



PROCEEDINGS

International Conference on Education
Faculty of Tarbiyah | UIN Syekh Wasil Kediri
E-ISSN: 3025-6828

Volume 3, Number 1, 2025

Systematic Literature Review: Exploration of Ethnomathematics on Malay Culture in West Kalimantan

Ressy Rustanuarsari

Institut Agama Islam Negeri (IAIN) Pontianak

Correspondence e-mail: ressyrustanuarsari@iainptk.ac.id

Abstract:

Ethnomathematics in mathematics education has the potential to foster meaningful learning experiences by integrating students' cultural backgrounds and lived experiences as members of specific ethnic communities. This study explores the ethnomathematical elements of Malay culture in West Kalimantan using a Systematic Literature Review (SLR) approach. Data were collected via the Publish or Perish application from journal articles indexed in Google Scholar, yielding fourteen studies published between 2017 and 2025. The review shows that ethnomathematical practices are most frequently represented in weaving, cultural traditions, games, dances, and architectural heritage. These cultural elements embed diverse mathematical concepts, with geometry and measurement as the most dominant domains, followed by algebra, probability, set theory, and logic. The results imply that Malay culture in West Kalimantan offers authentic learning resources that can enhance the meaningfulness of mathematics learning.

Keywords: Ethnomathematics, Systematic Literature Review, Malay Culture, West Kalimantan

Article History:

Received : 27 July 2025

Revised : 25 August 2025

Accepted : 12 October 2025

Introduction

Mathematics is a fundamental discipline that underpins various aspects of human life and activities. The significance of mathematics lies in its role as a tool to fulfill individual needs, particularly in social practices (Umbara et al., 2021, p. 8). Thus, proficiency in mathematics thus enables individuals to navigate the complexities of everyday life.

However, mathematics is often taught as an abstract and decontextualized subject, detached from students' real-life experiences. It is important to emphasize that mathematics should not be taught as a closed system, but rather as an activity of mathematizing reality and, when possible, even mathematizing mathematics itself (Van den Heuvel-Panhuizen & Drijvers, 2020). In this perspective, learning mathematics is not just remembering a formula for a concept, but rather constructing a concept in a real context (Richardo et al., 2020).

Mathematics education should be designed to ensure high relevance and meaningfulness by empowering human life through real-world contexts, positioning mathematics both as a cultural product and as a process for developing culture (Umbara et al., 2021, p.41). In line with this perspective, (Richardo, 2017) states that meaningfulness in learning can be achieved by connecting mathematical content with students' personal experiences, social contexts, and by integrating elements of local art and culture. One way to achieve this goal is by embedding cultural elements into mathematics learning through the field of ethnomathematics.

The concept of ethnomathematics was introduced by Ubiratan D'Ambrosio as a methodology for tracing and analyzing the processes of formation, transmission, dissemination, and institutionalization of mathematical knowledge across diverse cultural systems (Gerdes, 1994). Ethnomathematics is regarded as a field of study that investigates the knowledge of cultural groups, historical artifacts, indigenous communities, and other aspects related to mathematics and its teaching and learning (Richardo et al., 2020). As noted by Kyremeh et al. (2023), ethnomathematics links mathematics with culture and students' meaningful life experiences.

Through ethnomathematics, it becomes evident that mathematics is not solely produced by mathematicians, but that mathematical concepts naturally emerge and develop within communities in response to their everyday needs (Umbara et al., 2021). From its inception, the ethnomathematics approach has emphasized that the creation of new knowledge requires a holistic view of society, including its cultural dimensions, traditions, and the expectations of its members. This paradigm also challenges the conventional image of mathematics education, which tends to prioritize the transmission of mathematical content while giving insufficient attention to social and cultural issues (D'Ambrósio & Knijnik, 2020).

Ethnomathematics-based learning encourages students to recognize mathematics as an integral part of everyday life. This approach not only enhances students' ability to build meaningful mathematical connections but also deepens their understanding of various mathematical concepts (Rosa & Orey, 2020). Moreover, the use of concrete learning resources within an ethnomathematics approach has been proven to make the learning process more meaningful (Sholihah & Marsigit, 2022). The findings of (Novitasari & Sopiany, 2024) demonstrate that mathematics learning based on local culture can improve students' mathematical literacy skills. Thus, ethnomathematics offers a meaningful approach that strengthens mathematical understanding while preserving cultural heritage.

Indonesia is a multicultural nation in which each region has its own distinctive traditions and cultural characteristics, forming a rich heritage that must be introduced

and preserved for future generations. Schools play a crucial role in preserving and transmitting this cultural wealth to the younger generation, and it is expected that such heritage can be integrated into learning activities (Irawan et al., 2023). Within mathematics education, ethnomathematics offers opportunities to incorporate various cultural elements such as architecture, weaving, sewing, agriculture, traditional dances, traditional games, batik, kinship systems, ornaments, spiritual practices (Abroriy, 2020), traditions, languages (Nirmalasari et al., 2021), and other cultural heritage.

Historically, ethnic groups in Indonesia have historically spread heterogeneously, with a large diversity. Among these, the Javanese, Sundanese, and Malay represent three of the largest ethnic groups (Pitoyo & Triwahyudi, 2018). In West Kalimantan, the Malay community is one of the dominant ethnic groups, where at least thirteen Malay kingdoms once flourished across regions such as Pontianak, Sambas, Mempawah, Ketapang, Sukadana, Landak, and Sintang (Yusriadi, 2019). Previous studies have highlighted that Malay culture in West Kalimantan is particularly rich in mathematical concepts, which can be identified in various cultural practices and artifacts (Darmayanthi et al., 2020; Firdaus & Hodiyanto, 2019; Iqbal et al., 2018; Iwan et al., 2023; Kurniasari et al., 2020; Nursila et al., 2023; Panjaitan et al., 2021).

Building on this background, the present study aims to conduct a systematic literature review of ethnomathematics within the context of Malay culture in West Kalimantan. Specifically, it seeks to identify cultural elements of the Malay community that embody ethnomathematical practices and to analyze the mathematical concepts embedded within these cultural traditions.

Methods

This study employed the Systematic Literature Review (SLR) method, which is designed to recognize, review, and evaluate all relevant research related to a specific topic through clearly formulated research questions (Triandini et al., 2019). The SLR process in this research followed several stages, namely: (1) formulating the research problem; (2) developing and validating the review protocol; (3) conducting literature searches; (4) screening studies for inclusion; (5) assessing the quality of selected studies; (6) extracting relevant data; (7) analyzing and synthesizing the data; and (8) reporting the findings (Xiao & Watson, 2019).

Two research questions guided this study: (1) What elements of Malay culture in West Kalimantan have been explored in the study of ethnomathematics? and (2) What mathematical concepts are embedded within these cultural elements? To address these questions systematically, a review protocol was established, which outlined the search strategy, inclusion and exclusion criteria, methods of data extraction, and approaches for data analysis.

The literature search was conducted using the *Publish or Perish* application with the Google Scholar database. The keyword applied was “ethnomathematics in Malay culture”, with publication restrictions from 2017 to 2025. Each article retrieved was screened to determine its eligibility for data extraction and analysis. The inclusion criteria specified that studies must (a) be related to mathematical concepts found in Malay cultural elements of West Kalimantan, and (b) be published in journals, proceedings, or theses.

Following the initial screening, the full texts of the studies were reviewed for quality assessment based on established criteria. Studies that did not meet the inclusion standards were excluded from the final dataset. Through this process, fourteen studies were identified and selected for further analysis.

Subsequently, data from the selected studies were systematically extracted, focusing on research objectives and findings. The extracted data were then categorized and thematically analyzed to identify recurring patterns, similarities, and differences. This process provided a comprehensive understanding of Malay cultural elements and the mathematical concepts embedded within them. Finally, the findings were synthesized into a coherent narrative, leading to the study's conclusion.

Results and Discussion

Findings

This literature review draws on the analysis and synthesis of various studies concerning the ethnomathematics of Malay culture in West Kalimantan. The review identifies fourteen relevant articles, which are summarized in Table 1.

Table 1. Studies on Ethnomathematics in West Kalimantan Malay Ethnic Culture

Researcher(s) and Year	Research objectives	Findings
Sartika and Komalasari (2025)	To examine the cultural tradition of <i>Meriam Karbit</i> and identify its ethnomathematical elements for integration into mathematics learning.	The <i>Meriam Karbit</i> , shaped like a cylinder, is decorated with <i>Corak Insang</i> motifs. The <i>Corak Insang</i> motif embodies mathematical elements, including rectangles, isosceles triangles, and the spatial arrangement of the <i>Meriam Karbit</i> , which forms a right triangle.
Ainiyyah and Rustanuarasi (2025)	To identify geometric transformation concepts in the <i>Pucuk Rebung</i> motif of <i>Linggi Sambas</i> woven fabric.	The motif contains reflection, translation, and rotation, making it a valuable resource for teaching geometric transformations and fostering meaningful learning.
Jamilah and Nurmaningsih (2024)	To explore the ethnomathematical elements in the <i>Corak Insang</i> weaving of Malay Pontianak.	The motifs consist of parallel lines with identical gradients (slope 11/4) and plane figures that are similar and congruent, where corresponding sides and angles are equal
Oktapiani et al. (2024)	To examine ethnomathematics in the Sambas Malay <i>Saprahan</i> tradition, focusing on fundamental mathematical activities, related tools, and their integration into elementary school learning.	The <i>Saprahan</i> tradition reflects mathematical activities: counting (arithmetic operations), measuring (measurement and plane figures), locating (addition and plane figures), designing (arithmetic and plane figures), and explaining (arithmetic and plane figures). These concepts can be adapted into instructional tools for innovative elementary mathematics learning.
Ismawati et al. (2023)	To explore ethnomathematical elements in the <i>Bujur Serong Jepin</i> dance as a	The dance reflects geometry through floor patterns (equilateral triangles, parallelograms, trapezoids), foot movements (right

	source for mathematics learning.	and acute angles), and hand movements (right, acute, obtuse angles).
Nursila et al. (2023)	To explore geometric elements and concepts in the Songket of Malay Pontianak.	The Songket fabric contains geometric elements such as rhombuses, circles, and parallelograms, as well as transformations including reflection, translation, and dilation.
Iwan et al. (2023)	To identify mathematical concepts in the <i>Gasing</i> game of the Malay Sambas ethnicity and their application in learning.	The <i>Gasing</i> game involves concepts such as solid figures with curved surfaces (tubes, cones, spheres), prisms, cuboid, tangents to circles, congruence, Cartesian coordinates, parallel and perpendicular lines, plane figures, the Pythagorean theorem, probability, logic, sets, even numbers and standard units (weight and length). Activities include grouping, counting, measuring, designing, locating, and explaining.
Faruq (2023)	To identify and describe mathematical objects embedded in the architecture of Masjid Jami' Sultan Syarif Abdurrahman in Pontianak, as well as to explore their potential utilization in mathematics learning.	The mosque's architectural forms contain various ethnomathematical elements. These include geometric concepts such as triangles, hexagons, cubes, rectangular prisms, pyramids, and cylinders. The findings demonstrate that these mathematical concepts can be meaningfully integrated into the teaching of geometry, thereby connecting local cultural heritage with school mathematics learning.
Panjaitan et al. (2021)	To identify mathematical concepts in the motifs of Sambas Malay Songket cloth and describe its characteristics.	The weaving process involves counting, measuring, designing, locating, and explaining. Motifs include shoots of bamboo shoots, chained clouds, betel trails, crowned peacock's crest, grapes, orchids, eastern, stars, crowns, grass flowers, and a single rose. Geometry concepts include straight lines, parallel lines, line symmetry, rhombuses, congruence, triangles, and kites.
Kurniasari et al. (2020)	To identify mathematical concepts in the Malay Sambas <i>Engset</i>	The <i>Engset</i> game embodies: (a) tools—flat and spatial concepts; (b) arena—plane figures, similarity

	game and integrate them into student worksheets.	and congruence, and reflection; (c) rules—logic and sets; (d) play method—probability, sets, counting, number patterns.
Darmayanthi et al. (2020)	To analyze movements in the <i>Jepin Tali Bui</i> dance of the Pontianak Malay community.	The mathematical concepts in the <i>Tali Bui Jepin</i> dance are: operations on integers, the associative property of operations on whole numbers, circles (center point, radius, and central angle), straight line equations, distance from a point to a line, line symmetry, probability, relations and functions, geometric transformations, units of time, angles, and plane figure (rhombus).
Firdaus and Hodiyanto (2019)	To describe tools and activities in the <i>Besaprah</i> tradition at Malay wedding ceremonies in Sambas.	Tools include <i>alas saprah</i> , <i>batel</i> , <i>pinggan saprah</i> , etc., and activities such as <i>merancap</i> , <i>bekaot</i> , <i>nyiapkan sajian saprahan</i> , <i>besurong</i> . These reflect geometry, spatial structures, numerical patterns, and plane figures.
Iqbal et al. (2018)	To explore ethnomathematics in the construction of Ketapang Malay traditional houses.	Measurement terms (<i>Depa</i> , <i>Seta</i> , <i>Jar</i> , <i>Ukor</i> , <i>Koyam</i>) which are sequentially used to measure land length, connecting beam length, round wood, room width, pond volume, and work area size. Patterns appear in rafters (5,9,13,17,21, ...) and stairs (4, 7, 10, 13, 16, ...). The roof consists of a sledge made up of two rectangular sections, and another part of the roof is formed from two trapezoidal and two triangular sections. Decorations apply geometry and transformations.
Septiadi and Hartoyo (2017)	To investigate the potential of the <i>Robo-Robo</i> tradition of the Malay community in Mempawah as a meaningful source for integrating cultural heritage into school mathematics learning.	The study revealed that the <i>Robo-Robo</i> tradition embeds diverse mathematical concepts across multiple school levels. These include set theory represented by the heirlooms of Amantubillah Palace (Grade 7); kite shape geometry and counting activities derived from ceremonial shields (Grades 1–2); color patterns and sequences from the seven-colored cindai thread used in the toana ritual (Grade 12); algebraic inequalities reflected in the makan syafar ritual (Grade 7);

distance, time, speed, and volume found in the buang-buang procession (Grade 5); and set relations from the different community groups involved in the event (Grade 7). These findings highlight the richness of *Robo-Robo* as a cultural resource for contextualizing mathematics education.

Based on the 14 articles that have been analyzed, the cultural elements and mathematical concepts from these studies are presented in Table 2.

Table 2. Malay Cultural Elements that Apply Mathematical Concepts

Researcher(s) and Year	Cultural Elements	Mathematical Concepts
Sartika and Komalasari (2025)	Cultural tradition: <i>Meriam Karbit</i>	Plane figures: rectangle, isosceles triangle, right triangle; Solid figure: cylinder
Ainiyyah and Rustanuarasi (2025)	Weaving: <i>Pucuk Rebung</i> motif of Lunggi Sambas woven fabric	Geometric Transformations: reflection, translation, rotation
Jamilah and Nurmaningsih (2024)	Weaving: <i>Corak Insang</i> motif	Similar and congruent, parallel lines, slope
Oktapiani et al. (2024)	Cultural tradition: <i>Saprahan</i> of Sambas Malay	Basic mathematical activities: counting, measuring, designing, locating, explaining
Ismawati et al. (2023)	Traditional dances: <i>Bujur Serong Jepin</i>	Plane figures: equilateral triangle, parallelogram, trapezoid; Angles: right, acute, obtuse
Nursila et al. (2023)	Weaving: Malay Pontianak Songket	Plane figures: rhombus, circle, parallelogram; Geometric Transformations: reflection, translation, dilation
Iwan et al. (2023)	Traditional game: <i>Gasing</i>	Solid figures: cylinder, cone, sphere, prism, cuboid; Plane figures: square, rectangle, trapezoid, circle Tangent to a circle; Pythagorean theorem; Parallel lines, intersecting and perpendicular lines; Cartesian coordinates; Congruent;

		Basic mathematical activities: grouping, counting, measuring, designing, locating, explaining Probability; Sets and logic; Even number; "Unit" of measurement: mass, length
Faruq (2023)	Architecture: Masjid Jami' Sultan Syarif Abdurrahman Pontianak	Plane figures: triangle, hexagon; Solid figures: cube, rectangular prism, pyramid, cylinder
Panjaitan et al. (2021)	Weaving: Sambas Malay Songket	Geometry: straight lines, parallel lines, line symmetry, congruent; Plane figures: rhombus, triangles, kite; Basic mathematical activities: counting, measuring, designing, locating, explaining
Kurniasari et al. (2020)	Traditional games: Engset	Plane figures; Solid figure; Similar and congruent; Geometric transformation: reflection; Probability; Sets and logic; Counting; Number patterns
Darmayanthi et al. (2020)	Traditional dances: <i>Jepin Tali Bui</i>	Number Properties and Operations: operations on integers, associative law on whole numbers operations Geometry: circles (center point, radius, central angle), plane figure (rhombus), angles, line of symmetry, geometric transformations, distance from a point to a line; Probability; Relation and function; "Unit" of measurement (time)
Firdaus and Hodiyanto (2019)	Cultural tradition: <i>Besaprah</i> at Malay wedding ceremonies	Plane figure; Spatial structures; Number patterns
Iqbal et al. (2018)	Architecture: Ketapang Malay ethnic house	Non-standard measurement units; Plane figures: rectangle, trapezoid, triangle; Sequences and patterns; Geometric transformations;
Septiadi and Hartoyo (2017)	Cultural tradition: <i>Robo-Robo</i> in Mempawah	Set theory: sets, subsets, intersections and unions

Plane figure: kite
 Counting activities
 Patterns and sequences
 Algebra: inequalities (algebraic form)
 Measurement: distance, time, speed, volume

Analysis

This review identified fourteen relevant studies published between 2017 and 2025 that examined ethnomathematics within the Malay culture of West Kalimantan. The studies, drawn from journal articles indexed in Google Scholar and analyzed through a systematic procedure, demonstrate a growing scholarly interest in this field, with most works published in the past eight years.

The cultural elements investigated in the reviewed studies demonstrate both diversity and thematic concentration. Weaving practices emerged as the most frequently studied domain, including Sambas songket (Panjaitan et al., 2021), Lunggi Sambas woven fabric with the *Pucuk Rebung* motif (Ainiyyah & Rustanuarsi, 2025), Pontianak Malay songket (Nursila et al., 2023), and *Corak Insang* motifs (Jamilah & Nurmaningsih, 2024). Beyond weaving, several studies explored cultural tradition, such as *Meriam Karbit* (Sartika & Komalasari, 2025), *Robo-Robo* (Septiadi & Hartoyo, 2017), and *Saprahan* (Firdaus & Hodiyo, 2019; Oktapiani et al., 2024), which embed rich mathematical structures. Traditional games, including *Gasing* (Iwan et al., 2023) and *Engset* (Kurniasari et al., 2020), also received attention, illustrating diverse mathematical concepts. Additionally, cultural expressions such as dances—*Jepin Bujur Serong* (Ismawati et al., 2023) and *Jepin Tali Bui* (Darmayanthi et al., 2020)—were examined for their geometric and numerical features. Architectural heritage was likewise represented in studies on Ketapang Malay ethnic house (Iqbal et al., 2018) and the Masjid Jami' Sultan Syarif Abdurrahman Pontianak (Faruq, 2023), both of which reveal mathematical patterns in built forms.

Across these studies, a wide range of mathematical domains was identified. Geometry emerged as the most dominant, encompassing plane figures (triangles, rhombuses, kites, parallelograms, trapezoids, circles, and squares) and solid figures (cylinders, cones, spheres, prisms, and cuboids) (Faruq, 2023; Iwan et al., 2023; Sartika & Komalasari, 2025). Geometric transformations—including reflection, rotation, translation, and dilation—were especially evident in weaving, where motifs demonstrate systematic patterns and spatial reasoning (Ainiyyah & Rustanuarsi, 2025; Nursila et al., 2023). Algebraic concepts, such as inequalities, sequences, and number patterns, surfaced in cultural traditions and games (Kurniasari et al., 2020; Septiadi & Hartoyo, 2017). Probabilistic thinking, set theory, and logical reasoning were also identified, particularly in traditional games and cultural tradition (Iwan et al., 2023; Septiadi & Hartoyo, 2017). Measurement concepts were well represented, encompassing both standard units (distance, time, speed, volume, mass, and length) and non-standard measures rooted in local practices (Darmayanthi et al., 2020; Iqbal et al., 2018). Moreover, across nearly all cultural domains, fundamental mathematical activities—such as counting, measuring, designing, locating, and explaining—emerged as recurring themes (Oktapiani et al., 2024; Panjaitan et al., 2021).

Overall, the findings indicate that ethnomathematics research in Malay culture has concentrated on weaving, cultural traditions, games, and architecture. Geometry appears as the predominant mathematical domain, followed by algebra, probability, set theory, logic, and measurement. This suggests that Malay cultural practices embody a rich and diverse range of mathematical ideas that can serve as meaningful contexts for mathematics learning.

Nevertheless, several research gaps were identified. First, scholarly attention has remained limited to a few cultural elements, leaving other practices—such as sewing, agriculture, batik, kinship systems, ornaments, spiritual practices, languages and culinary traditions—largely unexplored. Second, the mathematical focus has centered on geometry and measurement, with little investigation into advanced domains such as statistics, calculus, or discrete mathematics. Third, the majority of studies adopt a descriptive approach to documenting cultural practices, while few have examined how these ethnomathematical insights can be systematically integrated into mathematics teaching and learning.

This highlights the need for future research to extend ethnomathematics studies in the Malay culture of West Kalimantan, particularly by exploring cultural domains such as sewing, agriculture, batik, kinship systems, ornaments, spiritual practices, languages, and culinary traditions. Such work has the potential to enhance students' mathematical understanding while simultaneously fostering the appreciation of local cultural identity. In this sense, mathematics education should be understood not only as a cognitive endeavor but also as both a product of human culture and a process of cultural development (Umbara et al., 2021). Building on this perspective, ethnomathematics and culturally relevant pedagogy offer approaches to curriculum design that make school mathematics more meaningful and contextually relevant, while also enhancing the overall quality of students' educational experiences (Rosa & Orey, 2020).

Conclusion

This study reviewed ethnomathematics research on Malay culture in West Kalimantan to identify the cultural elements examined and the mathematical concepts embedded within them. The findings show that weaving, cultural traditions, games, dances, and architecture are the most frequently explored domains, with geometry, measurement, algebra, probability, and logic as the dominant mathematical concepts. This synthesis advances current knowledge by mapping existing work, highlighting its pedagogical potential, and identifying underexplored areas such as sewing, agriculture, batik, kinship systems, ornaments, spiritual practices, languages and culinary traditions. Future research should move beyond descriptive studies toward classroom integration and broader cultural practices, thereby strengthening the role of ethnomathematics in developing culturally responsive mathematics education.

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