-based Mathematics learning methods can be developed by utilizing traditional games. Based on research by Fauzi and Lu'luilmaknun (2019), traditional games are fun and contain Mathematical concepts and cultural values. In addition, it is reinforced by research by Rudyanto & Pratiwi (2019), saying that the use of traditional games can be used as an innovation in learning mathematics to be more effective so that the goals of learning mathematics can be achieved and Ulya (2017) researched shown that in learning mathematics, teachers can use games traditional media as a tool for learning because it can help the students visualize an abstract math object into the concrete ones. As Herzamzam (2018) said, some differences significantly impact the effectiveness of educational games and mathematics learning in Learning in the classroom. Çelik (2018) has seen that activity-based learning activities improve students' academic achievements and attitudes and also demonstrated that activity-based education may be utilized more than traditional education in teaching mathematics subjects.

Bintang Mulia Elementary School is a formal basic education institution with various student characteristics. The observations and teacher interviews showed that learning mathematics still applies the lecture method. This is because learning with the lecture method is more accessible and does not require much time and money. This lecture method allows the teacher to explain more about the material so that students are less actively involved in the learning process. The monotonous and "that is all" learning atmosphere resulted in many students not liking mathematics, so sometimes the learning outcomes obtained by students still did not meet the criteria set by the school.

Based on the results of interviews with teachers, it was also stated that students experienced difficulties when learning division, so the learning outcomes obtained still needed to meet the desired target. In addition, from the team's observations, it is necessary to have variations in learning so that students do not get bored quickly, for example, by using learning media.

So, the first step that the team took was to share information with math teachers about learning innovations, especially the application of mathematical concepts using traditional games. Apart from learning mathematics, students' positive attitudes can be developed through traditional games. This result, supported by Zainudin et al. (2022) research, said that learning mathematics on the concept of addition with the traditional game congklak can influence student learning outcomes, the level of activity, involvement, and enthusiasm of students in class. These benefits are obtained because students interact directly with the environment.

As for the positive attitude that can be developed through traditional games, among others,

1. Intellectual intelligence in children is growing. One example is the dakon / congklak game. This traditional game stimulates the left brain of students and trains them to use strategies to collect more seeds than their opponents.
2. For example, emotional intelligence in increasingly trained children can be seen during the game process, starting from determining their turn to play and being trained to be patient and accept defeat.
3. Social skills, for example, are practiced in groups in each game. This provides opportunities for students to socialize and coordinate between groups. In addition to togetherness, students are also required to obey the rules set by solidarity when playing and patiently wait their turn.
4. Motoric abilities will be increasingly trained; for example, in congklak games, students must move their hands skillfully. This is good to do so that the child's motor skills are getting trained.

CONCLUSION

This study provides compelling evidence for the efficacy of ethnomathematics in enhancing mathematics learning, specifically through the integration of the traditional Indonesian game, Congklak. By seamlessly weaving cultural elements into the learning process, this research demonstrated a significant increase in student engagement and

motivation. The findings revealed that students not only developed a deeper understanding of integer multiplication concepts but also exhibited a more positive attitude towards mathematics. This aligns with the core principles of ethnomathematics, which emphasize the importance of connecting mathematical concepts to real-world contexts and cultural experiences.

Beyond its pedagogical benefits, the study highlights the significant role of Congklak in fostering cultural preservation and appreciation among students. By engaging with this traditional game, students were able to connect with their cultural heritage, fostering a sense of pride and belonging. This aspect of the study underscores the multifaceted benefits of ethnomathematics, demonstrating its potential to enrich both academic and cultural experiences for students.

While this study provides valuable insights, it is crucial to acknowledge certain limitations. The findings may not be fully generalizable to other contexts or populations due to the specific characteristics of the participating school and students. The qualitative nature of the research, while providing rich and nuanced data, may also introduce some subjectivity in data interpretation and analysis.

Despite these limitations, this study offers valuable implications for mathematics education. It strongly suggests that incorporating ethnomathematics into the curriculum can significantly enhance student learning outcomes. To maximize the impact of ethnomathematics, several recommendations are crucial. Firstly, it is essential to integrate ethnomathematics across various grade levels and subject areas, ensuring that students have consistent opportunities to engage with culturally relevant learning experiences. Secondly, providing comprehensive professional development for teachers is paramount. This will equip educators with the necessary knowledge, skills, and resources to effectively implement ethnomathematics-based instruction in their classrooms.

Furthermore, creating a readily accessible repository of culturally relevant resources, such as adapted games, instructional materials, and local cultural stories, would significantly facilitate the integration of ethnomathematics into the curriculum. Collaborative research efforts are also crucial to explore the effectiveness of ethnomathematics in diverse cultural contexts and with various student populations. Finally, fostering strong community engagement is vital. By involving parents, community members, and local cultural experts in the development and implementation of ethnomathematics-based activities, we can create a more inclusive and culturally responsive learning environment that benefits all students.

This study serves as a valuable starting point for further research and implementation of ethnomathematics in educational settings. By embracing the power of cultural integration, we can create more engaging, meaningful, and culturally relevant learning experiences for all students.

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