

A Systematic Literature Review of Ethnomathematics-Based Card Games in Mathematics Learning

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ABSTRACT

Ethnomathematics-based card games are a mathematics learning innovation that integrates local cultural elements to create contextual and meaningful learning experiences. However, previous research is limited and has not comprehensively mapped the integration between game design, cultural context, and mathematical abilities through a Systematic Literature Review (SLR) approach. This study aims to describe game design, gameplay, regional culture, materials, educational level, and mathematical abilities developed through ethnomathematics-based card games. This study used a Systematic Literature Review approach with the PRISMA protocol. A Google Scholar search yielded 636 initial articles, which were then selected based on inclusion and quality criteria, resulting in 13 articles for analysis. The results indicate that card games, developed in both analog and digital formats, incorporate cultural contexts such as traditional games, local food, cultural motifs, and traditional houses, and are predominantly used in elementary and junior high schools. The use of this medium contributes to improving students' conceptual understanding, numeracy skills, problem-solving skills, and learning motivation. This study provides a comprehensive synthesis of the design, implementation, and impact of ethnomathematics-based card media as a basis for developing innovative and contextual mathematics learning.

INTRODUCTION

Education plays a crucial role in character formation (Ichsan, 2021) and improving the quality of human resources (Rochmiyatun, 2023). In this context, mathematics, as a core subject, serves to develop logical, systematic, and analytical thinking skills (Lestari et al., 2018) and is an integral part of human life (Anastasya et al., 2015). Mathematics learning is often considered difficult because it does not fully meet students' needs, which demand active, contextual, and enjoyable learning experiences (Idapitasari, 2021). This situation highlights the need for innovative learning media that can enhance student engagement and conceptual understanding (Devian et al., 2024). The development of learning media is supported by three main theoretical foundations, namely ethnomathematics theory which connects mathematics with cultural practices so as to help students understand concepts contextually according to

D'Ambrosio 1985 (Zayyadi et al., 2025), game-based learning (GBL) that increases motivation and conceptual understanding through games (Harlina, 2022; Himmawan et al, 2023) and culturally responsive pedagogy (CRP) that emphasizes the importance of cultural relevance in learning (Setiaputra et al, 2025; Sulistyowati, 2016; ZainoviPutri et al, 2025). The integration of these three approaches has been proven to be able to develop students' mathematical abilities and 21st-century skills (Selepe et al, 2025). The application of this approach is reflected in innovative ethnomathematics-based card games, such as Gaple (Afandi et al, 2024a), Umbul Wayang cards (Hasanah, Gustiwati, et al., 2024), traditional food cards (Cantika, 2025), and Javanese traditional house cards (Izah et al, 2023a), which have been proven valid, practical, and effective in improving understanding of mathematical concepts (Angeline et al, 2026; Benita et al, 2025; Ema et al, 2024; Siti waroah et al, 2025).

Previous research tends to separate educational games and ethnomathematics, both at the national and international levels (Iffah et, 2025). Comprehensive studies using a systematic literature review (SLR) approach are also limited. Most studies focus on the development or effectiveness of specific products without comprehensively mapping the game design, game mechanics, cultural context, materials, and mathematical skills developed. In a global context, although ethnomathematics research has shown significant growth, with Indonesia as a major contributor (Iffah et, 2025; Setiaputra et al, 2025) the integration of educational games and ethnomathematics in systematic SLR studies remains limited. This limitation indicates a gap in comprehensive studies that map the integration of game design, cultural context, and mathematical ability in mathematics learning, particularly in the context of global education in countries with cultural diversity.

This study aims to describe the game design, gameplay, regional culture, materials, educational level, and mathematical ability in an innovative ethnomathematics-based card game. This study can contribute to the development of innovative, contextual, and relevant mathematics learning in a global context.

METHODS

This study employed a systematic literature review (SLR) method, structured according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al, 2021). The research design aimed to identify, evaluate, and synthesize literature in a structured and transparent manner to analyze game design, gameplay, regional culture, materials, educational level, and mathematical ability in ethnomathematics-based card game innovations. The data sources for this study were scientific articles obtained from the Google Scholar database. The study population included all articles from the initial search results, while the research sample consisted of articles that met the inclusion criteria.

The literature search was conducted using a combination of keywords "Game innovation", "Card media", "Ethnomathematics" and "mathematics learning" with the Boolean operators "AND" and "OR" in the titles and abstracts of articles with a publication period of 2015–2025. The research instruments used included the PRISMA guidelines as a framework for article selection, keyword search strategies for the search process, inclusion and exclusion criteria, quality assessment rubrics, and thematic analysis sheets for data extraction. The inclusion criteria in this study included: (a) empirical articles, (b) published in Indonesian or English, (c) published between 2015–2025, (d) relevant to elementary, junior high, or high school levels, (e) available with full access, (f) focused on mathematics learning with card games, and (g) published in

scientific journals, while articles that did not meet these criteria were excluded from the selection process.

The article selection process followed the PRISMA flow, which consists of four stages: identification, screening, feasibility assessment, and inclusion. The identification stage resulted in an initial 636 articles, followed by a screening stage through title and abstract reading, resulting in 19 potential articles. Next, the feasibility assessment stage was carried out through full-text reading and quality assessment using a seven-indicator rubric covering objectives, literature review, theoretical framework, participants, methods, results, and significance. Consequently, 6 articles were excluded for not meeting quality standards. Thus, the inclusion stage resulted in 13 final articles analyzed in this study, and the selection flow is presented in Figure 1.

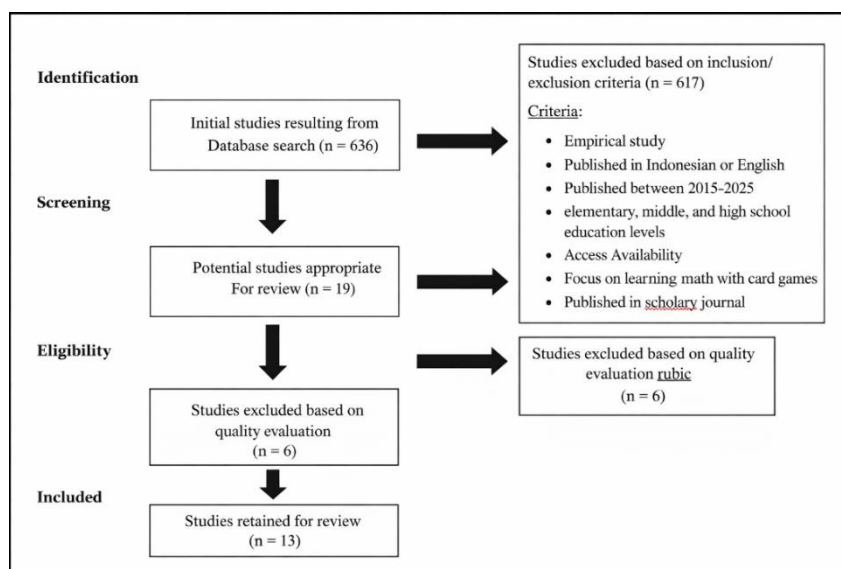


Figure 1. Article selection process

Based on the selected articles, data analysis was conducted using thematic analysis techniques through the stages of grouping data by category (game design, gameplay, culture, materials, educational level, and mathematical ability), coding, thematic categorization, and drawing conclusions to produce a systematic and comprehensive synthesis. The entire data collection process was conducted in January–February 2026.

RESULTS AND DISCUSSION

Based on the literature selection process using the PRISMA protocol, 13 articles met the inclusion criteria and were eligible for further analysis. These articles demonstrated a variety of innovative ethnomathematics-based card games in mathematics learning, both in analog and digital formats, incorporating local cultural contexts such as traditional games, batik motifs, regional culinary delights, and other cultural symbols. In general, ethnomathematics cards demonstrated a positive contribution to improving students' understanding of mathematical concepts, numeracy skills, problem-solving skills, and learning motivation. More specifically, the majority of the reviewed studies (9 of 13 articles) reported significant improvements in students' mathematical conceptual understanding, while others highlighted aspects of problem-solving skills and learning motivation, and only a few specifically addressed

mathematical communication skills. This indicates that the primary focus of research remains on strengthening conceptual understanding rather than other mathematical skills. Therefore, it can be concluded that ethnomathematics-based card games tend to be more widely used to improve contextual understanding of mathematical concepts. All articles were first analyzed through a quality assessment stage using a seven indicator rubric. The results of the article quality assessment are presented in Table 1.

Table 1. Quality Assessment of Selected Studies

No.	Article Title	Author(s)	I	II	III	IV	V	VI	VII	Total Score	Assessment
1	Development of KARMARU (Fun Mathematics Cards) Based on Ethnomathematics for Circle Materials	(Saudah et al., 2023)	3	3	3	3	3	3	3	21	Eligible
2	Development of Ethno-Virtual Cards Based on Students' Mathematical Problem-Solving Skills and Curiosity	(Amalia et al., 2022)	4	3	3	3	3	3	3	22	Eligible
3	Ethnomathematics: Mathematical Concepts in the Gapple Card Game	(Farabi et al., 2025)	3	3	2	2	2	3	2	17	Eligible
4	Ethnomathematics-Based Tabak Learning Media for Plane Geometry in Grade IV Elementary School	(Afandi et al., 2024)	4	4	3	3	3	3	3	23	Eligible
5	Development of Ethnomathematics-Based Digital Flashcards for Elementary Mathematics Learning	(Sari et al., n.d.)	3	3	3	3	3	3	3	21	Eligible
6	Ethnomathematical Exploration of the Traditional Wayang Umbul Card Game	(Hasanah et al., 2024)	3	2	2	3	2	3	2	17	Eligible
7	Development of UNO Cards as Mathematics Learning Media Associated with Traditional Games	(Kurniati et al., 2025)	3	3	3	3	3	3	3	21	Eligible

8	Development of Ethnomathematics-Based Mathematics Flashcards on Traditional Foods	(Cantika, 2025)	4	4	4	3	3	4	4	26	Eligible
9	The Effect of Ethnomathematics-Based Learning Using Umbul Cards on Grade I Students' Numeracy Skills	(Turmuzi et al., 2024)	3	3	3	3	3	3	3	21	Eligible
10	Development of the AiK Card Board Teaching Aid for the Numeracy Content of the Martapura Kingdom	(Puspitasari et al., 2024)	4	3	3	3	3	3	3	22	Eligible
11	Development and Feasibility of KARMAGAMA (Illustrated Ethnomathematics Cards of Traditional Javanese Houses)	(Izah et al., 2023)	3	3	2	2	3	3	3	19	Eligible
12	KOMET-QR: Ethnomathematics Exploration Cards with QR Codes for Plane Geometry in Grade IV Elementary School	(Solihin et al., 2024)	3	3	3	3	3	3	3	21	Eligible
13	Ethnomathematics in Mathematics Learning: Numbers through Madurese Batik and Traditional Dances	(Ekowati et al., 2017)	3	3	3	3	3	3	3	21	Eligible

Column description:

Quality assessment criteria (1–4) are quality assessments (1 = does not meet standards, 4 = exceeds standards, 2 or 3 = adequate). The rubric criteria are as follows:

I: Aims and Objectives

II: Literature Review

III: Theoretical Framework

IV: Participants/Sample

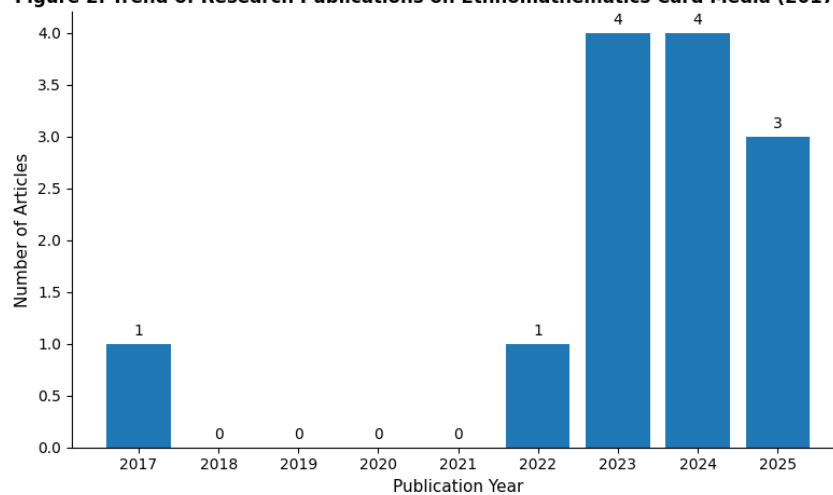
V: Method

VI: Results and Conclusions

VII: Significance

All 13 articles scored ≥ 15 out of a maximum score of 28 based on seven quality assessment criteria, thus all were deemed suitable for further analysis. The article with the highest score (26) was "Ethnomathematics in the Traditional Game of Congklak," while several other articles scored lower (17–19) but still met the eligibility criteria. Despite the variation in scores, none of the articles fell below the minimum threshold, indicating that all studies were of consistent scientific quality and relevant to the research topic. Furthermore, the majority of articles (approximately 10 out of 13) were in the medium to high quality category, strengthening the validity of the findings regarding the use of local culture-based card games as a contextual and enjoyable medium for mathematics learning (Amalia et al, 2022; Saudah et al., 2023) Therefore, it can be concluded that the analyzed literature is of sufficient quality to support a comprehensive synthesis of research findings. The publication trend of research on ethnomathematics card media has also increased year after year. A visualization of the publication development is presented in Figure 2.

Figure 2. Trend of Research Publications on Ethnomathematics Card Media (2017-2025)



Based on Figure 2, studies of ethnomathematics card games began to emerge in 2017 and experienced a significant increase in 2023 and 2024. This increase indicates that the integration of local culture into mathematics learning media is increasingly receiving attention from researchers as an innovative and contextual learning approach. The variety of cultural contexts used in ethnomathematics card media is presented in Figure 3.

Figure 3. Distribution of Cultural Categories in Ethnomathematics Card Media

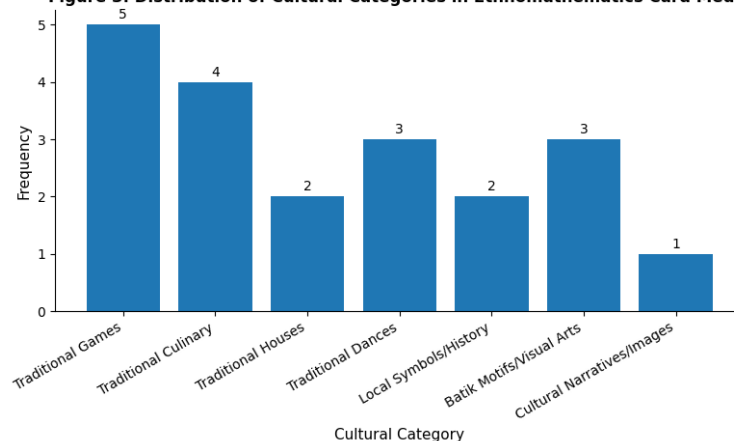


Figure 3 shows that traditional games are the most widely used cultural context because they are easily recognized by students and facilitate the association of mathematical concepts with real-life experiences. Furthermore, traditional culinary arts are also widely used to visualize geometric and fraction concepts. Batik motifs, regional dances, traditional houses, and historical symbols are also used to introduce the concepts of patterns, symmetry, and geometric transformations. These findings demonstrate that ethnomathematics cards serve not only as a means of learning mathematics but also as a medium for preserving local culture. Various ways to play ethnomathematics cards are shown in Figure 4.

Figure 4. Types of Game Patterns in Ethnomathematics Card Media

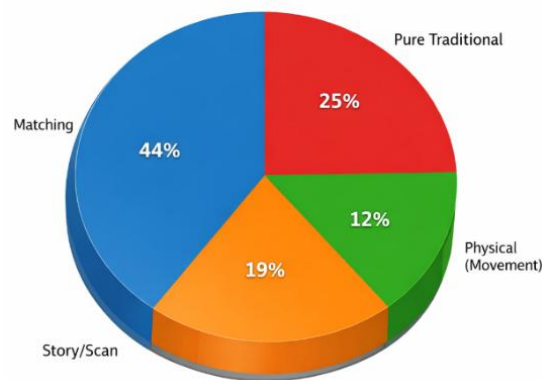
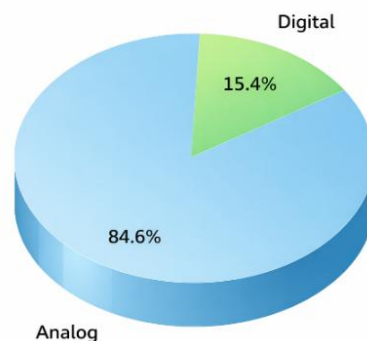


Figure 4 shows that card-matching games are the most dominant learning mechanism due to their ease of implementation and effectiveness in enhancing learning engagement. Furthermore, innovative story-based games and the use of digital technologies such as QR codes and virtual cards are emerging. Traditional games such as gapple, congklak, engklek, and wayang umbul demonstrate a strong integration between cultural activities and contextual mathematics learning. The distribution of analog and digital media types is shown in Figure 5.

Figure 5. Distribution of Card Types



The analysis shows that most studies still use analog cards, while the use of digital cards is still limited. This suggests that physical media is still considered more appropriate for the characteristics of concrete learning at the elementary and junior high school levels. Next, a summary of the material topics, educational levels, and mathematical skills developed is presented in Table 2.

Table 2 describes the material topics, educational levels used, and mathematical skills developed through these media.

No	Topic Material	Education Level	Cognitive Aspect	Affective Aspect
1	Circle	middle school	Learning outcomes	Motivation to learn, activeness
2	Quadrilaterals and Triangles	middle school	Problem solving	Curiosity, enthusiasm, liveliness
3	Set, Addition, Probability, Inequality	Not mentioned	Concept understanding	-
4	Perimeter & Area of Plane Figures, Power & Roots	elementary school	Understanding perimeter & area, problem solving	Activeness, learning outcomes
5	Fractional	elementary school	Understanding the concept of fractions	Active engagement
6	Rectangles, Positive Integers, Congruence	elementary school	Understanding basic mathematical concepts	Fun, contextual learning
7	Mixed Integer Calculation Operations	elementary school	Mixed operations, mathematical logic	Cooperation, communication
8	Geometry	elementary school	Understanding geometry, classification	-
9	Addition & Subtraction of Whole Numbers	elementary school	Basic arithmetic operations, logic	Engagement, focus, love of culture
10	Numbers & Basic Counting Operations (Numeration)	middle school	Basic operations, numeration	-
11	Build Flat	middle school	Geometry, calculation, reasoning	Active engagement
12	Perimeter & Area of Rectangles and Triangles	elementary school	Perimeter & area, calculation skills	Cultural contextualization
13	Numbers	elementary school	Concept of numbers, algorithm	Play while learning

Based on table analysis, ethnomathematics-based card media is most widely used at the elementary school (SD) level, although some is also applied at junior high schools (SMP). The dominance of use in elementary school shows its suitability to the characteristics of elementary age students who require a concrete and contextual approach. In terms of achievement, cognitive aspects are more prominent, especially in increasing understanding of mathematical concepts such as numbers, arithmetic operations, geometry, fractions and logic. However, affective aspects also receive significant attention, such as increasing motivation, activeness, emotional involvement, and strengthening local cultural values in accordance with findings from (Turmuzi et al, 2024) and (Kurniati et al., 2025). Thus, ethnomathematics-based card media is not only useful in developing conceptual abilities, but also forms a positive attitude

towards holistic mathematics learning. The distribution of branches of mathematical material developed is shown in Figure 6.

Figure 6. Distribution of Topics Based on Math Branches

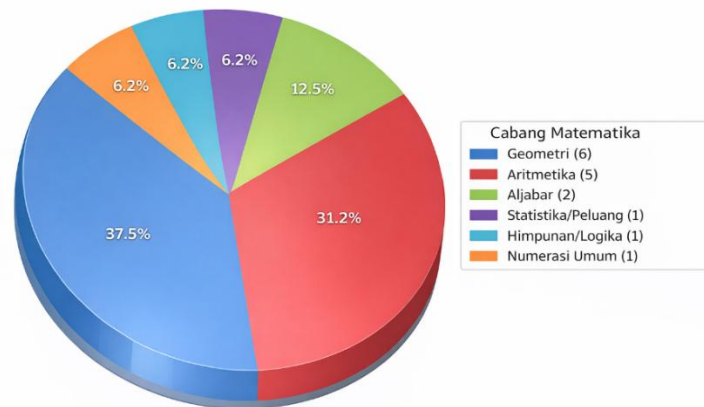


Figure 6 shows that geometry is the most dominant branch of mathematics developed through ethnomathematics card media because it is easy to visualize through local culture. Arithmetic is the second most widely developed branch because it is easily integrated into counting game activities. Meanwhile, the branches of algebra, statistics, probability and logic are still relatively small, thus opening up opportunities for further research.

Overall, the results of the study show that ethnomathematics card media is able to improve students' cognitive and affective abilities. However, most research still focuses on low-level thinking abilities according to Bloom's Taxonomy (C1-C3) (Listiani & Rachmawati, 2022). while the development of higher order thinking abilities (HOTS) is still limited. In addition, the majority of research uses the Research and Development (R&D) method because it is suitable for developing concrete and contextual culture-based learning media. Thus, ethnomathematics-based card media has great potential as a mathematics learning innovation that is contextual, interactive, and capable of meaningfully integrating local cultural elements in the learning process.

CONCLUSION

Based on the results of a systematic literature review, ethnomathematics-based card game media has an important contribution as a contextual mathematics learning innovation and is able to support the development of students' cognitive and affective abilities. The integration of local cultural elements in learning media has been proven to improve conceptual understanding, problem-solving skills, and student learning motivation. The research findings also indicate that most studies still focus on lower-order thinking skills, so the development of higher-order thinking skills (HOTS) needs to be improved. Further research is recommended to develop ethnomathematics card game designs that are more oriented towards HOTS and expand their application to various educational levels and learning contexts.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in carrying out the research, writing or publication of this article. The research was conducted independently

without any influence from certain parties which could potentially cause bias in the results and interpretation of the research.

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