Ethnomathematics Journal
Volume 6, No. 1, March 2025 (1-17)
Online: http://journal.uny.ac.id/index.php/ethnomath

PATTERN OF ETHNOMATHEMATICS RESEARCH TOWARDS HISTORICAL BUILDINGS

Arifin Riadi, Universitas Pendidikan Indonesia, Indonesia
Turmudi*, Universitas Pendidikan Indonesia, Indonesia
Dadang Juandi, Universitas Pendidikan Indonesia, Indonesia
*e-mail: turmudi@upi.edu (corresponding author)

Abstract: Historical buildings serve as a rich source for discovering mathematical concepts for educational purposes. This literature review aims to identify (1) the mathematical concepts that have not emerged in the exploration of historical buildings and (2) the most frequently utilized research designs used in ethnomathematics studies related to historical buildings. A total of 64 articles were analyzed using the PRISMA protocol. The reviewed studies primarily explore traditional houses, but also encompass other architectural forms such as mosques, tombs, temples, museums, and monuments. The research results indicate that (1) the mathematical concept largely unexplored in historical building ethnomathematics in "Number and Operation" and (2) the most frequently used research design in these studies is ethnographic. This review highlights the importance of expanding the scope of ethnomathematical studies both geographically and conceptually, and suggests potential applications for mathematics education to enhance cultural relevance. The study contributes to the preservation of local heritage by linking cultural practices with mathematical principles, offering valuable insights for both academic research and educational practice.

Keywords: ethnomathematics, historical building, literature review, Indonesia, mathematical concepts

How to cite:

Riadi, A., Turmudi, T., & Juandi, D. (2025). Pattern of ethnomathematics research towards historical buildings. *Ethnomathematics Journal*, 6(1), 1-17.https://doi.org/10.21831/ej.v6i1.78748

INTRODUCTION

Ethnomathematics explores the intricate relationship between mathematics and culture, focusing on how mathematical concepts are integrated into the practices, traditions, and artifacts of various communities (D'ambrosio, 1985). Since its inception in the 1980s, ethnomathematics has grown into a significant field of research, particularly due to its potential to bridge formal mathematical education with the cultural practices of diverse societies (Rosa & Orey, 2016). The increasing global attention towards ethnomathematics is further evidenced by the organization of seven International

Conferences on Ethnomathematics (ICEm), held regularly every four years. Recent ICEm was conducted virtually in 2022, was organized through collaboration among four countries: the Philippines, Nepal, Indonesia, and Papua New Guinea, with the theme "Ethnomathematics: Embracing Diverse Knowledge Systems for Social Justice and Peace" (Owens, 2023). This demonstrates the growing global attention toward ethnomathematics. Ethnomathematics not only encompass indigenous and traditional knowledge but also extends to various social groups, integrating cultural mathematics with classroom applications, policy studies, and theoretical frameworks (Borba, 1990).

In Indonesia, a country known for its rich cultural heritage, ethnomathematics provides a valuable lens to explore how different ethnic groups apply mathematical ideas in their everyday lives, particularly in the design and construction of historical buildings. Given its over 1,300 recognized ethnic groups (Na'im & Syaputra, 2011), Indonesia presents immense potential for uncovering culturally embedded mathematical knowledge through ethnomathematics studies. Furthermore, the country's wealth of historical artifacts, including 2,873 buildings (traditional houses and grand mosques), 1,037 sites (tombs and monuments), 363 structures (temples), and 442 museums is recorded in Indonesia (Pusdatin, 2024). This highlights both the potential and challenges of ethnomathematical research in Indonesia, particularly concerning historical buildings. The distribution of building types and ethnomathematical research locations needs to be identified so that future studies can enrich the knowledge base and avoid merely duplicating previously explored buildings and locations. Historical buildings-such as temples, tombs, mosques, monuments, museums, and especially vernacular houses-function not only as architectural landmarks but also as repositories of local mathematical practices, such as the use of geometric principles, measurements, and proportional designs (Fitriza *et al*., 2019). Recent research has begun to document these practices, illustrating how various ethnic groups integrate mathematical concepts into their traditional architecture. For instance, studies on the Banjar traditional house Palimbangan reveal the extensive use of algebra, geometry, and measurement concepts in their construction (Riadi, Turmudi, & Juandi, 2023).

The five main contents standards used as a guide in mathematics instruction are Number and Operation, Algebra, Geometry, Measurement, and Data Analysis and Probability (National Council of Teachers of Mathematics, 2000). However, beyond these, five key mathematical content standards for students also include "Number and Operation" and "Data Analysis and Probability". A clear identification and documentation of these content standards in ethnomathematical studies, particularly

related to historical buildings, is essential to clearly identify which concepts have been explored and which remain undiscovered. Furthermore, this documentation can be useful for the development of ethnomathematics-based learning tools related to traditional buildings, allowing future researchers to directly utilize published exploration results that are relevant to the targeted mathematical concepts.

Nevertheless, there has not yet been a study on ethnomathematical research of historical buildings that conclusively identifies which research design is most suitable for use. This research is expected to serve as a reference for initial studies in explaining the framework and projection of ethnomathematics research on traditional buildings. To further explore these aspects, this study aims to answer the following questions: (a) What is the scope of ethnomathematics research on historical buildings? (b) What research methods are relevant for ethnomathematics research on historical buildings? (c) What mathematical concepts have been discovered in ethnomathematics research on historical buildings? (d) What is the distribution of ethnomathematics research locations on historical buildings in Indonesia? and (e) What types of buildings have been studied in ethnomathematics research?

METHOD

This study employed the Systematic Literature Review (SLR) method to answer the research questions. This review adhered to the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) protocol (Pahmi *et al*., 2023). The PRISMA protocol is essential for ensuring transparency and methodological rigor in systematic literature reviews. It offers guidelines for reporting systematic reviews and meta-analyses, thereby enhancing the quality and reproducibility of research across various fields (Liberati *et al*., 2009; Moher *et al*., 2009). Adhering to PRISMA standards enables researchers to bolster the credibility and impact of their systematic literature reviews by ensuring comprehensive reporting and methodological transparency (Rachmawati *et al*., 2024).

Articles were assessed based on items from a checklist, specifically title, author, year, research question, cultural setting, method, sample/subject, and findings. These items were selected primarily for their relevance to the research questions and to support additional analysis (Yusri, Yusof, & Sharina, 2024). The target documents included articles from local journals, international journals indexed by Scopus, local proceedings, and international proceedings indexed by Scopus. The initial search was conducted in the Google Scholar database with the assistance of the Publish or Perish (PoP) application. Additionally, articles or proceedings indexed by Scopus were accessed directly from the

Scopus database. The keywords used to search for PoP manuscripts were "ethnomathematics" AND "traditional" OR "historical" AND "building" OR "house" OR "architecture" OR "residence". Meanwhile, the Scopus database search employed the keyword "ethnomathematics" with the filter COUNTRY: Indonesia [TITLE-ABS-KEY (ethnomathematics) AND (LIMIT-TO (AFFILCOUNTRY, "Indonesia"))]. The stages for selecting study sources were as follows: (a) identifying journal articles and proceedings according to the search keywords; (b) screening duplicate documents after both results are combined; (c) removing incomplete documents or those with disclaimer notes; (d) selecting relevant documents based on titles and abstracts; (e) checking the quality of relevant documents and ensuring full texts are accessible; (f) summarizing the obtained documents for further analysis needs.

Descriptive statistics were used to present the extracted and tabulated data. Findings related to the research questions are presented in narrative form. **Figure 1** illustrates the data extraction process based on the PRISMA protocol for SLR.

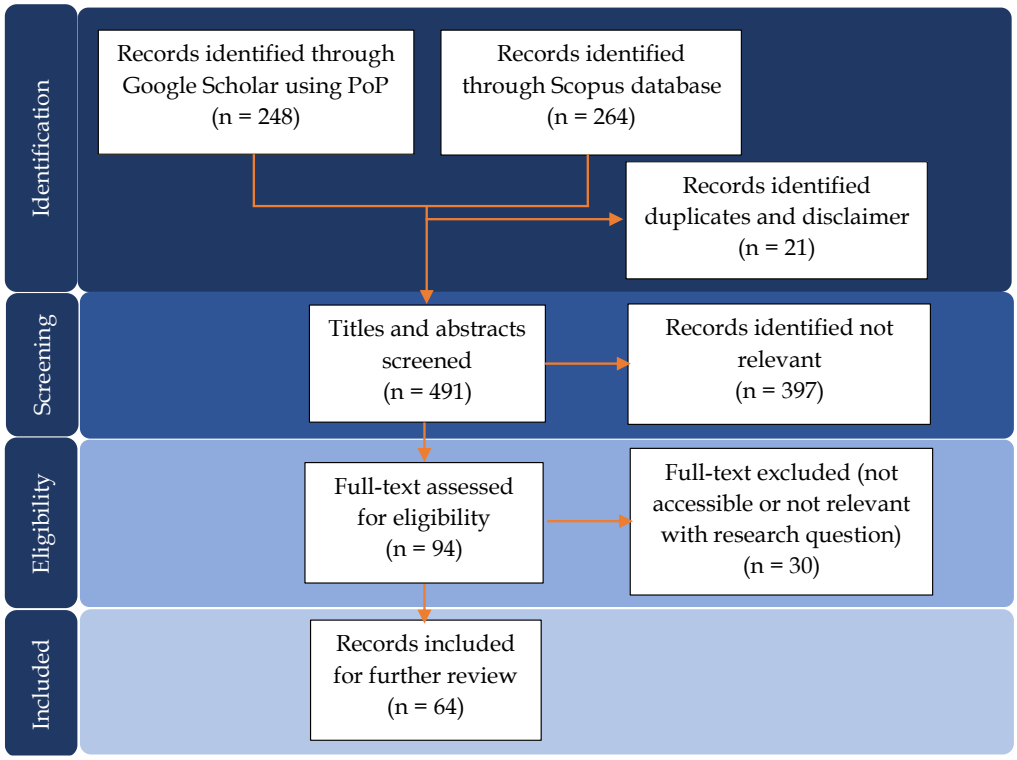

Figure 1. PRISMA protocol flowchart

As depicted in **Figure 1**, the initial data obtained through PoP were 248 articles, and from the Scopus database were 264 articles. This combined total of 512 initially included duplicate results. After removing 21 duplicates, 491 unique data points remained for title and abstract review. The screening process identified 397 irrelevant data points (e.g., not conducted in Indonesia, unrelated to historical buildings, not in English, or not empirical research). This left 94 data points that proceeded to full-text examination. At

the eligibility stage, 30 data points were found to be irrelevant (due to unavailable full texts or misalignment with the research questions). Consequently, a final set of 64 documents was included in this SLR to answer the research questions.

RESULTS AND DISCUSSION

The research on historical buildings from an ethnomathematical perspective encompasses studies directly related to such structures. This includes qualitative explorations of these buildings, quantitative implementations of ethnomathematics-based learning (utilizing these buildings), and investigations into related aspects such as carvings and motifs. In addition to traditional houses, the historical buildings examined include temples, tombs, grand mosques, monuments, and museums.

The scope of research on ethnomathematics related to historical buildings

The scope of research on ethnomathematics related to historical buildings includes the investigation of mathematical concepts inherent in the design, construction, and cultural significance of historical structures. This includes qualitative studies exploring the integration of mathematical principles such as symmetry, proportions, and geometric patterns within the architecture, spatial organization, and aesthetic details of these structures. Additionally, it includes quantitative research applying ethnomathematics in educational settings, utilizing historical buildings as a medium for teaching mathematical concepts. The scope also extends to the study of related cultural artifacts, such as carvings, motifs, and construction methods, providing insights into the relationship between mathematics and historical architecture across diverse cultures.

According to ISGE (International Study Group on Ethnomathematics), there are four areas of interest in ethnomathematics: (1) Field Research, (2) Mathematical Work in Cross-Cultural Situations, (3) Classroom Applications of Ethnomathematics, and (4) Theoretical, Sociological, and Policy Studies of Ethnomathematics (Shirley & Palhares, 2016). Referring to these four areas, only three have been addressed based on the literature analyzed in this study. The area that remains unexplored is related to Theoretical, Sociological, and Policy Studies of Ethnomathematics. This gap may stem from this area encompassing studies on how the inclusion of ethnomathematics in the curriculum can impact educational equity, or how educational policies can be adjusted to support more culturally relevant mathematics teaching. The details related to these findings are presented in **Table 1**.

Table 1. Ethnomathematics Areas of Interest Identified

Type of Article's Source	Number of Articles		
	Field Research	Cross-Cultural Situations	Classroom Applications
Non-Scopus Indexed Journals	21	0	3
Scopus Indexed Journals	4	0	1
Non-Scopus Indexed Proceedings	8	1	1
Scopus Indexed Proceedings	21	0	4
	54	1	9

Table 1 demonstrates that the articles exploring historical buildings significantly outnumber those addressing their application in classroom learning. Moreover, only one article is categorized under cross-cultural situations. Among the 54 articles categorized as Field Research, it was found that most employed an ethnographic research design. Of the seven research designs available (Creswell, 2015), only five have been identified in the reviewed literature. Details regarding the variations of research designs used are presented in **Figure 2**.

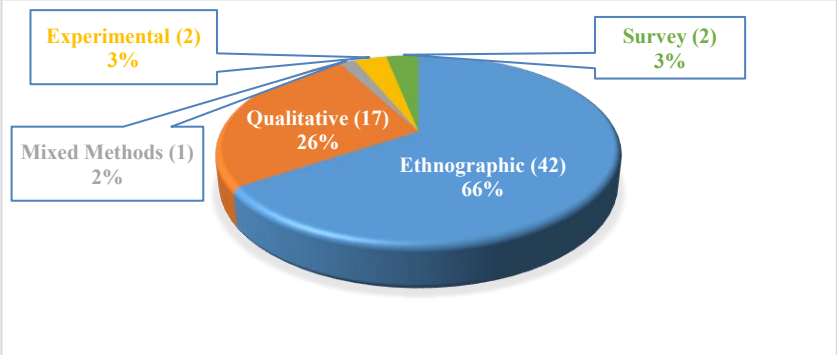

Figure 2. Distribution of research designs identified

Ethnography is essential in ethnomathematics because it enables researchers to gain a deep understanding of how various cultures incorporate mathematical ideas into their daily lives, highlighting the culturally specific and evolving nature of mathematics (Rosa & Orey, 2016). Moreover, ethnography allows researchers to delve into and document the unique ways in which cultural groups, such as the Bedouins, integrate mathematical practices into their everyday lives, thereby providing insights into the cultural relevance and application of mathematics in non-formal settings (Amit & Quoder, 2017).

Content Standards for Mathematics Education

Based on established guidelines for mathematics contents standards, only four content areas appeared in the findings realted to ethnomathematics in historical buildings. A summary of thus categorization is presented in **Table 2**.

Table 2. Summary of Findings Related to Content Standards

Content Standards		Total Findings	Percentage
Measurement	Length and Distance	13	4.48%
	Area and Perimeter	18	6.21%
	Volume and Surface Area	12	4.14%
Data Analysis & Probability	Probability	1	0.34%
Geometry	Square	27	9.31%
	Rectangle	30	10.34%
	Triangle	31	10.69%
	Circle	17	5.86%
	Parallelogram	2	0.69%
	Trapezoid	22	7.59%
	Rhombus	5	1.72%
	Hexagon	3	1.03%
	Cube	9	3.10%
	Pyramid	7	2.41%
	Cylinder	7	2.41%
	Reflection	23	7.93%
	Translation	15	5.17%
	Rotation	14	4.83%
	Dilation	6	2.07%
Algebra	Functions	7	2.41%
	Patterns	20	6.90%
	Mathematical Modelling	1	0.34%

In **Table 2**, it can be seen that the most frequent findings are related to the connection between historical buildings and geometry, particularly triangles, while the least frequent findings are associated with mathematical modeling. All the findings in **Table 2** can be summarized in the research results presented in **Table 3**.

Table 3. Detailed Findings Related to Content Standards

Authors	Research Results
Fitriza *et al.* (2019)	The article explores how traditional craftsmen, *tukang tuo*, use non-standard units of measurement, such as *dapo* (fathom), *eto* (cubit), and *jangko* (span), to determine the **length and distance** in the construction of the *Rumah Gadang* of the Minangkabau.
Dwidayati & Zaenuri (2021)	The study of traditional Bugis houses in the Karimunjawa Islands reveals the application of **area and perimeter** in their design, using geometric shapes to optimize space and maintain architectural balance.
Rangkuti & Siregar (2023)	The article highlights the application of **volume and surface area** concepts in the architecture of the *Mandailing* Natal traditional house, *Bagas Godang*. Specifically, the pillars are shaped like octagonal prisms, and their volume can be calculated by determining the area of the octagonal base and multiplying it by the height. Additionally, cuboid shapes are found in the house's interior, allowing for calculations of both volume and surface area.
Munthahana & Budiarto (2020)	The study on *Panataran* Temple reveals the use of **probability** in the Palah Inscription, where decisions about granting tax-exempt status (Sima) reflect an ancient application of probability in governance and societal organization.
Muwaffiq & Suparni (2022)	The article highlights the use of the *Joglo* house to teach the concept of a **square**. The square-shaped windows serve as practical examples for students to explore properties such as equal sides, right angles, and diagonals.

Authors	Research Results
Heriani *et al.* (2023)	The study on Desa Beleq's traditional house highlights the use of **rectangles** in the design of key structural elements like the roof, stairs, doors, and support poles.
Kurino & Akbar (2022)	The study on the *Panjalin* Traditional House in Majalengka highlights the use of **triangles** in its architectural design, particularly in the geometric elements of the roof and structural layout.
Susanti *et al.* (2023)	The article highlights that the Minangkabau *Gadang* house utilizes the concept of a **circle** in its roof design. The roof features a semi-circular arc that helps break strong winds and direct water flow during rain.
Permata, Budiarto, & Ekawati (2021)	The research on the *Radakng* House in *Sahapm* Village highlights the use of **parallelograms** in the design of the rice storage structure, integrating this geometric shape into the traditional architecture to serve both functional and cultural purposes.
Hariastuti, Budiarto, & Manuharawati (2021)	The study on the traditional Using house in Banyuwangi reveals the use of **trapezoids** in its architectural design, particularly in the shape of the side walls known as "*gedhek penangkur*".
Liesandra (2022)	The research on *Rumoh* Aceh highlights the presence of **rhombus** shapes in its decorative carvings, where these geometric patterns enhance the aesthetic and cultural significance of the traditional Acehnese architecture.
Moriolkosu, Handayani, & Sunarso (2020)	The study on the culture of North Aru identifies the use of **hexagons** in traditional fishing traps called "*Vuuf*." These hexagonal shapes are integral to the design of the traps, demonstrating the application of geometric concepts within the local culture's practical tools for fishing.
Friansah & Yanto (2020)	The study on the cultural heritage of *Musi Rawas* Regency identifies the use of **cubes** in the design of the Raudhatus Sa'adah Mosque's tower. The base of the tower is cube-shaped, symbolizing the Kaaba, which reflects the integration of geometric concepts with cultural and religious symbolism in traditional architecture.
Fauzi, Gazali, & Fauzi (2021)	The article highlights the *bale mangina* roof of the Segenter traditional house, which is **pyramid**-shaped. This structure exemplifies geometric concepts, with the roof featuring both triangular and trapezoidal sides.
(Tlonaen & Deda, 2021)	The study on the traditional *Ume Kbubu* house in North Central Timor identified key mathematical concepts within its structure, particularly the **cylinder**. The house's pillars resemble cylinders, with circular bases and vertical sides.
Suharta, Sudiarta, & Astawa (2017)	The article highlights that the concept of **reflection** is used in the design of Balinese traditional house carvings. Carvers often create symmetrical patterns by reflecting designs across a line of symmetry, resulting in mirror-image motifs.
Hidayat *et al.* (2020)	The study on the Batak Toba traditional house identified the use of geometric transformations, including **translation**, in the decorative carvings known as "gorga." These carvings exhibit patterns that are shifted or repeated across different parts of the house, demonstrating the concept of translation.
Ditasona (2018)	The study found that the Gorga ornaments on Batak Toba houses use the geometric concept of **rotation**. Some motifs are rotated 180 degrees, showing rotational symmetry, where the design remains unchanged.
Budiarto, Artiono, & Setianingsih (2019)	The study on Sasak pottery from Banyumulek highlights the use of the geometric transformation concept of **dilation** in the creation of motifs. Craftsmen apply dilation to resize and scale patterns without altering their fundamental shapes.
Darmayasa, Wahyudin, & Mulyana (2018)	The study on the traditional Bale Saka Roras house in Songan Village, Bali, discovered the application of mathematical **functions** through multiple linear regression. The relationship between the width and height of the house's pillars was modeled using the function Y=18.2X+26.3, where X represents the pillar width and Y the pillar height.

Authors	Research Results
Dosinaeng, Lakapu, & Leton (2020)	The study highlights the use of **patterns** in Boti woven fabrics, where geometric shapes like triangles and rectangles are repeated and transformed through reflection, translation, rotation, and dilation, creating intricate and meaningful designs.
Ditasona, Turmudi, & Rosjanuardi (2021)	The study highlights the use of **mathematical modeling** in algebra through the application of arithmetic sequences by Gorga carvers. These sequences help determine the placement and repetition of motifs on wooden boards, linking traditional carving practices to algebraic concepts.

Distribution of Research Locations

Research on traditional buildings was first published in 2017, focusing on the ethnomathematics of traditional Balinese architecture. Since then, similar studies on historical buildings in various other regions have started to emerge. The regions that have been explored for their historical buildings can be seen in **Figure 3**.

Figure 3. Explored location of historic building

As observed in **Figure 3**, the explored historical buildings are predominantly located on the islands of Java and Sumatra. This concentration is attributed to Java and Sumatra being centers of culture and history (Fisher, 1970), resulting in many historical buildings in these regions possessing significant cultural and architectural value. In addition, as the two most densely populated islands in Indonesia (Badan Pusat Statistik, 2024), Java and Sumatra benefit from better infrastructure support. (PwC Indonesia, 2024). Furthermore, the abundance of educational and research institutions on these islands has led to more extensive exploration of historical buildings.

Distribution of Identified Building Types

A summary of the findings related to the types of buildings identified can be found in **Figure 4**.

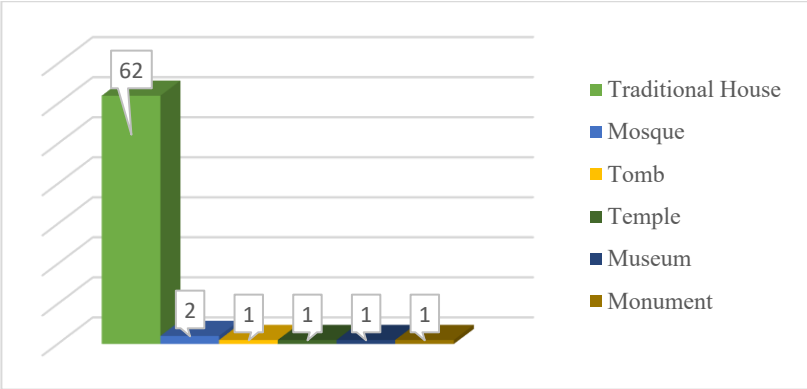

Figure 4. Distribution of building types

Out of the 64 articles reviewed, 62 buildings studied were traditional houses from various regions of Indonesia (see **Figure 4**). These articles explore the application of mathematical concepts such as measurement, geometry, and algebra. Findings regarding measurement content standards, particularly for the concepts of length and distance, area and perimeter, as well as volume and surface area, were obtained from research on Sundanese traditional houses (Suciawati, Jatisunda, & Kania, 2021).

Some studies reveal that geometry is an essential element in the design of traditional houses. For example, research on the architecture of Sasak traditional residence identifies concepts such as square, rectangle, triangle, trapezoid, pyramid, reflection, translation, rotation, and dilation (Fauzi *et al*., 2022). Another finding highlights the concept of parallelogram in Sundanese traditional houses (Imswatama & Zultiar, 2020). Meanwhile, the concepts of circle, rhombus, and cube were identified from the study of the Sonaf Maubes-Insana traditional house (Tas'au, Son, & Maifa, 2023). Additionally, research on the Tafatik Maromak Oan traditional house in Malaka revealed the presence of the concept of cylinder (Tahu, Son, & Deda, 2023).

Several studies indicate that algebra content standards are found in traditional houses, such as the concept of function in Buton traditional houses (Kadir *et al*., 2021) and the concepts of pattern and mathematical modeling in the Gorga carvings of Batak traditional houses (Ditasona et al., 2021).

From the two mosques identified, the mathematical concepts found include geometric concepts (square, rectangle, trapezoid, triangle, cube, reflection, translation, rotation, and dilation) and measurement concepts (area and perimeter) in relation to the Kudus Mosque (Zaenuri, Cahyono, & Dwidayanti, 2019). Meanwhile, in the Raudhatus Sa'adah Mosque, the concepts of volume and surface area were found for the measurement section, the concept of pyramid for the geometry section, and the concept of pattern for algebra (Friansah & Yanto, 2020).

There is only one article that discusses each of the following: tombs, temples,

museums, and monuments. Findings related to the concepts of hexagon and isosceles triangle were obtained from the Ka Jogel sacred tomb (Friansah & Yanto, 2020). Meanwhile, findings related to geometric concepts such as circle, square, reflection, rotation, translation, and dilation were obtained from Borobudur Temple (Zaenuri, Dwidayati, & Suyitno, 2018). The findings at the Silahisabungan Monument include the concepts of rectangle, isosceles trapezoid, and triangle (Astuti & Rakhmawati, 2024). As for the State Museum of North Sumatra, the geometric concepts discovered were triangle, trapezoid, rhombus, octagon, translation, reflection, rotation, and dilation (Sagala & Hasanah, 2023).

CONCLUSION

This review demonstrates the significant role of ethnomathematics in understanding how mathematical concepts such as geometry, measurement, and algebra are integrated into the traditional architecture. The research, heavily concentrated on Java and Sumatra Island in Indonesia, highlights the cultural importance and infrastructural advantages of these regions. However, the lack of studies focusing on other Indonesian islands suggests a research gap that needs to be addressed to provide a more comprehensive view of Indonesia's architectural heritage. Moving forward, expanding the scope of research beyond Java and Sumatra and further exploring the application of ethnomathematics in educational contexts are crucial to fully appreciate the rich mathematical traditions embedded in Indonesia’s diverse cultures.

This study found that most of the research focuses on traditional houses as the main object, while a few studies explore buildings such as mosques, tombs, temples, museums, and monuments. Ethnographic methods dominate the research design, enabling researchers to explore how mathematical concepts are applied in the design and construction of these historical buildings. In particular, geometry emerged as the most frequently observed content standard, with shapes like triangles, squares, and trapezoids being commonly found in traditional architecture. Additionally, the study shows that measurement concepts, including length, area, and volume, are prevalent in the design of Indonesian traditional houses, reflecting the intersection between cultural elements and mathematical principles. The review also reveals a gap in the literature concerning theoretical, sociological, and policy studies in ethnomathematics. While field research and classroom applications are well-represented, there is a lack of studies that examine how ethnomathematics can be formally integrated into educational policies or applied across cultural contexts.

One significant limitation of this study is the geographical focus on research from Indonesia. While the findings offer valuable insights into the integration of mathematics in traditional architecture, the limited geographic scope may reduce the generalizability of these results to other cultural contexts. Although the mathematical concepts identified—such as geometric shapes and measurement principles—are universally applicable, further research across different regions is necessary to expand the cultural scope. Additionally, the review primarily relied on secondary sources from existing literature, meaning that the study did not engage in empirical data collection or fieldwork, which could provide more concrete evidence to substantiate the findings. Expanding future research to include primary data collection and broader geographic regions will enhance the comprehensiveness of ethnomathematics research.

ACKNOWLEDGEMENTS

The authors would like to express gratitude to the Indonesia Endowment Fund for Education (LPDP) for funding this research.

REFERENCES

Amit, M., & Quoder, F. A. (2017). Weaving culture and mathematics in the classroom: The case of bedouin ethnomathematics. In M. Rosa, L. Shirley, M. E. Gavarrete, & W. V Alangui (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education*. http://www.springer.com/series/15585

Astuti, S., & Rakhmawati, F. (2024). Explored ethnomathematics on *Silahisabungan* monument. *Unnes Journal of Mathematics Education*, *13*(1), 46–54. https://doi.org/10.15294/11xwmq74

Badan Pusat Statistik. (2024). *Jumlah penduduk menurut provinsi (ribu jiwa), 2023-2024*. [Central Statistics Agency. (2024). Population by province (thousands of people), 2023-2024]. https://sumsel.bps.go.id/id/statistics-table/2/NTczIzI=/jumlah-penduduk-menurut-provinsi.html

Borba, M. C. (1990). Ethnomathematics and education. *For the Learning of Mathematics*, *10*(1), 39–43. https://www.jstor.org/stable/40247974

Budiarto, M. T., Artiono, R., & Setianingsih, R. (2019). Ethnomathematics: Formal mathematics milestones for primary education. *Journal of Physics: Conference Series*, *1387*(1), 1–6. https://doi.org/10.1088/1742-6596/1387/1/012139

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (5th ed.). Pearson Education, Inc. https://thuvienso.hoasen.edu.vn/handle/123456789/12789

D'ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, *5*(1), 44–48. https://www.jstor.org/stable/40247876

Darmayasa, J. B., Wahyudin, W., & Mulyana, T. (2018). Ethnomathematics: The use of multiple linier regression y = b1X1 + b2X2 + e in traditional house construction *Saka Roras* in Songan Village. *Journal of Physics: Conference Series*, *948*(1), 1–5. https://doi.org/10.1088/1742-6596/948/1/012076

Ditasona, C. (2018). Ethnomathematics exploration of the Toba community: Elements of geometry transformation contained in Gorga (ornament on Bataks house). *IOP Conference Series: Materials Science and Engineering*, *335*(1), 1–6. https://doi.org/10.1088/1757-899X/335/1/012042

Ditasona, C., Turmudi, T., & Rosjanuardi, R. (2021). Arithmetic sequence at Gorga. *Advances in Social Science, Education and Humanities Research*, *560*, 172–175. https://doi.org/https://doi.org/10.2991/assehr.k.210615.034

Dosinaeng, W. B. N., Lakapu, M., & Leton, S. I. (2020). Ethnomathematics in *Boti* Tribe culture and its integration. *Journal of Physics: Conference Series*, *1657*(1), 1–7. https://doi.org/10.1088/1742-6596/1657/1/012021

Dwidayati, N., & Zaenuri, Z. (2021). Ethnomathematics exploration in the remote areas. *Journal of Physics: Conference Series*, *1918*(4). https://doi.org/10.1088/1742-6596/1918/4/042117

Fauzi, L. M., Gazali, M., & Fauzi, A. (2021). Ethnomathematics: A mathematical exploration on the Layout of *Tui Gubuk* and the architecture of *Segenter* traditional house. *Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah Di Bidang Pendidikan Matematika*, *7*(2), 135–148. https://doi.org/10.29407/jmen.v7i2.16519

Fauzi, L. M., Hanum, F., Jailani, J., & Jatmiko, J. (2022). Ethnomathematics: Mathematical ideas and educational values on the architecture of Sasak Traditional Residence. *International Journal of Evaluation and Research in Education*, *11*(1), 250–259. https://doi.org/10.11591/ijere.v11i1.21775

Fisher, C. A. (1970). The history of Sumatra. By William Marsden. A reprint of the third edition introduced by John Bastin. Oxford in Asia Historical Reprints, Oxford University Press: Kuala Lumpur, 1966. Pp. x + viii + 479, map, plates, £10 8s. The Policy and Administration of the Dutch in Java. By Clive Day, with an Introduction by John Bastin. Oxford in Asia Historical Reprints, Oxford University Press: Kuala Lumpur, 1966. Pp. xxi + 434, 52s. *Modern Asian Studies*, *4*(4), 371–373. https://doi.org/10.1017/S0026749X00012051

Fitriza, R., Turmudi, T., Juandi, D., & Harisman, Y. (2019). Traditional measurement units: A study on the construction of Rumah Gadang of Minangkabau. *Journal of Physics: Conference Series*, *1157*(4), 1–6. https://doi.org/10.1088/1742-6596/1157/4/042123

Friansah, D., & Yanto, Y. (2020). The exploration of ethnomathematics in the cultural heritage of *Musi Rawas* regency through ethnographic studies. *Journal of Physics: Conference Series*, *1521*(3), 1–6. https://doi.org/10.1088/1742-6596/1521/3/032101

Hariastuti, R. M., Budiarto, M. T., & Manuharawati, M. (2021). *Gedhek*, when culture teaches mathematical concepts. *Advance in Social Science, Education and Humanities Research*, *550*, 150–156. https://doi.org/https://doi.org/10.2991/assehr.k.210508.057

Heriani, B. M. R., Nurhasanah, N., Rahmawati, R., Adlani, L. A., Taufiqurrahman, A., & Salsabila, N. H. (2023). Exploring the utilization of mathematical concepts in the traditional house of Desa Beleq Sembalun. *Mandalika Mathematics and Education Journal*, *5*(2), 266–275. https://doi.org/10.29303/jm.v5i2.6097

Hidayat, E., Ratnaningsih, N., Sunendar, A., & Siregar, J. S. (2020). Ethnomathematics: Disclosing mathematical concept in Batak Toba traditional house. *Journal of Physics: Conference Series*, *1657*(1), 1–7. https://doi.org/10.1088/1742-6596/1657/1/012053

Imswatama, A., & Zultiar, I. (2020). Traditional house architecture in geopark Ciletuh Sukabumi as mathematical learning materials in basic education. https://doi.org/10.4108/eai.28-9-2019.2290991

Kadir, Jafar, Samparadja, H., Arvyaty, Sarniasih, N. K., & Nurtilawah. (2021). Differences in ethnomathematical characteristics between *Buton* traditional houses. *Journal of Physics: Conference Series*, *2123*(1). https://doi.org/10.1088/1742-6596/2123/1/012026

Kurino, Y. D., & Akbar, A. (2022). Ethnomathematical exploration at home *Panjalin* custom in Majalengka. *Proceeding The 4th International Conference on Elementary Education*, *4*(1), 913–919. http://proceedings.upi.edu/index.php/icee/article/view/2071

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of Clinical Epidemiology*, *62*(10), e1–e34. https://doi.org/10.1016/j.jclinepi.2009.06.006

Liesandra, S. O. (2022). A cultural semiotics study: Ethnomathematical exploration in geometry materials through cultural site in Aceh. *Jurnal Cakrawala Pendas*, *8*(3), 688–697. https://doi.org/10.31949/jcp.v8i2.2537

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. In *BMJ (Online)*, 339(7716). https://doi.org/10.1136/bmj.b2535

Moriolkosu, A. D., Handayani, S. S. D., & Sunarso, A. (2020). Ethnomathematics and ethnoscience analysis of *Aru* culture related to mathematics and science concepts at elementary school. *Educational Management*, *9*(2), 163–171. https://journal.unnes.ac.id/sju/eduman/article/view/39504

Munthahana, J., & Budiarto, M. T. (2020). Ethnomathematics exploration in *Panataran* Temple and it's implementation in learning. *Indonesian Journal of Science and Mathematics Education*, *3*(2), 196–209. https://doi.org/10.24042/ijsme.v3i2.6718

Muwaffiq, M. N., & Suparni, S. S. (2022). The use of miniature *Joglo* houses in learning to understand plane and solid figure. *Al-Khwarizmi: Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, *10*(1), 23–34. https://doi.org/10.24256/jpmipa.v10i1.1953

Na'im, A., & Syaputra, H. (2011). *Kewarganegaraan, suku bangsa, agama, dan bahasa sehari-hari penduduk Indonesia: Hasil sensus penduduk 2010*. [Citizenship, ethnicity, religion, and daily language of the Indonesian population: Results of the 2010 population census]. https://www.bps.go.id/id/publication/2012/05/23/55eca38b7fe0830834605b35/kewarganegaraan-suku-bangsa-agama-dan-bahasa-sehari-hari-penduduk-indonesia

National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. The National Council of Teachers of Mathematics. https://www.nctm.org/Standards-and-Positions/Principles-and-Standards/

Owens, K. (2023). Proceedings of ICEm-7 international conference on ethnomathematics 7. Ethnomathematics: Embracing Diverse Knowledge Systems for Social Justice and Peace, 1–331. https://www.researchgate.net/publication/378902702_Proceedings_of_the_7th_International_Conference_on_Ethnomathematics_-_ICEm7_2022_online

Pahmi, S., Hendriyanto, A., Sahara, S., Muhaimin, L. H., Kuncoro, K. S., & Usodo, B. (2023). Assessing the influence of augmented reality in mathematics education: A systematic literature review. *International Journal of Learning, Teaching and Educational Research*, *22*(5), 1–25. https://doi.org/10.26803/ijlter.22.5.1

Permata, J. I., Budiarto, M. T., & Ekawati, R. (2021). Ethnomathematics: Geometry and values from architecture of the *Radakng* house in Sahapm Village. *Advance in Social Science, Education and Humanities Research*, *611*, 495–499.

Pusdatin. (2024). *Data referensi jumlah cagar budaya dan museum*. [Reference data on the number of cultural heritage and museums]. https://referensi.data.kemdikbud.go.id/kebudayaan/cagarbudaya

PwC Indonesia. (2024). *PwC Indonesia Economic Update: First Quarter of 2024*. https://www.pwc.com/id/en/publications/general/indonesia-economic-update-2024-q1.pdf

Rachmawati, D., Sahid, S., Mahmud, M. I., & Buang, N. A. (2024). Enhancing student career readiness: a two-decade systematic literature review. *International Journal of Evaluation and Research in Education*, *13*(3), 1301–1310. https://doi.org/10.11591/ijere.v13i3.26485

Rangkuti, A., & Siregar, M. A. P. (2023). Design of mandailing Natal traditional houses as a learning resource. *Journal Of Medives : Journal Of Mathematics Education IKIP Veteran Semarang*, *7*(2), 298–309. https://doi.org/10.31331/medivesveteran.v7i2.2639

Riadi, A., Turmudi, & Juandi, D. (2023). Palimbangan: Ethnomathematics of the Banjar traditional house in South Borneo with religious contents. *AIP Conference Proceedings*, *2733*(1). https://doi.org/10.1063/5.0140153

Rosa, M., & Orey, D. C. (2016). State of the art in ethnomathematics. In M. Rosa, U. D'Ambrosio, D. C. Orey, L. Shirley, W. V. Alangui, P. Palhares, & M. E. Gavarrete (Eds.), *Current and Future Perspectives of Ethnomathematics as a Program*, 11–37. https://doi.org/10.1007/978-3-319-30120-4

Sagala, S. A., & Hasanah, R. U. (2023). Ethnomathematics exploration at the state museum of North Sumatra. *Mathline : Jurnal Matematika Dan Pendidikan Matematika*, *8*(1), 123–136. https://doi.org/10.31943/mathline.v8i1.364

Shirley, L., & Palhares, P. (2016). Ethnomathematics and its diverse pedagogical approaches. In M. Rosa, U. D'Ambrosio, D. C. Orey, L. Shirley, W. V. Alangui, P. Palhares, & M. E. Gavarrete (Eds.), *Current and Future Perspective of Ethnomathematics as a Program* (pp. 13–17). Springer. https://link.springer.com/book/10.1007/978-3-319-30120-4

Suciawati, V., Jatisunda, M. G., & Kania, N. (2021). How a traditional homemaker predicts: An ethnographic study. *Malikussaleh Journal of Mathematics Learning (MJML)*, *4*(1), 41. https://doi.org/10.29103/mjml.v4i1.2973

Suharta, I. G. P., Sudiarta, I. G. P., & Astawa, I. W. P. (2017). Ethnomathematics of Balinese Traditional Houses. *International Research Journal of Engineering, IT & Scientific Research*, *3*(4), 42. https://doi.org/10.21744/irjeis.v3i4.501

Susanti, E., Kurniawan, H., Widodo, S. A., & Perbowo, K. S. (2023). Ethnomathematics: Concept of geometry and cultural wisdom in the construction of The Minangkabau Gadang House. *Mathline: Jurnal Matematika Dan Pendidikan Matematika*, *8*(4), 1259–1270. https://doi.org/10.31943/mathline.v8i4.474

Tahu, O. M., Son, A. L., & Deda, Y. N. (2023). Exploration of geometry concepts in the *Tafatik Maromak Oan Malaka* traditional house. *Brillo Journal*, *2*(2), 80–93. https://doi.org/10.56773/bj.v2i2.33

Tas'au, M. F., Son, A. L., & Maifa, T. S. (2023). Exploration of ethnomathematics in the traditional house of *Sonaf Maubes-Insana*. *Indonesian Educational Research Journal*, *1*(1), 1–9. https://doi.org/https://doi.org/10.56773/ierj.v1i1.11

Tlonaen, M. A., & Deda, Y. N. (2021). Exploration ethnomathematics on traditional house *Ume Kbubu* in North Central Timor Districts. *Journal of Physics: Conference Series*, *1776*(1), 1–6. https://doi.org/10.1088/1742-6596/1776/1/012016

Wentzel, K. (2024). Student well-being: In search of definitions, measures, and research designs. *Learning and Instruction*, *94*. https://doi.org/10.1016/j.learninstruc.2024.101990

Yusri, R., Yusof, A. M., & Sharina, A. (2024). A systematic literature review of project-based learning: Research trends, methods, elements, and frameworks. *International Journal of Evaluation and Research in Education*, *13*(5), 3345–3359. https://doi.org/10.11591/ijere.v13i5.27875

Zaenuri, Cahyono, A. N., & Dwidayanti, N. (2019). Exploration on ethnomathematics phenomena in Kudus regency and its optimization in the mathematics learning. *Journal of Physics: Conference Series*, *1387*(1), 1–6. https://doi.org/10.1088/1742-6596/1387/1/012137

Zaenuri, Z., Dwidayati, N., & Suyitno, A. (2018). Ethnomathematics role as an encouragement of the growth of student's nationalism. *UNNES International Conference on Research Innovation and Commercialization*, 759–774. https://doi.org/10.18502/kss.v3i18.4766