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Implementation of Ethnomathematics in Teaching Geometry Concepts in Elementary School: Systematic Literature Review

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ABSTRACT

This study aims to identify forms of local cultural integration through ethnomathematics in teaching geometry concepts in elementary schools and analyze its impact on students conceptual understanding and learning motivation. The method used is a Systematic Literature Review (SLR) following the PRISMA flow, including definition, screening, and inclusion stages. Eight articles published from 2021 to 2025 were analyzed based on relevance and quality. The review shows that ethnomathematics effectively improves students conceptual understanding, motivation, and engagement. Cultural elements such as traditional games, artistic motifs, traditional foods, and traditional architecture are used as concrete media for learning geometry. The main challenges involve limited learning media and teachers' ability to develop culture-based materials. Ethnomatematics supports contextual learning and aligns with the principles of the Merdeka Curriculum.

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INTRODUCTION

Primary education plays a strategic role in shaping the intellectual, moral, and social foundations of future generations. In accordance with the National Education System Act Number 20 of 2003, elementary education aims to develop students' fundamental competencies, enabling them to live independently and pursue higher levels of learning (Hasibuan et al., 2024; Nahak & Feka, 2022). At this level, mathematics serves as a core discipline in cultivating logical reasoning, systematic thinking, and problem-solving abilities that are essential in daily life (Akbar et al., 2023). Beyond cognitive development, mathematics also supports the formation of critical and analytical thinking skills required in the 21st century.

However, mathematics learning in elementary schools continues to face significant challenges. Many students perceive mathematics as abstract and difficult to understand, which contributes to low motivation and achievement (Apriani & Sudiansyah, 2024; Yuliana et al., 2022). Data from the 2018 Programme for International Student Assessment (PISA) reveal that 72% of Indonesian students demonstrate low mathematical proficiency, with an average score of 379, far below the OECD average of 487 (OECD, 2019; Putrawangsa & Hasanah, 2022; Meyundasari et al., 2024). Furthermore, a national survey indicates that approximately 65% of elementary students struggle to comprehend abstract mathematical concepts, particularly in geometry (Firdaus & Robandi, 2025; Hariastuti, 2021). These findings highlight a persistent gap between curriculum expectations and students' conceptual understanding.

One of the contributing factors to these difficulties is the predominance of conventional, teacher-centered approaches that emphasize symbolic manipulation over contextual understanding (Barokah et al., 2025; Sulistyowati & Mawardi, 2023). Although Indonesia possesses rich and diverse cultural resources, these local potentials remain underutilized in mathematics instruction (Yandani & Agustika, 2022; Supriyadi et al., 2022). The disconnect between abstract curricular content and students' lived cultural experiences reduces learning relevance and engagement.

To address this issue, ethnomathematics offers a culturally responsive pedagogical alternative. Initially introduced by D'Ambrosio, ethnomathematics emphasizes the relationship between mathematical ideas and cultural practices (Pratiwi et al., 2022; Wulandari et al., 2024). This approach positions culture not merely as contextual decoration but as an epistemological source for mathematical exploration. By integrating local traditions, architecture, games, arts, and crafts into mathematics learning, students are able to connect abstract geometric concepts with meaningful real-world representations (Permana, 2023; Asriyanto et al., 2022; Fredy et al., 2020).

Several empirical studies demonstrate the effectiveness of this approach in elementary classrooms. The use of traditional games such as *engklek* has been shown to enhance students' understanding of flat shapes and spatial relationships while maintaining active engagement (Lestari et al., 2023; Naitili & Nitte, 2023). Similarly, the exploration of traditional dances and cultural artifacts provides concrete illustrations of symmetry, rotation, and geometric patterns (Hariastuti, 2021; Fatimah et al., 2024). The integration of architectural elements from traditional houses and religious buildings further strengthens students' conceptualization of three-dimensional shapes and spatial reasoning (Kurino et al., 2022; Hamidah et al., 2025). These culturally grounded learning experiences not only improve mathematical understanding but also foster appreciation for local wisdom and identity (Anggara & Zaenuri, 2023).

Moreover, the implementation of the Merdeka Curriculum encourages contextual and student-centered learning that integrates cultural values into instruction (Kemendikbudristek, 2022; Iswara et al., 2022; Salsabila et al., 2025). Ethnomathematics aligns closely with this framework by supporting the development of critical, creative, and collaborative competencies. By situating geometry learning within culturally familiar contexts, students are more likely to internalize mathematical concepts and develop meaningful understanding (Habibi, 2025).

Despite its promising potential, research on the systematic implementation of ethnomathematics in elementary geometry learning remains fragmented. While individual empirical studies highlight positive outcomes, comprehensive synthesis of findings is still limited (Mauluah & Putra, 2021; Bidiyah et al., 2024). A systematic literature review (SLR) is therefore necessary to identify patterns of cultural integration, evaluate the impact on conceptual understanding and learning motivation, and examine implementation challenges. Compared to narrative reviews, SLR provides methodological rigor, transparency, and reliability in synthesizing research evidence (Mengist et al., 2020; Mahardika et al., 2024).

METHOD

Research Design

This study employed the Systematic Literature Review (SLR) method to synthesize and critically analyze empirical findings concerning the integration of local culture through ethnomathematics in elementary school mathematics learning. The SLR approach was selected to systematically identify research trends, examine knowledge gaps, and evaluate how ethnomathematics has been implemented in teaching geometry concepts at the elementary level (Wisnawati et al., 2025). Compared with traditional narrative reviews, SLR ensures methodological transparency, replicability, and structured synthesis of evidence. The review procedure followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, which consists of four main stages: identification, screening, eligibility assessment, and inclusion. The entire selection process was visualized using a PRISMA flow diagram to enhance clarity and transparency (Siringo Ringo, 2025)

Search Strategy

The literature search was conducted using a combination of predefined keywords to ensure relevance and comprehensiveness. The main search terms included:

- "ethnomathematics"
- "geometry concepts"
- "mathematics learning"
- "elementary school"

The search targeted scholarly articles discussing the implementation of ethnomathematics in teaching geometry concepts at the elementary school level. Only publications from 2021 to 2025 were considered to capture recent developments in research and curriculum reform. Data were retrieved from several reputable academic databases, including Scopus, ScienceDirect, ProQuest, Google Scholar, and other accredited international journals. These databases were selected to ensure broad coverage of peer-reviewed national and international publications.

Study Selection Process

The initial identification stage yielded 157 articles relevant to the defined keywords. Duplicate records were removed prior to screening. During the screening stage, titles and abstracts were examined to determine relevance to the research focus. Articles that did not explicitly address ethnomathematics in relation to geometry learning at the elementary level were excluded. The eligibility stage involved full-text review to assess methodological rigor and thematic alignment. Based on this process, ten articles met the predefined inclusion criteria and were selected for final analysis.

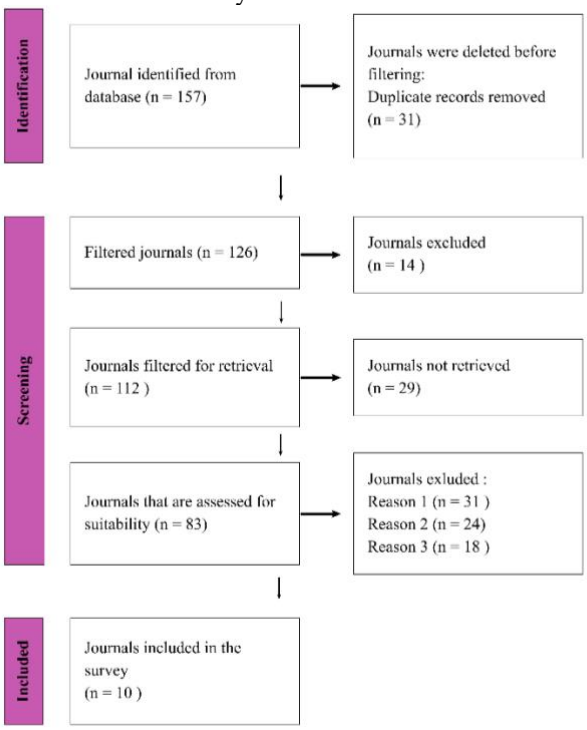

Figure 1. PRISMA diagram

Inclusion and Exclusion Criteria

To ensure the quality and relevance of the selected studies, the following inclusion criteria were applied:

- Articles published between 2021 and 2025.
- Studies focusing on the implementation of ethnomathematics in relation to geometry concepts.
- Research conducted at the elementary school level.
- Full-text articles accessible for comprehensive analysis.
- Publications in accredited national journals or reputable international journals.

The exclusion criteria included:

- Studies discussing ethnomathematics at junior high school, senior high school, or equivalent educational levels.
- Articles not specifically addressing geometry concepts.
- Publications without full-text access.

Through this systematic process, ten eligible studies were identified and analyzed to examine forms of cultural integration, instructional effectiveness, and implementation challenges of ethnomathematics in elementary geometry learning.

RESULTS AND DISCUSSION

Mathematics education at the elementary level not only aims to develop students' numeracy and reasoning skills, but also plays a strategic role in shaping logical, analytical, and creative thinking abilities. Indonesia's rich cultural diversity provides extensive opportunities to design learning experiences that are closely connected to students' daily lives (Nanda & Pradana, 2025). One strategic effort to achieve meaningful learning is through the integration of local cultural values using an ethnomathematics approach, which links regional cultural elements with mathematical concepts and learning activities (Arif & Mahmudah, 2022).

Various studies in Indonesia demonstrate that ethnomathematics has been implemented in elementary mathematics instruction through traditional games, weaving patterns, traditional house architecture, artistic motifs, and other local cultural artifacts. The integration of these elements allows abstract mathematical ideas—particularly geometry—to be presented in concrete and contextual forms.

Based on the literature review, the integration of local culture through ethnomathematics significantly contributes to contextual and meaningful mathematics learning (Siregar et al., 2024). Empirical findings indicate improvements in conceptual understanding, learning motivation, and students' appreciation of local culture. However, several studies also highlight implementation challenges, particularly in the development and availability of culture-based instructional media (Selamet et al., 2025). These findings underscore the need to optimize ethnomathematics-based strategies in order to enhance relevance and effectiveness in elementary mathematics education.

Furthermore, the success of ethnomathematics implementation strongly depends on the role of teachers as facilitators who connect mathematical concepts with cultural practices familiar to students (Yolanda et al., 2025). Teachers are expected to identify local cultural potential—such as traditional games, regional arts, and community activities—and transform these into meaningful mathematical learning resources. Through this process, students are not only exposed to abstract concepts but also engage with social and cultural realities that make learning more lively and authentic (Landong et al., 2025).

Analysis of Selected Studies

The following table summarizes the findings of ten selected studies examining the implementation of ethnomathematics in teaching geometry concepts at the elementary level.

Tabel 1. Research Related to Ethnomathematics Implementation in Geometry Learning

Reference	Tittle	Findings
(Fatimah et al., 2024)	Integration of Ethnomathematics in Mathematics Learning in Elementary Schools Based on Lampung Cultural Dance Arts	Sigeh Panguten dance movement patterns and formations were used to explain symmetry, rotation, translation, patterns, and measurement concepts.
(Octaviani & Mariana, 2023)	Exploring Ethnomathematics in Lapis Legit Cake with the Concept of Volume Geometry in Grade V Elementary School	Traditional layered cake was used as a spatial model to improve contextual understanding of volume and block geometry.
(Mulyasari et al., 2023)	The Effectiveness of Ethnomathematics Learning "Engklek Game" on Elementary School Students' Understanding of Geometry Concepts	The engklek game significantly improved understanding of flat shapes (84.6% classical completeness, significant t-test result).
(Hamidah et al., 2025)	Innovation in Elementary School Geometry Learning Through Pop-Up Books on the Ethnomathematics of the Al-Akbar Mosque Building in Surabaya	Pop-up book media based on mosque architecture strengthened understanding of three-dimensional structures.
(Rohim, 2021)	Exploration of Ethnomathematics in Troso Jepara Batik Motifs as Teaching Material for Elementary School Students	Batik motifs containing symmetry and repeating patterns enhanced conceptual understanding and student interest.
(Putri & Mariana, 2022)	Ethnomathematics at Sumur Temple as a Geometry Concept in Elementary School	Temple structures illustrated squares, trapezoids, parallelograms, and pyramid roofs as concrete geometry learning sources.

(Solihin & Habibie, 2024)	The Effect of Ethnomathematics-Based Karapan Sapi Cultural Integration on Elementary School Students' Geometry Learning Outcomes	Karapan Sapi cultural patterns significantly improved learning outcomes related to similarity, congruence, and measurement.
(Kurino et al., 2022)	Geometry Concepts Through Exploration of Ethnomathematics in Panjalin Traditional Houses	Traditional house architecture provided geometric elements such as trapezoidal roofs and rectangular walls for spatial concept learning.
(Nurhaliza, 2023)	The Application of Ethnomathematics in Geometry Games for Elementary School Students	Game-based ethnomathematics improved conceptual understanding and active engagement.
(Mangdhuroh et al., 2025)	Study of the Implementation of Ethnomathematics in Mathematics Education in Schools	Ethnomathematics improves conceptual understanding, motivation, critical thinking, and supports the Merdeka Curriculum.

Based on the results of the ten studies above, the concept of ethnomathematics in geometry can provide a positive trend in creating learning activities that are more contextual, meaningful, and based on the surrounding culture. Each of the above studies integrates local culture, such as traditional games, traditional buildings, regional arts, and cultural products as a context for introducing geometric concepts to students, including flat shapes, spatial shape, symmetry, similarity, and measurement. In a study (Mulyasari et al., 2023) it was proven that the traditional game of engklek can increase student learning completeness by up to 84.6% in introducing the concept of flat shapes. In line with, this, a study (Octaviani & Mariana, 2023) found that the concept of spatial shapes can be explained through the use of traditional foods, namely kue lapis legit. This can strengthen students concrete understanding of the concept of volume. Meanwhile, research (Fatimah et al., 2024) explains that the pattern ad formations of the Sigeh Pengetuen dance form Lampung can be to explain symmetry and rotation, making learning more meaningful and interesting for students. The study (Hamidah et al., 2025) explains that through pop-up books based on the architecture of the Al-Akbar Mosque in Surabaya, it is shown that learning media that highlight cultural elements not only strengthen three-dimensional concepts but also foster religious values towards local culture. The results of this study are in line with (Kurino et al., 2022) which explores the Panjalin traditional house as a source of learning geometric concepts, where the architectural elements of each trapezoidal roof and beam support are used to introduce the shapes and properties of spatial structures.

Research conducted by (Solihin & Habibie, 2024; Musnaini, et al. 2022) explains that the integration of Madura Karapan Sapi culture in learning geometric concepts throught patterns, measurement, and strategies in karapan has a significant effect on student learning outcomes. Students become more active and understand the application of geometry in a real-word context. Meanwhile, (Rohim, 2021) (Putri & Mariana, 2022) show that Troso batik motifs and Sumur Temple architecture can be ised as concrete teaching materials to introduce the concepts of symmetry, patterns, and flat shapes.

Research conducted by (Nurhaliza, 2023; Narita, R. et al., 2022; Azmi, N. et al., 2021) emphasizes that the application of ethnomathematics through traditional children's games can overcome student's difficulties in understanding abstract geometric concepts. Through games that contain elements of shape andspace, students become more active, motivated, and able to construct their own understanding of flat and spatial shapes. These findings show that culture-based play activities are not only a means of entertainment, but also an effective vehicle for developing the logical and spatial thinking skills of elementary school children.

Meanwhile, research (Mangdhuroh et al., 2025) broadens the perspective by reviewing 33 national and international articles on the implementation of ethnomathematics. Their analysis-shows that this approached not only improves conceptual understanding and learning motivation, but also encourages critical thinking skills and appreciation of local culture. The integration of ethnomathematics has been proven to support the implementation of the Merdeka Curriculum, as it connects mathematics learning with socio-cultural contexts that are relevant to students' lives.

Overall, the results of this literature review confirm that ethnomathematics plays an important role in bridging the gap between abstract mathematical concepts and the real-life experiences of students. The integration of local culture makes the learning process more contextual, in line with the principle of the Merdeka Curriculum, which is student-centered learning.

However, in implementing all of this, there are also challenges, namely the limited ability of teachers to relate mathematical concepts to cultural contexts, the lack of ready-to-use ethnomathematics-based learning media, and the lack of explicit curriculum guidance on the integration of local culture. There is a need for

training for teachers to develop culture-based learning resources and collaboration with local communities to make learning more authentic.

Mathematics education in elementary schools, in integrating ethnomathematics concepts of geometry, not only enriches the context of mathematics learning, but also contributes to the preservation of local culture and the character building of students. In general, the application of ethnomathematics in geometry learning contributes significantly to improving student learning outcomes and character. These findings reinforce the idea that mathematics cannot be separated from culture, so that the development of innovative learning models and media based on ethnomathematics is an important direction for future research and practice in education and serves as.

CONCLUSION

The findings of this systematic literature review demonstrate that the integration of local culture through ethnomathematics in teaching geometry concepts at the elementary level significantly enhances students' conceptual understanding, learning motivation, and active engagement. By presenting geometric ideas in concrete and contextual forms through traditional games, artistic motifs, indigenous architectural designs, and traditional foods abstract mathematical concepts become more meaningful and accessible to learners. However, despite its demonstrated effectiveness, the implementation of ethnomathematics still faces several challenges. These include the limited availability of instructional media, insufficient teacher capacity to design and develop culture-based learning resources, and the absence of structured guidelines for systematic integration within classroom practice. Therefore, it is recommended that professional development programs be provided to strengthen teachers' competencies in designing ethnomathematics-based instructional materials. Future research should also conduct direct classroom-based empirical investigations to obtain more comprehensive evidence regarding its effectiveness across diverse educational contexts. In addition, further studies are encouraged to develop geometry-focused ethnomathematics teaching instruments that integrate local cultural elements into digital learning environments. Such developments would not only enhance instructional innovation but also align ethnomathematics implementation with the principles of the Merdeka Curriculum, which emphasizes contextual, student-centered, and culturally responsive learning.

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