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EXPLORING THE ETHNOMATHEMATICS OF JAVANESE TRADITIONAL HOUSES

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Abstract: The continuous exploration of the role of mathematics underscores the significance of ethnomathematics research. Ethnomathematics investigates mathematical concepts embedded within diverse cultures. Among the rich array of ethnomathematical objects, Javanese traditional houses stand out as a promising area for investigation. These houses, deeply rooted in a rich cultural heritage, offer substantial potential for understanding and the concrete application of mathematical principles. This study, employing a systematic literature review, aimed to explore the various mathematical concepts inherent in Javanese traditional houses. Data were systematically collected from Google Schoolar (2019-2023), with a specific focus on articles discussing ethnomathematics in traditional houses. The findings reveal the pervasive presence of ethnomathematics within the architecture of Javanese traditional houses, encompassing mathematical concepts such as plane and solid geometry, liners, and geometric transformations (translation, reflection, rotation, dilation) as well as similarity and congruence.

Keywords: ethnomathematics, Javanese traditional house, systematic literature review

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INTRODUCTION

The prevailing perception among students is that mathematics is a challenging subject (Putra *et al.*, 2021), often stemming from difficulties in connecting abstract mathematical concepts (Kristiyani & Ernaningsih, 2024). This is often attributed to the fact that conventional school mathematics instruction tends to be overly formal and lacks relevance to students' daily experiences (Turmuzi, Sudiarta, & Suharta, 2022). To address this challenge, an innovative learning approach relevant to students' daily lives is

essential. In this context, ethnomathematics emerges as a particularly compelling and relevant approach.

Ethnomathematics is defined as mathematics intrinsically associated with the culture that exists and develops in society (Budiarto *et al.*, 2022). D'Ambrosio, for instance, posits that the goal of ethnomathematics is to identify diverse ways of engaging with mathematics by examining academic mathematics developed across various societal levels and stages, wherein different cultures negotiate their mathematical practices-such as how they classify, court, measure, and design buildings or play equipment (Sari & Fahmy, 2022). Consequently, ethnomathematics can serve as a didactic phenomenon in the learning process, facilitating deeper mathematical understanding among students (Febrian, Astuti, & Susanti, 2022).

Indonesia is a nation characterized by immense cultural diversity, encompassing numerous tribes with distinct cultural practices across its vast archipelago. This culture is closely related to human civilisation, and both are related to each other, so it is not surprising that each tribe has different characteristics, behaviours and values (Sari, 2023). Traditional houses are part of Indonesian culture. A traditional house is a typical building that is only owned by a certain region, usually used as a residence or used for traditional ceremonies. Previous research, such as that conducted by Sekarpandan, Wardani, & Setyani (2022) on Baduy traditional houses show that the architecture contains mathematical elements, including the concepts of flat shapes, spatial shapes, translations, and rotations. Similarly, Safitri (2023) shows that the concept of mathematical geometry contained in the Joglo traditional house in Dasri village includes flat triangles, trapezoids, squares, rectangles, circles, block spaces, congruence, and reflection. Given that prior ethnomathematics research on traditional houses has consistently identified diverse mathematical concepts, this study is motivated to conduct more in-depth literature investigations into ethnomathematics within traditional houses, particularly those found in Java.

The purpose of this research is to analyse the literature related to the application of ethnomathematics in the context of Javanese traditional houses. The findings of this study are anticipated to provide guidance for teachers and mathematics education researchers, enabling them to develop textbooks and utilise local culture, especially Javanese traditional houses, as valuable resources for mathematics learning in schools. Ultimately, this approach is expected to increase both the attractiveness and relevance of learning mathematics for students.

METHOD

The study employed a Systematic Literature Review (SRL). Through this method, researchers identify, review, and evaluate all relevant research findings to answer the research questions set (Triandini *et al.*, 2019). This research consists of several steps, namely formulating research questions, searching for literature, determining inclusion and exclusion criteria, selecting literature, presenting data, processing data, and drawing conclusions (Wahyudi & Putra, 2022).

First, the research questions guiding this study were: (PP1) Do Javanese traditional houses apply mathematical concepts? and (PP2) what mathematical concepts are applied in Javanese traditional houses? Second, literature searches were conducted using the keywords "ethnomathematics" and "traditional houses" on Google Scholar. Only articles published between 2019 and 2023 were collected. This timeframe ensured the literature's recency and relevance to the research topic, while also streamlining the analysis process by limiting the number of articles for review. Third, the inclusion criteria for the literature search encompassed studies on mathematical concepts identified in Javanese traditional houses, and specifically, those published in national journals. Fourth, the retrieved literature was selected and analyzed based on the inclusion and exclusion criteria. From the initial pool, 14 articles most relevant to the specified keyword were chosen by the researchers. Fifth, researchers recorded and summarized key data from each selected article in a table, including the author's name, year of publication, journal name, and the main research results. Sixth, the collected data was analyzed. Finally to conclude the study, the findings from several articles were compared, and conclusions were drawn.

RESULTS AND DISCUSSION

The research data included in this literature review is an analysis and summary of articles on ethnomathematics in traditional houses, and the articles are listed in the Table 1.

Table 1. Research Results

No.	Researcher		Journal	Research Results
1.	Kurino	&	Jurnal	The architecture of the Panjalin traditional
	Rahman	R.	Cakrawala	house from West Java Province show
	(2022)		Pendas	geometric concepts: (1) the roof is trapezoid, supports are beam-shaped, (2) the ceiling has square elements, (3) the walls are rectangular, and (4) the supporting part of the Panjalin traditional house in the form of a beam. These geometric concepts can serve as

No.	Researcher	Journal	Research Results
			an alternative sources for ethnomathematics- based geometry learning.
2.	Nurhasanah	Jurnal	The Kampung Pulo traditional house from
	& Puspitasari	Pendidikan	West Java Province incorporates geometric
	(2022)	Matematika	concepts in its roof shape, room layout, wall
			motifs, foundation, and pillars, including
			spatial figures, plane shapes, angles, and
			lines. The highlights the need for culture-
			based mathematics learning to enhance
			conceptual understanding and foster cultural
2	Liounati	DDICMA	appreciation.
3.	Liaupati,	PRISMA, Prosiding	Research results on the Kranggan Stage traditional house from West Java Province
	Soverenty, & Kusuma	Seminar	show that the parts of the Kranggan Stage
	(2022)	Nasional	traditional house described in this study
	(2022)	Matematika	include the roof of the house, the radius of the
			window, the stage frame, and the carvings on
			the windows and doors. The mathematical
			concepts and principles found are triangular
			prism, beam, trapezoid, three-dimensional
			cartesian coordinates, plane in the third
			dimension, distance of two parallel lines, set,
4.	Wulandari,	Jurnal	and reflection on geometry transformation.
4.	Kusumah, &	Surnai Cendekia:	Research on Kasepuhan Palace in West Java Province shows that the philosophical values
	Priatna Priatna	Jurnal	are contained in the roof of the entrance,
	(2022)	Pendidikan	where the iconic Mega Mendung pattern is
	,	Matematika	featured. The Mega Mendung pattern
			incorporated color gradations on its cloud
			layers and features odd numbers of layers (5,
			7, and 9), symbolizing, respectively, the five
			pillars of Islam, the seven layers of the sky,
			and the nine layers of Sunan Wali Songo.
			Additionally, a mathematical concept is identified in the geometric reflection present
			on the arch of the Palace's entrance. This
			particular study suggests that local culture
			can be incorporated into school learning
			through ethnomathematics, facilitating
			students' application of material in daily life
_		A D YEST 2	and their local environment.
5.	Imswatama &	ARITHMETIC	The results of the traditional house in
	Zultiar (2019)	: Academic	Sukabumi research from West Java Province
		Journal of Math	show that in the architecture there are mathematical elements including geometry
		1 v1 at11	consisting of rectangles, squares, and lengths.
6.	Nurkhafifah,	Jurnal Ilmiah	The Joglo Semar Tinandhu traditional house
* -	Pailokol, &	Mahasiswa	in Central Java Province contains several
	Megawanti	Pendidikan	geometric concepts, including: (1) flat shapes
	(2021)	Matematika	such as squares, rectangles, triangles,
			trapezoids, and rhombuses; (2) spatial

No.	Researcher	Journal	Research Results
			shapes, including cubes, cuboids, pyramids,
			and prisms; and (3) the concept of congruence, as well as geometric
			transformations.
7.	Mahiro	Journal of	The Joglo traditional house Research in
	(2021)	Educational	Sumurpule Village, Pati regency from
		Integration and Development	Central Java Province show that there is ethnomathematics in the form of basic
		Beverepment	concepts of geometry which are flat planes in
			the form of squares, triangles, rectangles,
			trapezoids and building spaces in the form of blocks and tubes. The concept of geometric
			transformation which consists of translation
			(shift), reflection (mirror), rotation (rotation),
Ō	Ditalala 0-	DDICMA	dilation and the concept of congruence.
8.	Pitaloka & Susanti	PRISMA, Prosiding	The research on Joglo Tumiyono traditional house from Central Java Province show that
	(2022)	Seminar	the structure and ornamentation of Joglo
		Nasional	Tumiyono have mathematical aspects. The
		Matematika	mathematical aspects contained in the structure and ornaments of Joglo Tumiyono
			traditional house are the concept of flat
			shapes such as trapezoids, triangles, squares,
			rectangles, and circles, spatial shapes, namely, blocks, the concept of geometry
			transformation, namely mirroring (reflection)
			and shifting (translation), pythagoras,
0	Culiatroni at	Madia	parallel lines, and angles.
9.	Sulistyani <i>et al.</i> (2019)	Niedia Pendidikan	The results of the research on the Joglo Tulungagung traditional house from East
		Matematika	Java Province show that building elements
			such as poles, doors, and roofs of the Joglo
			Tulungagung traditional house contain geometric concepts that can be implemented
			as a mathematics learning media in the
			material: two-dimensional figure, geometry,
			congruence, pythagoras, geometry transformation (translation, reflection,
			dilation).
10.	Safitri (2023)	SIGMA: Jurnal	The results of the Joglo traditional house
		Pendidikan	Research in Dasri Village, Banyuwangi
		Matematika	Regency from East Java Province show that the geometric mathematical concepts
			contained in the Joglo traditional house in
			Dasri Village include triangles, trapezoids,
			squares, rectangles, circles, rectangular shapes, congruence, and reflection.
11.	Daeli, Gulo,	PRISMA,	The results of study on the Pagelaran Ward of
	& Redianto	Prosiding	the Yogyakarta Palace in the Special Region
	(2022)	Seminar	of Yogyakarta Province show that its
			architectural elements are related to

No.	Researcher	Journal	Research Results
		Nasional Matematika	geometry, including: (1) the roof of Pagelaran Ward contains flat shapes of
		111000000000000000000000000000000000000	trapezoids, triangles, rectangles and spaces in
			the form of pyramids, blocks, and the concept
			of congruence, and (2) the pillars of Pagelaran Ward, including the pillars
			supporting the roof, resemble the shape of a
			tube and contain the concept of alignment.
			The results of this study are expected to be used as a contextual approach in learning
			mathematics.
12.	Manduapessy (2022)	PRISMA, Prosiding	The results of Lengkong traditional house from the Special Region of Yogyakarta
	(2022)	Seminar	Province show that the architectural
		Nasional	meaning; fundamental aspects of
		Matematika	mathematics in ethnomathematics reflected in the Lengkong traditional house include
			measuring activities, placing activities, and
			designing activities; parts of the traditional
			house; and geometry concepts in the design of the Lengkong traditional house, namely
			the concept of flat shapes, the concept of
			space, and the concept of lines. The concept
			of flat shape, the concept of space, the concept of space, and the concept of line.
13.	Sekarpandan	PRISMA,	The results of the Baduy traditional house
	at al. (2022)	Prosiding Seminar	research from Banten Province show that it contains elements of mathematics including
		Nasional	the concepts of flat building, space building,
	27	Matematika	translation, and rotation.
14.	Nisa, Rusmana, &	Diskusi Panel Nasional	Research on the Betawi Kebaya House in Jakarta Special Capital Region reveals that 1)
	Ahmad	Pendidikan	the ethnomathematical study conducted at the
	(2022)	Matematika	Kebaya Betawi House in Setu Babakan
			Betawi Cultural Village identified counting activities, measuring activities, location
			determination activities, designing activities,
			playing activities, and explaining activities. 2) The mathematical concepts identified in
			this house include integers, ratios, angles,
			one-dimensional geometry (e.g., horizontal
			and parallel lines), two-dimensional geometry (e.g., trapezoids, squares,
			rectangles, triangles, circles, and rhombuses),
			three-dimensional geometry (e.g., cubes,
			cuboids, and triangular prisms), geometric transformations (translation, reflection,
			rotation, and dilation), and congruence and
			similarity of plane figures.

Table 1 summarizes findings from 14 reviewed articles concerning traditional houses across various provinces on the island of Java, including West Java, Central Java, East Java, Special Region of Yogyakarta, Banten and Special Capital Region of Jakarta. It can be seen that traditional houses spread across Java contain mathematical concepts and principles (Liaupati *et al.*, 2022). In addition, the mathematical concepts found in Javanese traditional houses are also the basis for developing mathematics learning media (Sulistyani *et al.*, 2019). And also as an alternative source of learning mathematics, especially ethnomathematics-based geometry material (Kurino & Rahman, 2022).

Some mathematical concepts found in Javanese traditional houses, such as the concept of flat buildings, the concept of space and the concept of lines (Manduapessy, 2022). In addition, there is also the concept of geometric transformation consisting of translation (shift), reflection (mirroring), rotation (rotation), dilation and the concept of symmetry (Mahiro, 2021). The subsequent sections further discuss these mathematical concepts within the architecture of Javanese traditional houses, exemplified by the figures below.

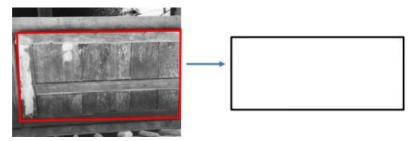


Figure 1. The wall of the Panjalin traditional house

Source: Kurino & Rahman/Jurnal Cakrawala Pendas

Figure 1. The walls of the Panjalin traditional house show a rectangular flat shape

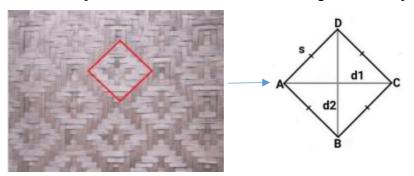


Figure 2. Baduy traditional house wall weaving Source: Andi Harapan/Jurnal Koridor

Figure 2. In the Baduy traditional house, there is a woven wall. The woven wall forms a rhombus and also a rotation.

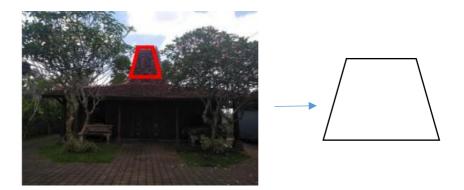


Figure 3. The roof of the Joglo traditional house in Dasri village

Source: Auliana Wahyu Safitri/SIGMA

Figure 3. The roof of the Joglo traditional house in Dasri village shows a Trapezoidal flat shape.

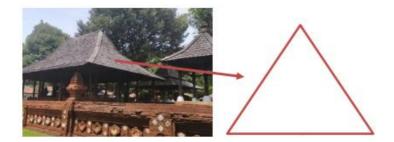


Figure 4. The roof of the Kasepuhan Palace, Cirebon

Source: Wulandari et al./Jurnal Cendekia

Figure 4. The roof of the Kasepuhan Palace, Cirebon is shaped like a triangle.

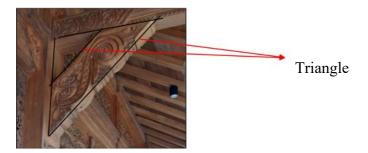


Figure 5. The supporting pillars of Joglo Tumiyono traditional house

Source: May Susanti/PRISMA

Figure 5. In the traditional Joglo Tumiyono house there is a triangular support pole.

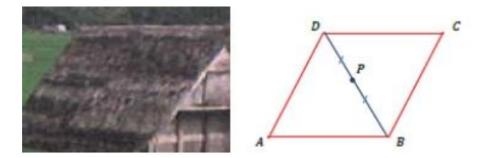


Figure 6. The roof of traditional house in Sukabumi Source: Aritsya Imswatama & Indra Zultiar/Arithmetic

Figure 6. The roof of the traditional house in Sukabumi is parallelgram.

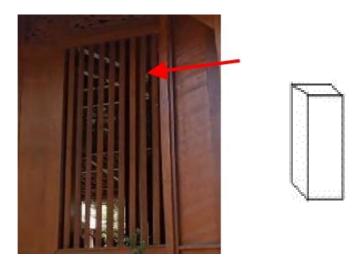


Figure 7. The front window of the Joglo Semar Tinandhu traditional house Source: Nurkhafifah et al./Himpunan

Figure 7. The front window of the Joglo Semar Tinandhu traditional house is a block space.

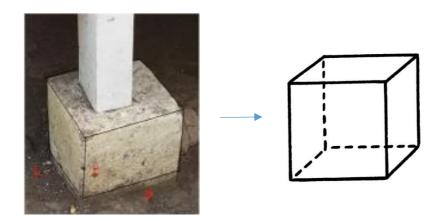


Figure 8. The foundation of Kampung Pulo traditional house Source: Nurhasanah & Puspitasari/Plusminus

Figure 8. The foundation in the Kampung Pulo traditional house is in the form of a cube.

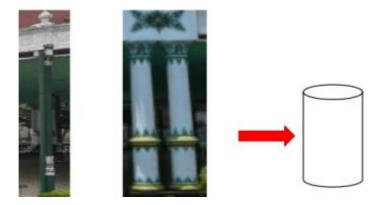


Figure 9. The columns of the Yogyakarta Palace Pagelaran Ward

Source: Daeli et al./PRISMA

Figure 9. Overall, the shape of the columns in the performance ward resembles a tube shape.



Figure 10. Lengkong traditional house

Source: Yuningih et al./Jurnal Riset Pendidikan Matematika Jakarta

Figure 10. Shows that there is a concept of lines, one of which is the horizontal line in the Lengkong traditional house.



Figure 11. The main pillar of the Joglo traditional house in Sumurpule Village,
Pati

Source: Marfu'atul Mahiro/JEID

Figure 11. The main pillar of the Joglo traditional house in Sumurpule Village, Pati shows the concept of translation.





Figure 12. Window carving of Kranggan Stage traditional house Source: Liaupati et al./PRISMA

s on the windows of the Kronggon Stage h

Figure 12. The carvings on the windows of the Kranggan Stage house show the concept of reflection.

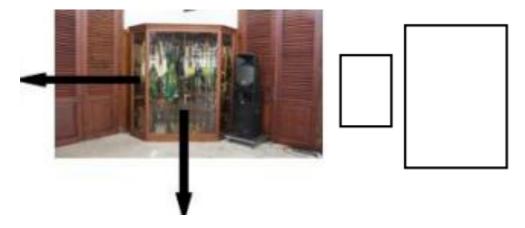


Figure 13. Glass cabinet of Joglo Tulungagung traditional house Source: Sulistyani at al./Media Pendidikan Matematika

Figure 13. The large glass cabinet in the Joglo Tulungagung traditional house demonstrates the concepts of dilation and similarity.

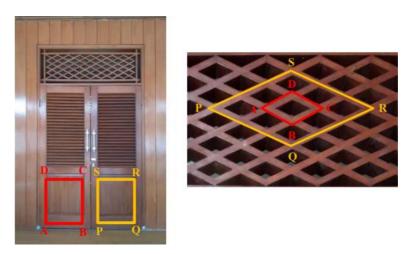


Figure 14. Kebaya Betawi traditional house ornament Source: Nisa at al./Prosiding Diskusi Panel Nasional Pendidikan Matematika

Figure 14. The door and diamond box ornaments of the Kebaya Betawi traditional house exemplify the concept of congruence.

Overall, the findings affirm that Javanese traditional houses indeed embody a rich array of mathematical concepts. These include fundamental concepts such as plane shapes, spatial shapes, and lines, as well as geometric transformations like translation, reflection, rotation, and dilation, along with similarity and congruence. By integrating cultural elements like traditional houses into mathematics education, abstract mathematical concepts become more concrete and accessible to students. This approach enhances learning interest and makes the educational experience more meaningful and relevant to their daily lives.

CONCLUSION

Ethnomathematics in Javanese traditional houses where mathematical concepts such as flat building, space building, line, translation, reflection, rotation, dilation, similarity and congruence are found. This proves that culture and mathematics are very close. Culture can be a rich source of inspiration for teaching mathematical concepts, while mathematics provides tools to understand and analyse various aspects of culture. Therefore, it is recommended that this approach be used more in learning mathematics, as it can make learning more interesting and meaningful for students.

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