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Research articles

Learning from Indonesia: A systematic literature review on the implementation of Indonesian traditional game for mathematics education

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Abstrak Sebagai bagian dari budaya, permainan tradisional memiliki dampak positif terhadap proses belajar mengajar matematika. Melihat fakta di lapangan terkait permasalahan dalam pembelajaran matematika, seperti kurangnya motivasi siswa belajar matematika hingga kesulitan dalam memahami matematika, maka guru dapat menggunakan permainan tradisional sebagai solusi terhadap masalah tersebut. Oleh karena itu, penelitian ini bertujuan untuk menyelidiki dampak permainan tradisional Indonesia terhadap pembelajaran matematika. Tinjauan literatur sistematis (SLR) digunakan sebagai metode dalam penelitian ini dan PRISMA 2020 sebagai kerangka kerja penelitian. Pada penelitian ini, terdapat lima kriteria inklusi yakni dokumen berasal dari artikel yang telah dipublikasikan, permainan tradisional harus berasal dari Indonesia, dokumen menggunakan bahasa Inggris, dikhususkan untuk mata pelajaran matematika, dan tujuan penelitian dari artikel tersebut adalah mengidentifikasi dampak penerapan permainan tradisional terhadap pembelajaran matematika. Terdapat 22 artikel yang memenuhi syarat untuk ditinjau untuk menjawab pertanyaan penelitian. Hasil penelitian menunjukkan, 1) permainan tradisional Indonesia terbukti memiliki efek potensial untuk mendukung kemampuan kognitif, psikomotorik, afektif, keterampilan proses matematika, dan keterampilan abad ke-21; 2) wilayah Jawa merupakan lokasi yang paling sering menjadi tempat penelitian implementasi permainan tradisional; 3) Bilangan dan Geometri lebih sering diajarkan dengan menggunakan permainan tradisional dibandingkan dengan topik matematika yang lain; 4) siswa sekolah dasar merupakan sampel yang paling sering dalam implementasi permainan tradisional; dan 5) *design research* merupakan jenis penelitian yang paling sering digunakan dalam penelitian implementasi permainan tradisional dalam pembelajaran matematika. Penelitian ini berkontribusi dalam menyajikan informasi terkait permainan tradisional yang dapat diimplementasikan dalam pembelajaran matematika dan menjadi bukti bahwa permainan tradisional memang memiliki efek positif terhadap pembelajaran matematika.

Kata kunci *Systematic literature review, Indonesia, Pendidikan matematika, Permainan tradisional*

Abstract As part of the culture, traditional games positively impact the process of teaching and learning mathematics. Teachers can use traditional games to solve problems in learning mathematics, such as students' lack of motivation and their difficulties in understanding mathematics. This systematic literature review (SLR) aims to investigate the impact of Indonesian traditional games on mathematics learning, with PRISMA 2020 as the research framework. Five inclusion criteria were applied to this study: the articles must be published, limited to Indonesia only, and written in English, focus on mathematics, and analyze the effects of the implementation of traditional games on mathematics learning. There are 22 articles eligible for review to answer the research questions of this study, and the findings are as follows: 1) Indonesian traditional games have been proven to have potential effects in supporting cognitive, psychomotor, affective, mathematical processing skills, as well as the 21st-century skills; 2) studies on the implementation of traditional games are was the most often carried out in the Java region; 3) Numbers and Geometry are more frequently taught using traditional games compared to other mathematics topics; 4) elementary school students are the most frequent samples in studies on the implementation of traditional games; and 5) design research is the

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type of research most often used to analyze the implementation of traditional games in mathematics learning. This study presents information about applicable traditional games in mathematics learning and provides evidence that traditional games have a positive impact on mathematics learning.

Keywords *Systematic literature review, Indonesia, Mathematics education, Traditional game*

Introduction

Currently, teachers still experience challenges in teaching mathematics to their students. The problems are complex because they are related to each other. One example of the problems in teaching and learning mathematics is the students' lack of interest and motivation that leads to increased mathematics anxiety, which negatively affects their achievements and performance in mathematics subject. To overcome this problem, teachers must find the best strategies to enhance students' motivation so as to improve their achievement (Tran & Nguyen, 2021; Woodard, 2004) and performance (Arthur et al., 2022; Pantziara & Philippou, 2015) in mathematics, one of which is by creating an environment where students can enjoy the teaching and learning process and experience meaningful learning (van Rijk et al., 2017). This can be achieved by linking the learning topics to a context that students can understand (van Oers, 1998) and connecting what they already know with the new information they will learn (Gunstone, 2015). In addition, teachers also believe that learning can be meaningful if it is related to students' daily life experiences (Polman et al., 2021).

Thus, integrating local culture can be an excellent way to help create a meaningful learning environment for students. As a set of norms, values, and beliefs shared within a group of people, local culture is very close and recognizable by students in their daily lives as part of the community (Walsham, 2002). Besides, utilizing local culture can solve difficulties in accessing learning resources, especially for schools with limited technological facilities such as those located in rural areas.

As one of the countries with the most extensive ethnic diversity, Indonesia is culturally rich. Each tribe in Indonesia has its own uniqueness in terms of traditions, foods, music, games, houses, belief systems, and many others. Therefore, cultural diversity has the potential as a learning resource in this country, not only for recognizing the richness of cultures in Indonesia but also for learning other subjects, including mathematics. Numerous studies have identified some mathematical concepts in Indonesian cultures (Roza et al., 2020; Supiyati et al., 2019), making the use of local culture as a context for teaching mathematics reasonable and acceptable.

As part of culture, traditional games can be applied in teaching mathematics. Studies have found that traditional games can effectively increase students' interest (Aras & Zahrawati, 2021) and motivation in learning mathematics (Aguilar, 2021; Harackiewicz et al., 2016), and even support their mathematical understanding (Atmaja et al., 2021; Nur'aeni, Muharram, et al., 2019). Additionally, integrating traditional games in mathematics teaching can improve students' communication skills (Kamid et al., 2022), which is one of the essential skills in the 21st century (P21, 2019). Apart from assisting mathematics learning, the use of traditional games can maintain their existence which is increasingly threatened by various technological developments in the era of digitalization. Nowadays, more students prefer playing online or digital games to traditional ones. Therefore, using traditional games as learning resources can

allow teachers to teach mathematics while introducing traditional games to students and preserving their existence.

The large number of traditional games existing in Indonesia makes it challenging for teachers to identify those applicable in mathematics teaching. Therefore, studies on this topic are needed to help teachers filter what types of traditional games they can use for a particular topic or grade. Meanwhile, a literature review about the implementation of Indonesian traditional games in mathematics education has not been conducted. For this reason, this study aims to carry out an in-depth investigation of literature that discusses the impact of Indonesian traditional games on mathematics education. The main objective of this study is to provide mathematics teachers with references on the practical implementation of traditional games in their classes. Furthermore, this study can also present scientific evidence of how traditional games can support the mathematics teaching and learning process, thus making teachers confident to integrate traditional games into their classes.

To provide meaningful information for teachers about the effects of Indonesian traditional games on mathematics teaching and identify research limitations, this study explores six components of research questions that become the main focus of this investigation. The first question is, "Where were the studies conducted?" (RQ 1), which investigates the research locations of previous studies on this topic. This is crucial to ensure that these studies are widely known throughout Indonesia. The second question is, "What mathematics topics can be taught using traditional games?" (RQ 2), which produces insights especially for teachers as to what mathematics topics can potentially be taught using traditional games. Then, "What grade can be taught using traditional games?" (RQ 3) is of the third question that can help teachers consider what types of traditional games are suitable for their students based on their grades. Next, the fourth question "What is the effect of the traditional game on students?" (RQ 4) explains the influences of implementing traditional games in increasing students' enjoyment and understanding, developing their communication skills, and other benefits so as to convince mathematics teachers to implement traditional games in their classes. The fifth question, i.e., "What types of research are primarily used in the studies?" (RQ 5) may indicate the types of previous studies on the effects of implementing traditional games in mathematics classes so that future researchers can either follow the method or modify it. In addition, the identification of the types of previous studies can also provide information on whether the results have been proven empirically or only theoretically. The last question, "What Indonesian traditional games can be used to teach mathematics?" (RQ 6) presents an overview on Indonesian traditional games that are typically used in teaching and learning mathematics. The six research questions above were proposed solely to contribute to the development of mathematics teaching and learning, especially in Indonesia.

Methods

This study employed the systematic literature review (SLR) method to answer the six proposed research questions designed to identify and synthesize specific research findings (Victor, 2008). The revised Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA 2020) was used as the framework of this study as it can ensure the transparency and accuracy of this study in answering the research questions (Page et al., 2021).

Data collection

Eligibility criteria

Table 1 shows the five inclusion criteria applied in this study: document, country, language, subject, and research goal. To ensure that the reviewed works are accessible for the public, this study only use published research articles or proceedings. The research location is restricted to Indonesia as this study aims to examine the impacts of Indonesian traditional games. The articles are written in English so that the findings can be understood by teachers, researchers, and people all over the world. Furthermore, this review focuses on the implementation of Indonesian traditional game in mathematics learning. Thus, the subject studied in the reviewed articles is limited to mathematics only. Lastly, the final criterion is the research goal, namely, the reviewed articles must report findings on the effects of the implementation of traditional games on mathematics learning.

Table 1. Eligibility criteria

Criterion	Inclusion
Document	Published Research Articles or Proceedings
Country	Indonesia
Language	English
Subject	Mathematics
Research Goal	Effect of the Implementation of the Traditional Games

Database and search terms

Relevant documents that meet the inclusion criteria of this study were obtained from the Garuda, Eric, and Scopus databases which cover a wide range of topics and journals. These databases also provide search algorithms that can assist in screening the eligibility criteria. The search string used (("traditional game") AND ("mathematics")) to retrieve articles in accordance to the eligibility criteria and coding frameworks.

Identification

A total of 78 articles were found using the search string. The screening of the inclusion criteria using automation tools (on the databases) obtained ten articles in Garuda, ten articles in Eric, and 18 articles in Scopus. These articles were then exported in CSV format and screened using MS Excel to exclude articles that were not related to this study. At this identification step, six duplicate articles were excluded prior to the screening stage. The flow of the Revised PRISMA 2020 is presented in Figure 1.

Screening

In this study, the screening process was carried out in three stages. The first screening focused on excluding articles that did not discuss the effects of implementing traditional games to mathematics teaching in Indonesia as identified in the title and abstract of the article. Four articles were removed at this stage as they met the exclusion criteria. Meanwhile, the second screening was conducted to determine which articles required full review access. Two articles were excluded at this stage as they are not open-accessible.

The remaining all-access articles were reviewed in the final screening to determine whether they were appropriate for review. The third screening focused on articles that were able to answer all of the six research questions in this study. Articles that failed to answer even one of the research questions were removed. Four articles were excluded at this stage, resulting in 22 articles included for review.

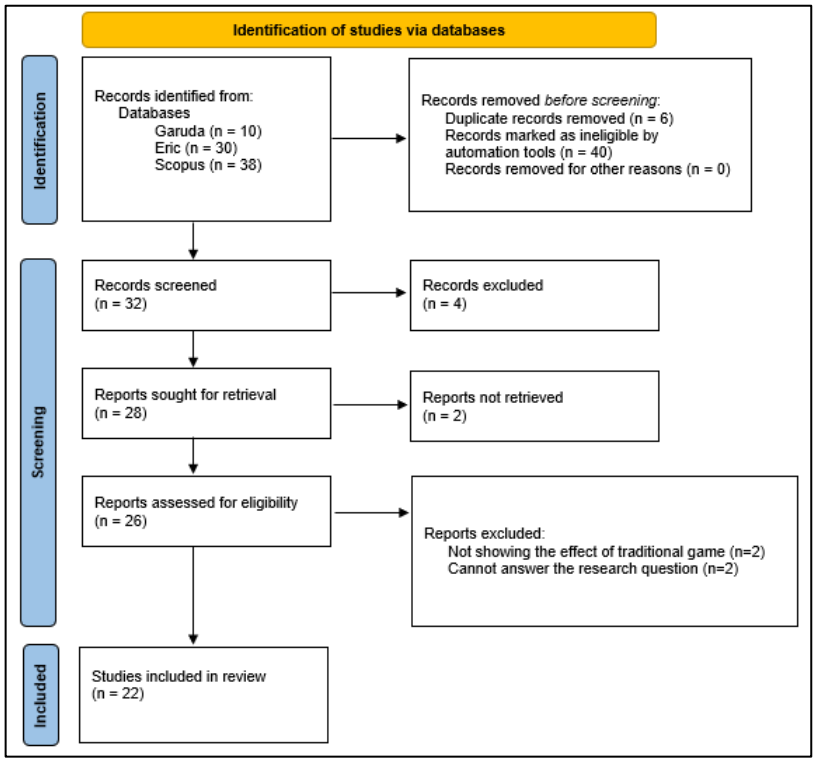


Figure 1. Revised PRISMA 2020 flow

Data analysis

The 22 articles were then reviewed using the defined Coding Framework displayed in Table 2. There are six dimensions of the coding framework, namely: geographical area, mathematics topic, grade, effect, type of research, and name of traditional game. The detailed explanations of these dimensions are as follows.

Geographical area dimension

This dimension does not refer to the origin of the traditional game but to the research location. This is because some of the same traditional games are called by different names in various locations throughout Indonesia, making it extremely difficult to determine the exact location of where these traditional games were first created. Therefore, this study divides this dimension into six categories: Sumatera, Java, Bali and Nusra, Maluku and Papua, Sulawesi, and Kalimantan.

Effect dimension

This study was carried out to provide detailed information on the effects of Indonesian traditional games on mathematics learning. Therefore, this dimension becomes the central focus of this study. These effects are concentrated on the development of cognitive, psychomotor, and

affective abilities as well as mathematical processing skills. The cognitive, psychomotor, and affective domains refer to Revised Bloom's Taxonomy (Anderson et al., 2001), while mathematical processing skills refer to the standard of the National Council of Teachers of Mathematics (NCTM, 2000).

Mathematics topics and grade dimension

These dimensions were used to identify in which branches of mathematics and which levels of education Indonesian traditional games have been utilized to support the mathematics teaching and learning process. Both dimensions are required as references for mathematics teachers in applying the most suitable traditional games in their classes according to a specific topic and grade.

Research type and name of traditional game dimension

These dimensions provide information regarding the types of research often used to examine the effects of implementing Indonesian traditional games in mathematics teaching and the names of traditional games frequently used in mathematics teaching. Since the names of traditional games can differ across areas in Indonesia, this domain was determined based on the names used in the reviewed articles.

Table 2. Coding framework

Dimension	Category
Geographical Area	Sumatra Java Bali and Nusra Maluku and Papua Sulawesi Kalimantan
Mathematics Topic	Algebra Geometry Statistic and Probability Number Calculus
Grade	Early Childhood Education Elementary School Junior High School Senior High School
Effect	Cognitive Affective Psychomotor Mathematical Processing Skills
Research Type	Quantitative Qualitative Mixed-Method Action Research Design Research Research and Development (R&D)
Name of Traditional Game	This dimension depends on the information in the articles

Findings

The 22 articles that passed the screening process were then reviewed to answer the research questions. The results of the review are described below.

RQ 1: Where were the studies conducted?
As shown in Figure 2, studies about the implementation of Indonesian traditional games in mathematics teaching and learning have been most frequently conducted in Java Island, followed by studies in Sumatra, Sulawesi, and Bali and Nusra. Conversely, studies on similar topics in Kalimantan, Maluku, and Papua were not found.

RQ 2: What mathematics topics can be taught using traditional games?
Graph 1 presents the findings for the second research question, concerning what mathematics topics can be discussed using Indonesian traditional games. Across 22 articles, Numbers and Geometry are the most common topics taught using Indonesian traditional games, followed by statistics and probability, algebra, and calculus.

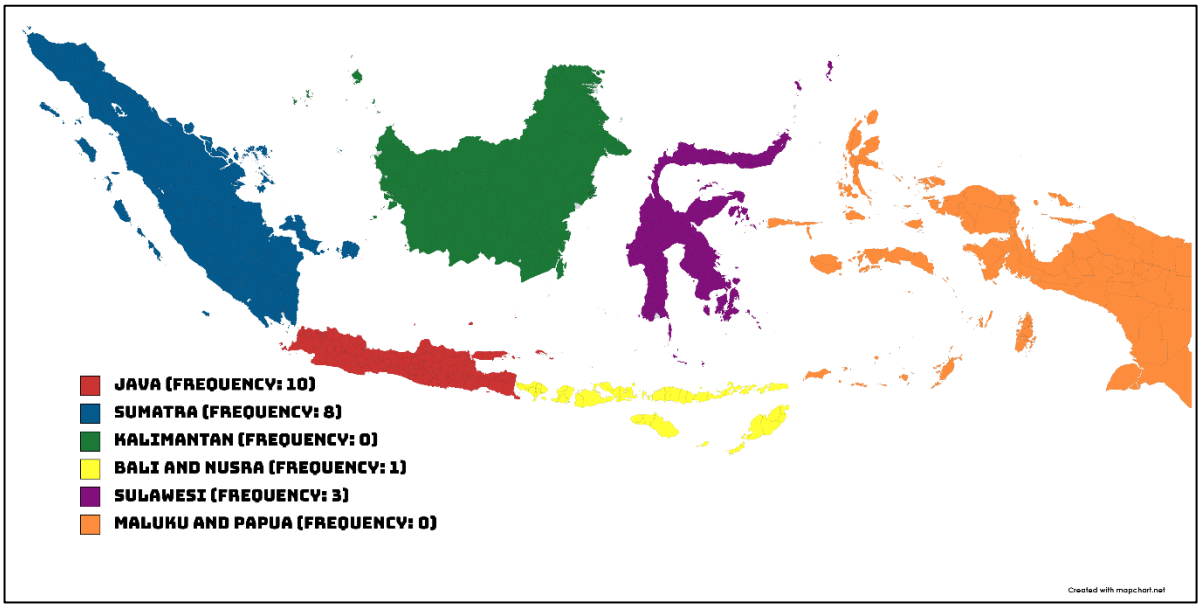
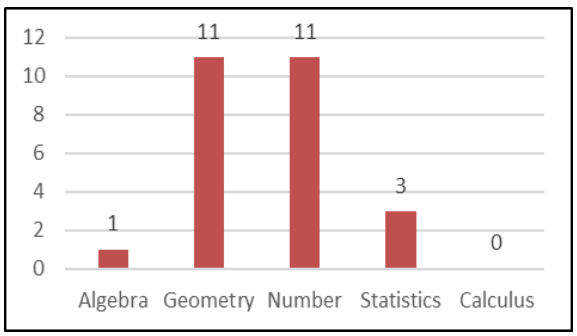
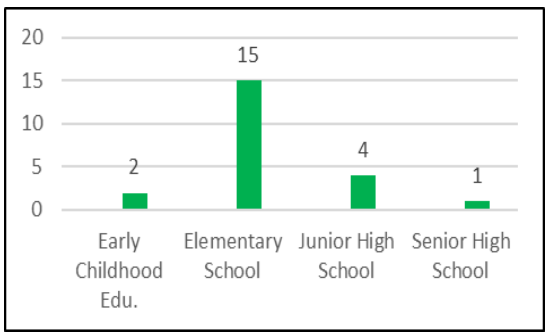


Figure 2. Geographical domain



Graph 1. Mathematics topic domain

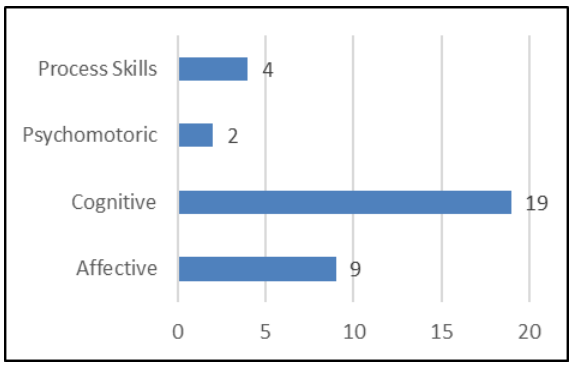


Graph 2. Grade domain

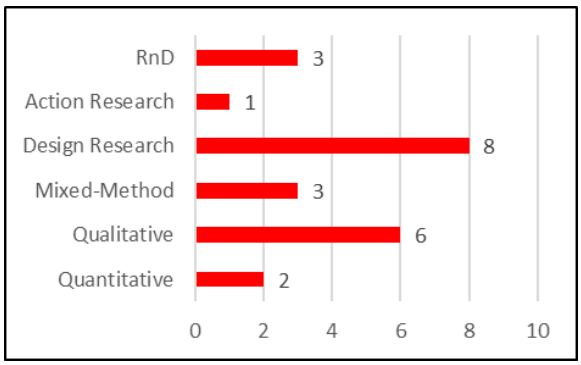
RQ 3: What grade can be taught using traditional games?
As shown in Graph 2, the elementary school level is the school grade that most frequently uses traditional games in mathematics learning, followed by junior high school, early childhood education, and senior high school.

RQ 4: What is the effect of the traditional game on students?
This study focuses on four effects of implementing Indonesian traditional games in mathematics learning. Based on Graph 3, the most common effect is observed in the cognitive domain, especially with regard to students' understanding, followed by the affective domain, e.g., students' motivation and enjoyment. Meanwhile, only two articles show the effectiveness of implementing traditional games in developing mathematical processing skills and psychomotor abilities.

RQ 5: What types of research is primarily used in the studies?
Graph 4 summarizes the findings for the fifth research question. It is shown that design research is the most common type of research applied in the studies on the implementation of Indonesian traditional games in mathematics learning, followed by qualitative research, mixed-methods, research and development (RnD), quantitative research, and action research.



Graph 3. Effect domain



Graph 4. Type of research domain

Table 3. Name of traditional game domain

No.	Name of Traditional Game	Frequency	No.	Name of Traditional Game	Frequency
1	Bermain Satu Rumah	1	10	Dakocan	1
2	Patil Lele	1	11	Tepuk Bergambar	1
3	Congklak/Dakon	3	12	Lojo-lojo pindip	1
4	Gotri Ayo Gotri	1	13	Endog-endogan	1
5	Bekel Ball	1	14	Rimau	1
6	Kite	1	15	Pacu Jalur	1
7	Marble (Gundu/Guli)	2	16	Gobak Sodor	1
8	Rubber	1	17	Kubuk Manuk	1
9	Engklek/Pecle/Makkudendeng	7	18	Ligu	1

RQ 6: What Indonesian traditional games can be used to teach mathematics?
Table 3 displays the names of Indonesian traditional games that have the potential to be learning resources for mathematics lessons. As mentioned previously, one traditional game can have different names in different areas in Indonesia. For example, the Javanese traditional game Engklek or the Sundanese Pecle is called Makkudendeng in Sulawesi. This traditional game is more widely used for teaching mathematics than other Indonesian traditional games, followed by Congklak and Marbles (Gundu/Guli). Meanwhile, this study found that the implementation of the other traditional games in mathematics learning has only been explored in one study each.

Discussion

While most people think that games are only played for entertainment, various types of games can actually be used for educational purposes (Noemí & Máximo, 2014). This is not only limited to digital games since which can be created, edited, and/or developed according to the needs of their creators or developers. Long before the advent of digital game, our ancestors have provided us with a wide array of traditional games as media for entertainment and even education, especially in developing character traits (Marlina, 2017; Masyhuri & Suherman, 2020; Shinta et al., 2019).

Previous studies have also revealed that traditional games can increase students' engagement by encouraging their communication (Melianasari & Suparno, 2018; Widiana et al., 2018) and collaboration (Suhaebah, 2019) with their peers. Therefore, integrating traditional games into the teaching and learning process can support students' learning activities and enhance their engagement in the learning process. As a result, students can enjoy their lessons and become interested in the subjects being taught.

The Vygotsky's theory seems to be the background for the implementation of traditional games as learning resources. Based on this theory, students need to learn through social interactions (Hamilton & Ghatala, 1994), and the traditional games provide students with rich social interaction (Jayadi & Arnidah, 2019; Syahria, 2020). Through interaction, students can learn more information and skills as well as develop their mental functions, such as reasoning (Mcleod, 2018). Apart from that, playing traditional games will also inspire students to carry out simulations and even problem-solving activities (Trajkovik et al., 2018). In addition, traditional games in the classroom are more accessible and easily applicable than digital ones. In some regions, especially rural areas, neither schools nor students can afford technology that supports digital gaming (du Plessis, 2014). Besides, over the use of digital games is riskier since they can make students addicted and cause physical problems, such as joint pain, eye pain, and musculoskeletal disorders (Mustafaoğlu & Yasacı, 2018). The implementation of traditional games as a context for teaching mathematics is also related to the realistic mathematics education approach where teachers must provide "real" situations that allow students to develop mathematical concepts and procedures (Van den Heuvel-Panhuizen & Drijvers, 2020).

The problems in mathematics teaching and learning process have triggered various studies to discover the best way to teach mathematics. The results indicate that there are mathematical concepts in Indonesian cultures, including traditional architecture (Supiyati et al., 2019), foods (Pathuddin et al., 2021), clothes (Prahmana & D'Ambrosio, 2020), specifically traditional games (Roza et al., 2020; Supahmi et al., 2022; Zaenuri et al., 2019) since they usually exist around students. In addition, previous studies have found that the implementation of traditional games, in particular, can effectively increase students' engagement and interest (Aras & Zahrawati,

2021) in learning mathematics, support their understanding (Atmaja et al., 2021; Nur'aeni, Muharram, et al., 2019), and eventually improve their achievement and performance. Furthermore, the use of traditional games in mathematics classes can help students develop their communication skills as part of the 21st century skills (Kamid et al., 2022). These findings suggest that traditional games can be potential learning resources to overcome problems in mathematics teaching and learning process.

The implementation of traditional games in mathematics learning influences the development of students' cognitive (Aini et al., 2022; Nur'aeni, Nur, et al., 2019; Risdiyanti et al., 2019; Yumiati et al., 2023), psychomotor (Kamid, Rohati, et al., 2021; Supriadi et al., 2019), and affective (Aras & Zahrawati, 2021; Rahmawati et al., 2020) abilities. The cognitive effect refers to students' understanding of certain mathematical concepts by playing traditional games in their mathematics classes. Some games can be applied to teach two to three mathematical concepts (Handayani & Iswantiningtyas, 2020; Roza et al., 2020). The nature of traditional games requires players to make several gestures or movements, thus supporting students' psychomotor development. Nevertheless, only two articles report findings about the effects of implementing traditional games on the psychomotor domain. Similarly, only few articles have revealed the impacts of implementing traditional games on the affective domain, despite the ability of traditional games to engage students in mathematics learning. The affective domain primarily measures students' enjoyment and interest while learning mathematics using traditional games. Besides, traditional games can also change students' negative perspectives on mathematics (Rahmawati et al., 2020).

Aside from supporting the development of students' abilities, the implementation of traditional games can also help students improve their mathematical processing skills, such as communication (Kamid et al., 2022), problem-solving (Nur et al., 2022), and connection (Fendrik et al., 2020). In playing Indonesian traditional games, students need to work collaboratively with their peers (Handayani & Iswantiningtyas, 2020; Kamid, Sofnidar, et al., 2021; Supriadi et al., 2019). Therefore, another potential benefit of playing traditional games is to hone students' collaboration skills. The application of traditional games in mathematics classes can ultimately support the development of students' 21st century skills. For these reasons, the use of traditional games which are cheaper and more easily applicable than digital games can be beneficial for mathematics teachers, especially those teaching mathematics in rural areas.

Regrettably, most studies about the implementation of traditional games have been extensively done in Java Island, which almost entirely comprises of suburban and urban areas. Meanwhile, other islands that mostly consist of rural and underdeveloped areas, i.e., Kalimantan, Maluku Islands, and Papua, have never been studied previously. Additionally, the research locations seem to align with the types of traditional games used in mathematics classes. For example, studies on the implementation of traditional games in Java have mainly examined well-known Javanese traditional games. This causes a huge research gap in this topic. Thus, further studies exploring traditional games in Kalimantan, Sulawesi, Nusa Tenggara, Bali, Maluku, and Papua can add insights into more Indonesian traditional games that can be used to teach mathematics.

Almost all types of research have been conducted to investigate the impacts of implementing Indonesian traditional games on mathematics teaching and learning. The effects of the traditional games can be seen from various research approaches, such as quantitative, qualitative, mixed-methods, and even research and development. However, previous studies about the implementation of Indonesian traditional games mostly employ design research

method, thus only focusing on learning designs that can support mathematics teaching using traditional games. On the other hand, quantitative studies on this topic are rarely conducted. Therefore, statistical and empirical evidences of the effects of implementing traditional games in mathematics teaching still need to be strengthened.

Of the various mathematics topics, Geometry and Numbers are frequently taught using traditional games as learning resources. This is possible because basic geometric shapes commonly appear in Indonesian traditional games. For example, triangles (Nur'aeni et al., 2020), rectangles, and squares (Ibrahim & Ahyan, 2020) are found in *Engklek*. Traditional games can also support the improvement of students' calculation abilities (Nasrullah & Zulkardi, 2011), such as addition (Nursyahidah et al., 2013) and multiplication (Prahmana et al., 2012), and help students recognize not only operation of integer numbers but also fractions (Supriadi, 2022). As traditional games can be used to introduce basic mathematical concepts, their implementation in elementary schools, particularly in mathematics classes, is worth considering.

Conclusion

Traditional games exist around students as part of the culture of the surrounding community. This makes traditional games the contexts that students can easily relate and understand as they are close to their daily life. Thus, traditional games can be used as a tool to provide meaningful mathematics learning experiences for students. The findings of this study prove that the implementation of Indonesian traditional games in mathematics teaching can help improve students' cognitive, affective, and psychomotor abilities as well as their mathematical processing skills and 21st-century skills. Among various mathematics topics, Numbers and Geometry are found to be most commonly taught using traditional games.

Meanwhile, in terms of the grade dimension, mathematics teachers in elementary schools most often implement traditional games in their classes, compared to the other levels of education. Design research is the type of research that is most frequently applied in studies on this topic, the studies are primarily conducted in Java Island, and the most commonly used traditional game is Engklek/Pecle/Makkudendeng.

Limitations and recommendations for future research

This study only focuses on articles written in English about Indonesian traditional games. Meanwhile, there are numerous other relevant studies written in Indonesian. Therefore, future studies can investigate these articles to provide more implications of the implementation of traditional games in mathematics learning. In addition, future studies can also explore the effects of implementing traditional games in mathematics learning within wider scope of areas, such as Southeast Asia or even Asia. Similar studies can also be carried out in other regions in Indonesia, such as Kalimantan, Papua, and Maluku Islands.

Based on the findings of this study, quantitative research has rarely been conducted to analyze the implementation of Indonesian traditional games in mathematics teaching, resulting in the weak empirical evidence from the findings of the reviewed literature. Such methodological gap can be an input for other researchers to conduct experimental studies to provide stronger empirical evidence about the impact of implementing Indonesian traditional game to the mathematics teaching and learning process.

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