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ETHNOMATHEMATICAL EXPLORATION OF THE ENGKLEK GAME IN ELEMENTARY MATHEMATICS LEARNING

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ABSTRACT
Mathematics learning in elementary schools is often perceived as abstract and less engaging for students, which can hinder their understanding of mathematical concepts. Integrating cultural elements into learning activities can help create more meaningful and contextual learning experiences. One approach is through ethnomathematics embedded in traditional games such as engklek. Therefore, this study aims to explore the ethnomathematical values in the traditional engklek game and examine its potential as a medium for teaching mathematics in elementary schools. This study employed a qualitative ethnographic approach. The research subjects consisted of elementary school teachers, students, and cultural experts selected through purposive sampling. Data were collected through interviews, observations, and documentation. The data were analyzed using qualitative analysis techniques, including data reduction, data display, and conclusion drawing. The results show that the traditional engklek game contains various mathematical concepts, including geometry, numbers, and measurement. These concepts can be observed in the patterns of the game field. The findings also indicate that using engklek as a learning medium can create contextual and engaging learning experiences, enhance students' critical thinking skills, and promote collaboration and character values. Therefore, integrating ethnomathematics through traditional games can support meaningful and culturally relevant mathematics learning in elementary schools.
Keywords: elementary school; engklek; ethnomathematics; mathematics; traditional games

ABSTRAK
Pembelajaran matematika di sekolah dasar seringkali dianggap abstrak dan kurang menarik bagi siswa, yang dapat menghambat pemahaman mereka terhadap konsep matematika. Mengintegrasikan unsur budaya ke dalam kegiatan pembelajaran dapat membantu menciptakan pengalaman belajar yang lebih bermakna dan kontekstual. Salah satu pendekatannya adalah melalui etnomatematika yang tertanam dalam permainan tradisional seperti engklek. Oleh karena itu, penelitian ini bertujuan untuk mengeksplorasi nilai-nilai etnomatematika dalam permainan tradisional engklek dan menguji potensinya sebagai media pengajaran matematika di sekolah dasar. Penelitian ini menggunakan pendekatan etnografi kualitatif. Subjek penelitian terdiri dari guru sekolah dasar, siswa, dan pakar budaya yang dipilih melalui pengambilan sampel bertujuan. Data dikumpulkan melalui wawancara, observasi, dan dokumentasi. Data dianalisis menggunakan teknik analisis kualitatif, termasuk reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa permainan tradisional engklek mengandung berbagai konsep matematika, termasuk geometri, angka, dan pengukuran. Konsep-konsep ini dapat diamati dalam pola lapangan permainan. Temuan juga menunjukkan bahwa penggunaan engklek sebagai media pembelajaran dapat menciptakan pengalaman belajar yang kontekstual dan menarik, meningkatkan kemampuan berpikir kritis siswa, dan mendorong kolaborasi serta nilai-nilai karakter. Oleh karena itu, mengintegrasikan etnomatematika melalui permainan tradisional dapat mendukung pembelajaran matematika yang bermakna dan relevan secara budaya di sekolah dasar.
Kata kunci*: engklek; etnomatematika; matematika; permainan tradisional; sekolah dasar*

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Introduction

Mathematics is one of the compulsory subjects in primary and secondary education in Indonesia as stated in Government Regulation No. 4 of 2022. Mathematics learning aims to develop students' reasoning, problem-solving skills, and the ability to communicate mathematical ideas through symbols, diagrams, tables, and other representations (Nurfitriyanti et al., 2020). Therefore, mathematics plays an important role in developing logical, systematic, and critical thinking skills in students. However, mathematics learning in elementary schools still faces several challenges. Many students perceive mathematics as a difficult and abstract subject, which reduces their motivation and interest in learning. This perception often leads to difficulties in understanding mathematical concepts and ultimately affects students' learning outcomes. In many cases, mathematics learning is still dominated by teacher-centered instruction and procedural exercises, making the learning process less meaningful and less engaging for students.

One of the main problems in mathematics education is the lack of contextual learning approaches that connect mathematical concepts with students' real-life experiences (Amalia & El Hakim., 2024). The development of this ethnomathematics-based video tutorial is expected to become a learning medium that can attract students' attention, as the video will be linked to cultural elements (Susanti et al., 2022). Introducing the diversity of Indonesian culture while increasing students' creativity (Vahlia et al., 2025). Elementary school students are still in the concrete operational stage of cognitive development, meaning that they learn more effectively through real and contextual experiences. When mathematics is taught only through abstract explanations and formulas, students often find it difficult to understand the concepts being taught.

In recent years, ethnomathematics has been widely discussed as an approach that integrates culture into mathematics learning. Ethnomathematics emphasizes the relationship between mathematical concepts and cultural practices, traditions, and daily activities within a community (Yanti, 2025). Usually (material) that is difficult to teach is easier if you use a cultural approach (Astriyani et al., 2024). Through this approach, mathematical ideas can be introduced in ways that are more meaningful and relevant to students' lives. Several studies show that cultural activities and traditional games contain various mathematical concepts such as geometry, arithmetic operations, number patterns, and measurement, which can be used as contextual learning resources.

Traditional games are considered potential learning media because they present mathematical concepts in a concrete and engaging way. Research indicates that integrating ethnomathematics through traditional games can help students better understand mathematical concepts, improve motivation, and create more meaningful learning experiences. Furthermore, ethnomathematics-based traditional games have also been found to support the development of students' logical–mathematical intelligence and cultural awareness (Priska et al., 2025).

Several studies have explored ethnomathematics in traditional games such as marbles, congklak, and hopscotch, revealing mathematical concepts related to geometry, measurement, probability, and number operations. However, research specifically examining the ethnomathematical elements of the traditional engklek game and its potential as a mathematics learning medium in elementary schools is

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still limited (Arisetyawan et al., 2025). Although some studies have identified mathematical concepts in traditional games in general, more in-depth exploration is needed to analyze how these concepts can be systematically integrated into mathematics learning activities.

Therefore, exploring the ethnomathematical aspects of traditional games is important to support contextual and culturally relevant mathematics learning (Kumar & Gopinath, 2025). By integrating local culture into mathematics education, students not only develop mathematical understanding but also strengthen their appreciation of cultural heritage. This study focuses on exploring the ethnomathematical values contained in the traditional engklek game and examining its potential as a medium for mathematics learning in elementary schools.

Research Problems

Based on the background above, the research problems in this study are:

1. What ethnomathematical concepts are contained in the traditional engklek game?
2. How can the traditional engklek game be utilized as a medium for mathematics learning in elementary schools?

Research Objectives

The objectives of this study are:

1. To identify and analyze the ethnomathematical concepts contained in the traditional engklek game.
2. To explore the potential of the traditional engklek game as a medium for mathematics learning in elementary schools.

Research Methods

This study employed a qualitative approach using an ethnographic method to explore ethnomathematical concepts embedded in the traditional engklek game and its potential as a medium for mathematics learning in elementary schools. The ethnographic approach was used to understand cultural practices, values, and meanings contained in the traditional game through direct interaction with participants and observation of the activities related to the game (Febriza et al., 2025).

This research was conducted through several stages. The first stage was the preparation stage, which included conducting a literature review related to ethnomathematics and traditional games, determining research subjects, preparing research instruments, and arranging the research schedule. The second stage was the data collection stage, where researchers conducted interviews, observations, and documentation in the research setting. The third stage was the data analysis stage, which involved organizing, interpreting, and drawing conclusions from the collected data. The final stage was the reporting stage, where the findings of the research were compiled systematically.

The research was conducted in an elementary school environment and involved several participants selected through purposive sampling. The research subjects consisted of one traditional game expert from the Indonesian Traditional Games and Sports Committee (KPOTI), one mathematics education expert, two elementary school teachers, and ten elementary school students who were familiar with the engklek game. These participants were selected because they were considered

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capable of providing relevant information related to the traditional game and its potential use in mathematics learning.

The instruments used in this study were interview guidelines, observation sheets, and documentation. Interviews were conducted in a semi-structured manner to obtain in-depth information regarding the origin, rules, and cultural values of the engklek game, as well as its relevance to mathematics learning. Observations were conducted to examine the gameplay process and identify mathematical concepts embedded in the game activities, such as geometric shapes in the game patterns, counting activities, and measurement of movement or distance during the game. Documentation was used to support the data obtained through interviews and observations, including photographs, field notes, and related written sources.

To ensure the credibility of the data, this study applied data triangulation techniques. Triangulation was conducted by comparing information obtained from different sources, including traditional game experts, teachers, and students. In addition, triangulation of methods was carried out by comparing data obtained through interviews, observations, and documentation. Member checking was also conducted by confirming the interview results with participants to ensure the accuracy of the collected information.

The data analysis in this study followed qualitative data analysis procedures. The first step was data reduction, where the researcher selected, simplified, and organized the raw data obtained from interviews, observations, and documentation. The second step was data categorization, where the data were grouped based on themes related to ethnomathematical concepts such as geometry, number concepts, and measurement. The third step was data presentation, where the categorized data were organized in the form of descriptive narratives to facilitate interpretation. The final step was drawing conclusions and verification, where the researcher interpreted the findings and verified them through repeated examination of the data to ensure consistency and validity.

Results and Discussion

a. Ethnomathematics Perspective

The findings of this study support the concept of ethnomathematics introduced by Ubiratan D'Ambrosio, which emphasizes that mathematical knowledge is closely related to cultural practices and daily activities within a community. From an ethnomathematical perspective, the engklek game reflects mathematical thinking embedded in local cultural traditions. The way children draw the game pattern, determine movement sequences, and follow the rules of the game demonstrates implicit mathematical reasoning developed through cultural practices (Galawe., 2023). Therefore, integrating traditional games into mathematics learning not only supports conceptual understanding but also preserves cultural heritage (Ridho Alfarisi, 2025).

b. Constructivist Learning Perspective

The results of this study can also be explained through constructivist learning theory proposed by Jean Piaget and Lev Vygotsky. According to Piaget, elementary school students are generally in the concrete operational stage, where they learn

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best through direct interaction with physical objects and real experiences. The engklek game provides such experiences by allowing students to physically interact with geometric shapes and number sequences.

Meanwhile, Vygotsky emphasized the importance of social interaction in the learning process. The engklek game involves collaborative activities, turn-taking, and communication among students. These social interactions support cognitive development and help students construct mathematical understanding together (Irwanti & Azizah, 2025).

c. Contextual Learning Perspective

The findings of this study also align with the principles of contextual learning, which emphasize the connection between academic knowledge and real-life situations. Through the engklek game, mathematical concepts are introduced in a familiar cultural context. Students do not only learn mathematical formulas but also experience how mathematical ideas appear in daily activities. This contextual approach makes learning more meaningful because students can relate abstract mathematical concepts to real experiences (Apriva Hidayana & Lianingsih, 2025).

d. Advantages and Limitations of the Findings

The results of this study indicate several advantages of using the engklek game as a mathematics learning medium. First, the game provides concrete learning experiences that help students understand abstract mathematical concepts. Second, it increases student motivation and participation in learning activities. Third, it supports the development of social skills such as cooperation, discipline, and respect for rules. However, several limitations were also identified. One challenge is the limited classroom space for conducting physical games. In addition, high student enthusiasm sometimes requires careful classroom management to maintain an organized learning environment.

Despite these limitations, teachers can overcome these challenges by modifying the game format or adapting it to available learning spaces (Connolly & Stansfield, 2006).

e. Contribution of the Study

This study contributes to the development of ethnomathematics-based learning by demonstrating how traditional games can be systematically integrated into elementary school mathematics learning. Unlike previous studies that mainly identified mathematical elements in traditional games, this research provides a deeper exploration of how the engklek game can function as a contextual learning medium aligned with curriculum competencies. Therefore, the integration of traditional games such as engklek offers a promising approach to creating mathematics learning that is meaningful, engaging, and culturally relevant for elementary school students. Based on the interview with Teacher 1, who asked, "What can be taught through hopscotch?" Teacher 1 answered:

"Actually, there are many things. Besides recognizing numbers and number sequences, children can also learn the concepts of addition and subtraction. Furthermore, from the hopscotch pattern itself, they can learn about geometric shapes like squares, triangles, semicircles, and straight lines."

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The data in this study were obtained through interviews, observations, and documentation related to the traditional game of engklek and its relation to mathematical concepts in elementary school learning (Afghohani et al., 2024). The analysis of the collected data indicates the presence of several mathematical concepts within the activities of the game, including geometry, arithmetic operations, and number concepts.

f. Geometry Concepts in the Engklek Game

Based on observations of the engklek game board pattern, the game pathway consists of several geometric shapes such as squares, rectangles, and semicircles. These shapes are drawn on the ground or floor and serve as the main pathway that players must follow during the game. During gameplay, students jump from one box to another according to the pattern that has been drawn. This direct interaction with the shapes reflects activities related to recognizing geometric forms, spatial orientation, and the distance between the boxes (Sirjon et al., 2025).

One teacher interviewed in this study explained:

"The engklek game actually makes it easier for children to recognize geometric shapes. When they play, they directly see and step on squares, rectangles, and other shapes. So they learn geometry naturally without realizing it." This statement illustrates how the activities in the engklek game are associated with students' concrete experiences in identifying geometric shapes.

g. Arithmetic Concepts in the Engklek Game

Arithmetic concepts in the engklek game can be observed through the numbering system of each box and the sequence that players must follow while playing. Each box is usually numbered sequentially, requiring players to move according to the given order when jumping. In some learning practices, the game may also be modified by incorporating simple arithmetic problems (Pangestuti et al., 2024). Teachers may provide mathematical operations and ask students to jump to the box that represents the result of the operation.

A teacher described this activity as follows:

"If the teacher says '3 + 2', the students must jump to box number five. This makes them think quickly while playing." This activity reflects the integration of physical movement with students' cognitive processes in solving simple arithmetic problems.

h. Number Concepts in the Engklek Game

Number concepts in the engklek game are reflected in the numbering of each box in the game pattern. The numbering functions as a guide for determining the sequence of movement during gameplay (Siska Sumarni, 2025). Through this structure, students interact directly with number sequences while following the game pathway. In addition, counting activities emerge when students determine turns, count the number of boxes they have passed, or estimate the next step during the game.

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Conclusion and Suggestion

Based on the results of the research, it can be concluded that the traditional game engklek has great potential to be used as a medium for learning mathematics in elementary schools (Roikhatul Jannah et al., 2024). This game not only contains local cultural values, but also naturally reflects mathematical concepts taught in elementary schools, such as numbers, flat shapes, patterns, and measurements. Engklek provides a concrete, fun and contextual learning experience, which is in line with the characteristics of elementary school-age students. With a few modifications, this game can be linked directly to math learning objectives, so that students not only play but also understand concepts more deeply (Aisyah & Awal Nur., 2025). Therefore, the engklek game is very feasible to use as an alternative learning media that not only strengthens the understanding of mathematical concepts, but also trains motor skills, social skills, and builds students' love for learning (Fatimatuszahro et al., 2024).

According to mathematicians, elementary school students have difficulty learning mathematics due to negative perceptions, the abstract nature of the material, and uninteresting learning methods. Low learning interest is influenced by monotonous teaching methods, necessitating strategies such as games, rewards, and group learning. An ethnomathematics approach through traditional games like hopscotch is considered relevant and has the potential to improve student understanding, especially if designed according to learning objectives and accompanied by rule modifications and the inclusion of mathematical concepts. The following table shows the results of interviews with mathematicians discussing this issue, shown in Table 1.

Table 1. Table of interview results with mathematicians

P	In your opinion, why do many elementary school students find it difficult to learn mathematics? What factors make students uninterested or bored when learning mathematics?
N	Many elementary school students find mathematics difficult because they already have an unpleasant initial impression of the subject. Based on observations in the field and my personal experience as a teacher, most students have a negative perception of mathematics from the beginning. When asked about their favorite subject, most students prefer Physical Education or learning activities conducted outside the classroom. Based on mapping conducted over the past three years, it can be concluded that children tend to enjoy activities that involve movement and fun rather than those that require abstract thinking, such as mathematics or science. Students' lack of interest in mathematics is also influenced by learning approaches that are less engaging, which causes students to feel bored and find it difficult to understand the material. Therefore, teachers need to design a more enjoyable learning atmosphere, for example through challenges in the

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	form of games or by providing non-material rewards such as points or stars to increase students' enthusiasm for learning. Another factor that causes students to lose interest in mathematics is the way the material is delivered by the teacher. If the teacher delivers lessons in a manner that is too serious or monotonous, students may feel pressured or even sleepy. On the other hand, if learning is presented through more varied approaches such as games or group learning, students tend to be more active and engaged. In this context, differentiated learning strategies become important. Teachers need to identify students' initial abilities so they can group them appropriately, not based on who is smarter or less capable, but to strengthen understanding according to students' needs. Such an approach allows the learning process to become more effective and enjoyable.
P	How do you, as a mathematics teacher, address this problem?
N	As a mathematics teacher, I apply various strategies to address this problem. The main goal is not only to make students academically proficient, but first to help them develop an interest in mathematics. One method used is a quick-response game where students answer simple questions quickly and receive points as rewards. This strategy has proven effective in increasing students' interest, even among those who are usually less active. In addition, I apply group learning using a heterogeneous system, where one or two students who understand the material better are given the responsibility of helping their peers in the group. This strategy not only accelerates students' understanding but also builds a sense of responsibility and collaboration in learning.
P	Is the concept of ethnomathematics relevant to be applied in mathematics learning in elementary schools?
N	Regarding the concept of ethnomathematics, I believe this approach is very relevant if applied in elementary schools, especially through enjoyable learning activities such as traditional games. Games such as *engklek* or *gobak sodor* contain rich local cultural elements and can also be connected to other subjects such as local culture education. In the context of mathematics learning, these games can be used to introduce basic mathematical concepts in a way that is more engaging and contextual for students.
P	Is the engklek game effective as a medium for learning mathematics? Please explain.
N	The effectiveness of the engklek game as a mathematics learning medium depends on the learning design implemented. It can be effective if the game is designed in accordance with mathematics

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	learning objectives. Teachers must ensure that the game remains focused on achieving competencies, not merely on entertainment. The game should be directly connected to the material being studied, such as concepts of area, perimeter, or recognizing plane shapes, so that students can understand the material more effectively.
P	In your opinion, is the engklek game effective in helping elementary school students understand mathematical concepts?
N	However, there are challenges in implementing games such as engklek as learning media. The main challenge is classroom management, as children tend to compete for turns to play, especially when the atmosphere becomes very enthusiastic. Therefore, it is important for teachers to organize the game strategy systematically from the beginning, for example by forming groups and arranging playing turns. This will help maintain order during the learning process.
P	According to you, which mathematics topics are most suitable to be taught using this game? (for example: number operations, geometry, measurement, etc.)
N	Overall, I believe that the engklek game has great potential to be used as a mathematics learning medium in elementary schools. As long as the learning design is carefully prepared and directly linked to the material being taught, this game can become an effective and enjoyable learning tool. It not only helps students understand mathematical concepts but also instills values such as responsibility, cooperation, and enthusiasm for learning through enjoyable and contextual activities.
P	Is it necessary to modify or adjust the game rules so that they align with mathematics learning objectives? If yes, what modifications are needed?
N	Yes, modifications or adjustments are necessary in the rules of the engklek game so that it aligns with mathematics learning objectives, especially when it is used in formal learning contexts in elementary schools. As a teacher, several adjustments can be made: 1. Adjusting the Mathematics Content Since the engklek game was not originally designed for mathematics learning, certain materials must be integrated to make it relevant to learning competencies. For example: o For geometry topics, the boxes in the game can be modified into different shapes (triangles, trapezoids, circles).

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	○ For arithmetic operations, students may be asked to add the numbers in the boxes they step on or jump according to the result of a given problem. ○ For fractions or decimals, the numbers inside the boxes can be replaced with fractional forms, and students must answer when landing on the box. 2. Modifying Rules to Insert Mathematical Questions For example: ○ Before jumping to the next box, students must answer a question given by the teacher based on their position. ○ The game can only continue if the question is answered correctly, adding elements of motivation and challenge. 3. Using Supporting Tools or Media Teachers can add question cards, spinners, or other media containing mathematics problems to make learning more varied and enjoyable. 4. Grouping Students To encourage cooperation and meaningful learning, students can play in groups and help each other answer questions. 5. Reinforcing Values and Character Education Teachers can emphasize values such as sportsmanship, cooperation, and honesty during the game, in line with character education in elementary schools. With these adjustments, the engklek game can become a contextual, enjoyable, and meaningful learning medium that helps students understand mathematical concepts concretely and actively.
P	Are there specific strategies teachers should use so that students do not only focus on playing but also understand the mathematical concepts within the engklek game?
N	Yes. It is important to implement specific strategies so that students do not focus solely on the playing aspect but also understand the mathematical concepts embedded in the game. Some strategies include: 1. Providing Clear Learning Objectives Before the game begins, the teacher should explain that the activity is part of mathematics learning and clarify which concepts will be learned, such as plane shapes, number operations, number patterns, or measurement. 2. Embedding Mathematical Questions or Challenges Teachers can insert questions that students must answer before jumping or continuing the game.

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	3. Reflection and Discussion After Playing After the game, the teacher should guide students to reflect and discuss what they learned and which mathematical concepts appeared in the activity. 4. Using Worksheets or Activity Sheets Students may complete worksheets related to the game, such as redrawing the engklek pattern and calculating the number of sides, area, or creating problems based on the numbers. 5. Forming Learning Groups Playing in groups allows students to discuss and help each other understand the concepts. 6. Structured Assessment Teachers can prepare assessment instruments that cover cognitive aspects (concept understanding), affective aspects (enthusiasm and cooperation), and psychomotor aspects (physical activity and accuracy in following instructions). Through a structured approach, traditional games such as engklek can become enjoyable and meaningful tools for introducing mathematical concepts in a contextual way.
P	What are the main challenges in implementing traditional game-based learning media in elementary schools?
N	From a teacher's perspective, the main challenges include: 1. Time Management Traditional games like engklek often require more time than lecture-based or assignment-based methods. 2. Students' Easily Distracted Focus Students may become overly excited about playing and forget to focus on the intended learning objectives. 3. Classroom Management and Discipline Physical activities can sometimes lead to noise, minor conflicts, or competition for turns. 4. Limited Facilities and Infrastructure Some schools may lack sufficient space or supporting materials such as playgrounds, chalk, or visual aids. 5. Need for Careful Learning Design Traditional games do not automatically become effective learning media. Teachers must redesign the rules, connect them to learning objectives, and prepare appropriate evaluation instruments. 6. Limited Teacher Understanding of Ethnomathematics Not all teachers are familiar with how to connect local culture or traditional games with mathematical concepts, and training in ethnomathematics is still limited in many schools.

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This study aims to explore the ethnomathematical values in the traditional game of engklek and its potential as a medium for mathematics learning in elementary schools (Shofa et al., 2025). Cultural introductions create engaging, interactive learning and enhance local wisdom (Sugiharti et a., 2025). The analysis shows that the engklek game reflects several mathematical concepts, including geometry, numbers, and basic arithmetic operations. These concepts appear through the structure of the game board, the numbering system, and the sequence of movements performed during gameplay. The use of the engklek game in learning activities provides a contextual and engaging learning experience for elementary school students. Through direct interaction with the game, students are able to connect mathematical concepts with real-life activities and cultural practices.

Based on these findings, the engklek game has the potential to be used as an alternative learning medium that supports meaningful and culturally relevant mathematics learning in elementary schools (Madela et al., 2024).

For future research, it is recommended to examine the effectiveness of the engklek game through experimental or quantitative approaches to measure its impact on students' mathematical understanding and learning outcomes. Further studies may also explore the integration of other traditional games as ethnomathematics-based learning media in elementary education .

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