Al-Ishlah: Jurnal Pendidikan
Vol.16, 2 (June, 2024), pp. 2082-2093
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v16i2.5166

Knitting Tradition and Mathematics: Systematizing the Literature on Indonesian Traditional Games and Mathematical Dimensions

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ARTICLE INFO

Keywords:

Indonesian traditional game;
mathematic;
Systematic Literature Review

Article history:

Received 2024-03-18
Revised 2024-05-07
Accepted 2024-06-29

ABSTRACT

Mathematics presents significant learning challenges for students globally, which is often reflected in poor academic performance. This research explores the potential of traditional Indonesian games to enhance math learning, an under-explored approach that can also contribute to cultural preservation This research investigates how traditional Indonesian games can enhance math learning. We conducted a Systematic Literature Review, selecting articles through keyword searches in the Google Scholar database. The criteria used were articles on Indonesian traditional games. The result of this study is that traditional Indonesian games can enhance math learning by: (1) Presenting a strong rationale that the use of Indonesian traditional games in mathematics learning is often motivated by difficulties in learning mathematics as well as cultural preservation; (2) Integrating traditional games in mathematics learning according to students' characteristics, especially at the elementary level; (3) Applying relevant mathematics topics, such as geometry and number, in traditional games; (4) Integrating traditional games that are widely known by students, such as engklek and congklak, in mathematics learning; (5) Apply the presentation technique of integrating traditional games and mathematics through learning activities at school with teachers; (6) Realize that the integration of traditional games in mathematics learning affects students' affective, cognitive, psychomotor, and skill abilities that will improve their mathematics abilities.

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1. INTRODUCTION

Mathematics learning plays a crucial role in education because it not only forms an important basis for understanding scientific and technical concepts, but also enriches critical skills such as problem solving, analysis, and logical thinking (Kurniawati & Ekayanti, 2020). However, many students face difficulties in understanding and mastering mathematics. This difficulty can be caused by various factors, namely lack of understanding of concepts, lack of interest in learning, learning approaches that are not in accordance with the characteristics of children (Amaliyah et al., 2020). Students have difficulty in understanding concepts which results in decreased motivation to learn. This will lead to a lack of development of their mathematical abilities (Hima et al., 2019). Thus, teachers should increase student learning motivation in accordance with student characteristics.

One of the characteristics of children is play (Anggita et al., 2023), thus the need for students to play is something that cannot be ignored in the learning process. Play is not only about fun, but also an important tool for students' social, emotional, and cognitive development (Utami et al., 2022). In the context of mathematics learning, play provides opportunities for students to apply the concepts they learn in real and interesting situations. Through play, students can develop critical thinking, problem solving and cooperation skills, all of which are important aspects of mathematics learning. In addition, play also helps to reduce stress and increase students' motivation towards learning, as they feel more engaged and excited to explore and understand mathematical concepts in a fun and interactive way (Kobari et al., 2022).

Vygotsky's theory about the role of social interaction in learning is a strong supporter of the application of traditional games in learning (Suciati, 2021). In addition to Vygotsky's theory, Piaget's theory of constructivism states that children actively construct their understanding of the world through interaction with their environment (Sugrah, 2019). In the context of traditional games and mathematics, children not only receive knowledge from adults, but are also actively involved in the process of constructing their own knowledge while playing traditional games. Through traditional games such as “Congklak” or “Engklek”, students not only learn math concepts such as addition or subtraction, but also develop social and collaborative skills through interaction with classmates (Setiawan, 2020). In the process of playing, students discuss, collaborate and support each other, creating an inclusive and supportive learning environment, in line with Vygotsky's principles.

Traditional Indonesian games contain mathematical concepts as well as cultural values and the formation of children's character. Thus, learning mathematics using traditional Indonesian games is also an effort to preserve the nation's culture in the next generation(Setiawan, 2020). Indonesian traditional games are not only a valuable cultural heritage, but also a source of wealth to enrich learning in various fields, including mathematics. Along with technological advances and globalization, traditional games are often forgotten or marginalized in everyday life, especially among children (Rizal et al., 2020). However, in an educational context, Indonesian traditional games offer great potential to help students understand mathematical concepts in a concrete and fun way (Wulansari & Dwiyanti, 2021). Indonesian traditional games are not only a valuable cultural heritage but also a rich source to enrich learning in various fields, including mathematics. Along with technological advancement and globalization, traditional games are often forgotten or marginalized in daily life, especially among children (Rizal et al., 2020). However, in an educational context, Indonesian traditional games offer great potential to help students understand mathematical concepts in a concrete and fun way.

Traditional games such as congklak, dakon, or gatrik, can teach students basic math concepts such as addition, subtraction, multiplication, and division (Choiriyyah et al., 2022). In addition, traditional games often involve problem solving, strategy and critical thinking skills, which are important aspects of mathematics learning (Rahayu, 2023). The use of traditional games in learning contexts also evokes a sense of love and pride in Indonesia's cultural heritage (Gultom et al., 2023). Through play experiences, students not only learn about math, but also appreciate the beauty and uniqueness of their own culture, forming a strong identity and a deep love for their heritage. By integrating traditional

games into the mathematics curriculum, educators not only enrich students' learning experiences, but also help maintain and strengthen Indonesia's cultural diversity.

This article aims to investigate how Indonesian traditional games can enhance mathematics learning. A systematic literature review was chosen to comprehensively gather and analyze existing research on traditional games in mathematics education, to ensure a robust synthesis of current knowledge and identify gaps. This research will explore studies that have been conducted to evaluate the effectiveness of using traditional games in mathematics learning contexts. We will present a summary of key findings from the relevant literature, highlighting how traditional games can be used as effective tools to improve students' understanding of mathematical concepts, critical thinking skills and problem-solving abilities. As such, this article not only provides an in-depth insight into the potential of Indonesian traditional games in the context of mathematics learning, but also provides a foundation for the development of innovative and culturally-based learning strategies in the classroom.

To uncover how traditional games can enhance math learning, the research explores key information from previous studies using several questions. First, why do researchers need to run traditional game-based math learning? This will provide insight into the motivation behind integrating math learning with traditional Indonesian games. Second, at what level can math and traditional game-based learning be implemented? With this information, we can determine at which level of education we should integrate traditional games in math learning. Third, what mathematics learning materials can be delivered through traditional games? This question will identify what materials can be delivered through traditional Indonesian games. Fourth, which traditional games can be integrated in math learning? With this question, we can find traditional games that are suitable for math materials. Fifth, what techniques can be used in integrating traditional games in math learning? With this information, we can find out effective techniques in integrating traditional games in math learning. Finally, how does the application of traditional Indonesian games affect math learning? This will provide insight into the impact of Indonesian traditional games on students' aspects of math learning.

2. METHODS

This study used a systematic approach in conducting a literature review, by applying the Systematic Literature Review (SLR) method refined by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) in 2020. This approach allows for a thorough and structured investigation of traditional games and math learning through data collection and analysis.

2.1 Collection of data

Eligibility Criteria

The data collection stage of the Systematic Literature Review (SLR) method involves identifying and assessing the eligibility of studies to be included in the analysis. Strictly defined eligibility criteria aim to ensure that only relevant and high-quality sources are included in the review. The criteria in this study were articles published between 2020-2024 with Scopus indexing and national journals Sinta 1 and 2. The selection of the 2020-2024 timeframe ensures that the sources used are the most relevant to the current issue or research topic so that they will provide up-to-date insights. Likewise, using sources indexed in Scopus and national journals Sinta 1 and 2 because they have passed a rigorous selection process for quality and credibility. Thus, the findings in this study are based on valid research results.

Identification

Data searches are carried out using the Publish or Perish application. Publish or Perish, is an application that can search the literature with certain relevant keywords that are relevant to research needs quickly and efficiently. In this study, data searches were sourced from Google Scholar data which has many article references using the keywords Indonesia Traditional Game and Mathematic.

The results of the search obtained as many as 500 articles. These articles were then exported in RIZ format and further filtered using a helper application.

Screening

In this study, the screening process was conducted in two stages. In the first stage, the filtering was focused on removing articles that did not have a relationship between Indonesian traditional games and mathematics. Data searches using the keywords Indonesian traditional games and mathematics, resulted in data on articles with the topic of mathematics only, articles with the topic of traditional games only, or articles that discuss the relationship between traditional games and mathematics. In the first stage of filtering, by looking at the titles and abstracts of the articles, 455 articles were eliminated and 45 articles were retained. In the second stage of screening, of the 45 retained articles, 28 articles were excluded because they did not explain the effect of traditional games on learning mathematics, were not indexed in Scopus or in accredited national journals, the research was conducted before 2020, and some journals were inaccessible. Thus, from the results of the second stage screening, 17 articles were retained for review.

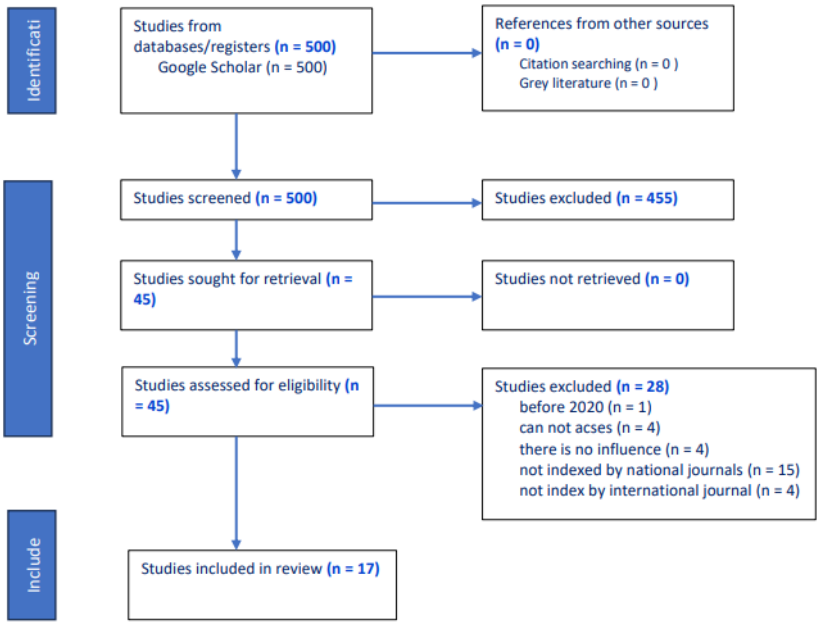

Figure 1. Screening Process Flow

2.2 Data Analysis

The seventeen articles will be reviewed using the specified frame work. There are six dimensions that are of concern in research on Indonesian traditional games and mathematics learning, namely: reason for application, mathematics topic, type of traditional game, level of education unit or group, application technique, and effect.

Background dimension

This dimension explains the reasons for the application of mathematics learning and traditional games, namely the background of the implementation of mathematics learning and traditional games. Knowing the background of each previous study will strengthen the reasons for the importance of integrating traditional games in mathematics learning. The researcher limited this dimension to the

following categories: math learning difficulties, cultural preservation, the link between math learning and cultural preservation, and character building.

User Dimension

The user dimension of Indonesian traditional games in Mathematics learning is divided into categories: Early Childhood Education, Elementary School, Junior High School, Senior High School, Community Environment. With this information, we can determine at which level of education we should integrate traditional games in mathematics learning.

Topic Dimension

The Topic Dimension presents the application of mathematical materials in traditional Indonesian games as an interesting and relevant context. Through this investigation, we will obtain information on topics that can be taught using traditional games.

Dimensions of game types

By investigating the types of traditional games used, information will be obtained on the types of traditional games that are often used in math learning. This will help teachers consider the types of traditional games that are suitable for mathematics learning.

Presentation technique dimension

This dimension provides information on how traditional games are presented in math learning. With this information, we will know how traditional games should be presented in math learning.

Dimension of Influence

This dimension will explain the effect of learning mathematics by using Indonesian traditional games categorized in cognitive, psychomotor, skills and affective. From this investigation, information will be obtained on the strong influence of traditional games on math learning.

In order to understand how Indonesian traditional games can effectively enhance math learning, we need to explore several interrelated aspects. First, it is important to understand the rationale behind the application of traditional games in the context of math learning. Next, we must consider the most appropriate level of education unit to implement traditional game learning, taking into account student characteristics and the prevailing curriculum. In addition, we need to select the topics of mathematics material that can be learned through traditional games, as well as identify the types of traditional games that are most suitable to facilitate the understanding of these concepts. Furthermore, the way traditional games are presented in the context of mathematics learning should be carefully considered, including the use of clear instructions and approaches that support the understanding of mathematical concepts. Finally, it is important to evaluate the impact of traditional games on mathematics learning, with an eye to improving students' motivation, concept understanding and academic achievement. By looking at all these aspects holistically, we can gain a deeper understanding of the potential of traditional games in effectively enhancing math learning.

Table 1. Categorization Framework

Dimensions	Category
Background	Math Learning Difficulties Preserving Culture Mathematics and Culture Linkages Character Building Lack of Playtime
Subject	Pre-School Education Primary School Secondary School High School

	Community Environment
Math Topics	Adapted to the emerging mathematical topics of each study.
Name of Game	Adjusted to the type of game that appears in each study.
Implementation Technique	Integreted in Learning Daily Games Teacher Reinforcment
Influence	Cognitive Psychomotor Affective Skills

3. FINDINGS AND DISCUSSION

Seventeen articles that had been obtained through a rigorous screening process were reviewed to answer the research questions. The results of the review are described below.

RQ 1: What is the background of the research?

As shown in diagram 1, the background of the research on Indonesian traditional games and mathematics learning includes difficulties in learning mathematics and the relationship between mathematics and culture. In addition, cultural preservation efforts, student character building, and the lack of children's play time are also the background of the research conducted.

RQ 2: Who are the research subjects?

Diagram 2 presents Elementary School is the level that most often applies Indonesian traditional games in mathematics learning. In addition to formal education, Indonesian traditional games and math learning are also often prescribed in social life in certain communities or play activities together in the community.

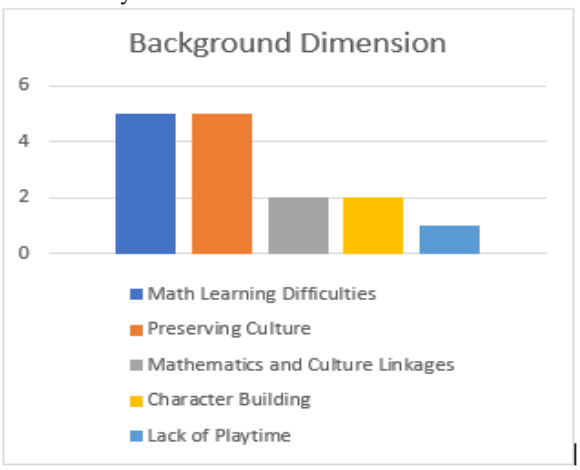

Figure 2. Background Dimension

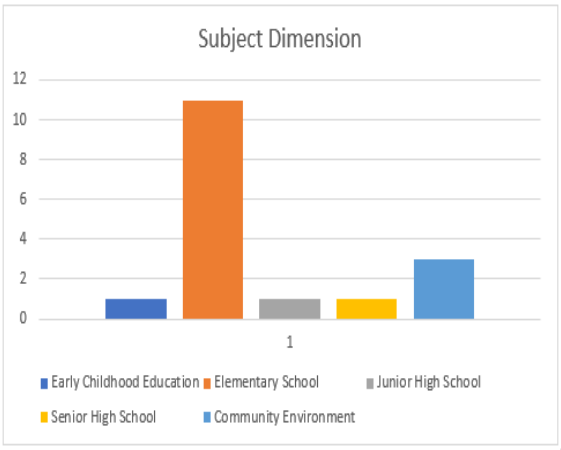

Figure 3. Subject Dimension

RQ 3: What are the most researched math topics in traditional Indonesian games and math learning?
Of the seventeen articles reviewed, Diagram 3 shows that geometry and number are the most frequently taught topics using traditional Indonesian games, followed by measurement, fractions, algebra, statistics, sets, probability, lines and angles.

RQ 4: What is the name of the traditional Indonesian game used in mathematics learning?
From the seventeen articles reviewed, Diagram 4 shows that engklek and congklak are traditional games that are widely used in mathematics learning.

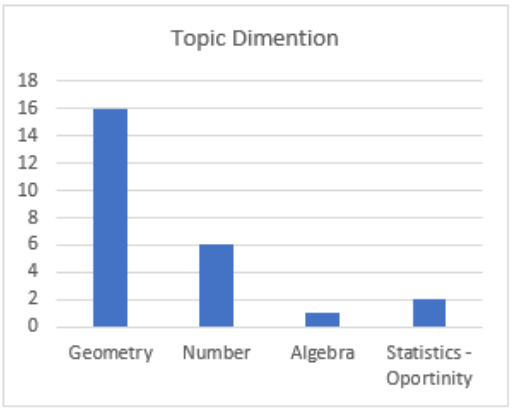

Figure 4. Topic Dimention

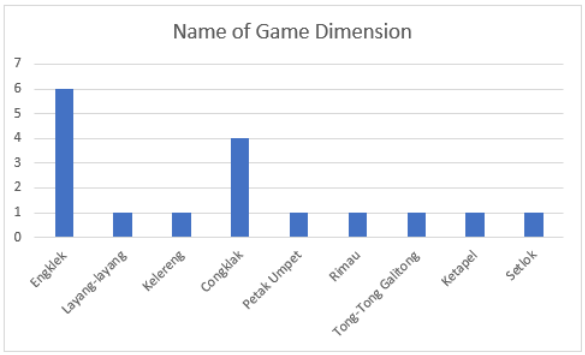

Figure 5 Game Dimention

RQ 5: What are the techniques of implementing traditional games in math learning? The research found three techniques of implementing traditional games in mathematics learning. Based on Diagram 5, the application of traditional games integrated in school learning is widely applied. Some applications are done informally outside of learning activities, through joint games in the community environment.
RQ 6: What are the effects of Indonesian traditional games on math learning? This research focuses on four effects of the implementation of traditional math games in mathematics learning. Based on Diagram 6, affective aspects have a significant impact on students. Some studies emphasize cognitive, psychomotor, or skill objectives, but affective effects always follow the other effects.
Gambar 5

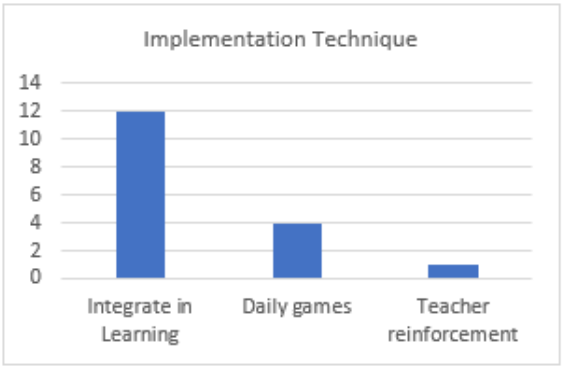

Figure 6. Implementation of Technique

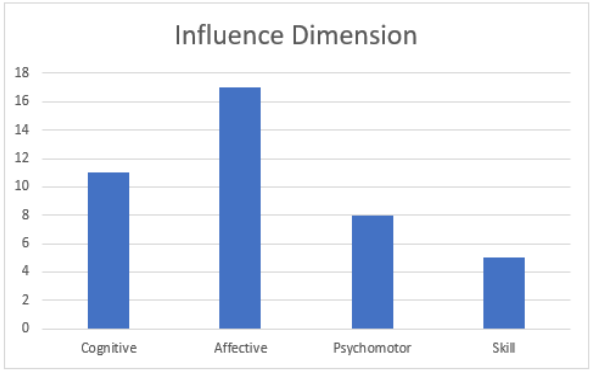

Figure 7. Influence Dimension

The article "Knitting Tradition and Mathematics: Systematic Literature on Indonesian Traditional Games and Mathematical Dimensions" presents an interesting study on the relationship between traditional cultural heritage, especially Indonesian games, and mathematical concepts. In this era of globalization, the sustainability and deep understanding of traditional games is becoming increasingly important to preserve. In this context, the article outlines how traditional games not only provide entertainment, but are also a vehicle for understanding fundamental mathematical concepts, and according to Taufek et al.(2022) traditional games make learning mathematics meaningful. By

reconnecting with this tradition, we can dig deeper into the cultural richness that can be used as a learning medium with realistic learning styles (Eldiana et al., 2023). In addition, culture can also be associated with relevant mathematical knowledge.

Two reasons that are often behind the integration of traditional Indonesian games and mathematics learning are the difficulty of learning mathematics and cultural preservation efforts. Mathematics is a subject that is often considered difficult by many students, therefore many efforts are made to make it more interesting and close to students, one of which is by integrating it in traditional games (Herman et al., 2022;Al Mukhtadibillah et al., 2020;Nur'Aeni et al., 2020). According to Zunarni et al., (2022) mathematics is a science that studies abstract structures and the patterns of relationships that exist in them. This abstract structure needs to be understood with a concrete activity. Traditional games provide a more real and fun context for learning math concepts, making them easier for students to understand and remember (Prabavathy & Sivaranjani, 2023). Traditional games are not only used as a vehicle for play, but also integrated into learning as an effort to preserve the nation's culture which has begun to be forgotten by children due to the flow of modernization that has occurred recently (Roza et al., 2020; Kamid et al., 2022; Asrial et al., 2020). By integrating math in traditional games, children can learn about math concepts while staying connected to their cultural values and ancestral traditions (Agita et al., 2023). While this approach offers many benefits, there are still some challenges that need to be overcome. One of these is finding a balance between fun and effective learning. Too much focus on the game aspect can detract from the actual learning of Mathematics (Jääskä & Aaltonen, 2022). Therefore, it is important to design activities that blend these two elements in a balanced way.

Integrating math learning with traditional games has also become a popular approach in many primary schools, (Kamid, Sabil, et al., 2022; Yantoro et al., 2021). Teachers realize that using traditional games in mathematics learning not only makes the lessons more interesting, but also helps students understand mathematical concepts better. This is in line with (Kamid, Rohati, et al., 2022) which states that innovation is needed in mathematics teaching methods in elementary schools by utilizing Indonesian cultural heritage, such as traditional games, as a learning tool through traditional games such as engklek, congklak, gundu, petak umpet, and so on students can directly experience the application of mathematical concepts such as addition, subtraction, geometry, and other concepts.

Almost all mathematics topics, such as geometry (Zulviansyach et al., 2023), number (Al Mukhtadibillah et al., 2020), statistics & probability (Supahmi et al., 2022), and algebra (Cesaria et al., 2022), have the potential to be taught through the use of traditional games. However, in this context, geometry is often the main focus in the application of traditional games in mathematics learning. This is due to the diverse application of traditional games such as engklek, which naturally proposes geometry concepts such as lines, angles, flat shapes and symmetry which are crucial points in geometry learning. This is in line with Mulyasari et al., (2021) who emphasized that the game engklek contains basic concepts of geometry. Thus, the use of traditional games, especially the engklek game, has been proven effective in facilitating the understanding and application of geometry concepts in a more fun and interactive context of mathematics learning.

In addition to the traditional game engklek (Nugraha et al., 2020), various other traditional games such as congklak (Wulansari & Dwiyanti, 2021), kite (Kamid, Rohati, et al., 2022), hide and seek (Nur'Aeni et al., 2020), marbles (Kamid, Sabil, et al., 2022), and a number of other traditional games can also be applied in mathematics learning. Researchers or teachers need to have a deep understanding of these traditional games so that the games chosen are in accordance with the mathematics topics to be taught. Thus, the use of traditional games in the context of mathematics learning can increase learning motivation and improve understanding of mathematical concepts effectively.

The implementation of traditional games in mathematics learning is mostly done in learning activities but can also be done outside of learning, precisely in the student's play environment (Supahmi et al., 2022). The implementation of traditional games integrated with learning at school not only improves students' cognitive abilities but also builds students' mathematical communication

skills, process skills, and character building that affect students' mathematics improvement. Traditional games become an effective learning media in learning mathematics. This is in line with the opinion Nurhalisa et al., (2021) which explains that the presence of media in the learning process has an important impact because it can make learning more interesting and increase student interest and understanding.

One of the reasons for integrating mathematics with traditional games is intended to overcome the difficulty of learning mathematics among students, which can certainly be expected to affect students' cognitive abilities. However, surprisingly, this approach has had a broader impact on students' affective aspects, particularly in their character building. Through traditional games, students learn math concepts in a more fun and interactive way (Wulansari & Dwiyanti, 2021), but also develop students' affective values such as teamwork, communication, sportsmanship, honesty (Zuhri et al., 2023), discipline (Kamid, Sabil, et al., 2022), creativity, responsibility, and patience. In addition, they also learn to appreciate local culture and traditions, which in turn forms a sense of pride in their cultural identity. Thus, integrating mathematics with traditional games not only improves students' academic understanding, but also helps shape strong and positive characters for future generations (Prayitno et al., 2022). In line with Rohayati et al., (2022) who stated that in an effort to advance technological education, it is important to integrate cultural elements in the learning process at school. This aims to allow students to maintain their character and cultural values, while keeping up with the changing times.

4. CONCLUSION

This study utilized a systematic literature review to investigate reliable sources on the integration of traditional Indonesian games into mathematics education, benefiting both mathematics and classroom teachers. The findings indicate that traditional games can enhance math learning by addressing learning difficulties and promoting cultural preservation, integrating games according to elementary student characteristics, applying relevant topics like geometry and number, and using widely known games such as *engklek* and *congklak*. Techniques for effectively presenting these games in the classroom were also highlighted. The integration of traditional games positively impacts students' affective, cognitive, psychomotor, and skill abilities, thereby improving their math abilities. However, this research is limited by its focus on a specific educational level and its reliance on qualitative data. Future research should conduct detailed analyses of the effectiveness of traditional games in improving mathematical understanding, retention, and learning behaviors. Expanding the scope to include different educational levels and developing game-based learning materials for broader math topics are also recommended. Additionally, further investigation into the affective impacts, such as increased motivation and confidence, should include both quantitative and qualitative measures.

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