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The geometric concepts of the *Istana Dalam Loka* traditional house: An ethnomathematics study

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Abstract

This study explores the philosophical aspects of traditional architecture and ethnomathematics geometry in the *Istana Dalam Loka* traditional house, located in West Nusa Tenggara. Employing a qualitative approach with an ethnographic design, data were gathered through observations and interviews with key, primary, and additional informants. Findings indicate that mathematical concepts are reflected in every architectural element, such as rectangles in doors, terraces, stairs, shields (*kantar*), *kandaga*, the sultan's palanquin (*tandu*), pineapple decoration, and frames. The study also identifies square concepts in the sultan's child's palanquin, glass boxes, and windows. Circular concepts are found in badong, and the concept of an isosceles triangle is present in the roof, offering potential for creative geometry learning. This research has implications in enriching students' mathematical education by utilising geometric examples from local culture. Integrating ethnomathematics into elementary school curricula can broaden students' cultural perspectives, increase student engagement in learning, and enrich students' understanding of mathematics.

Keywords: ethnomathematics; geometry; *Istana Dalam Loka* traditional house

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Introduction

Research on the investigation and application of ethnomathematics in mathematics education in schools has expanded quickly in several nations since D'Ambrosio introduced ethnomathematics in 1985 (Long & Chik, 2020; Orey, 2000; Pradhan, 2017; Risdiyanti & Prahmana, 2018; Rubio, 2016; Zhang et al., 2021). Education and teachers worldwide are highly in demand of D'Ambrosio's concept of bringing mathematics back to be ingrained in students' daily lives and culture, as well as their internalization of socio-cultural values that can help students develop good character (Acharya et al., 2021; Brandt & Chernoff, 2014; François, 2012). Numerous scholars and educators have come to the conclusion that ethnomathematics is a potent pedagogical tool for understanding mathematical ideas in light of students' experiences and cultural backgrounds (Pradhan & Sharma 2021).

Studying mathematics is considered one approach to introducing culture to students in the classroom (Afifah et al., 2020). Ethnomathematics, the study of the relationship between mathematics and culture, represents a significant advancement in mathematics education Marsigit et al. (2018). Mathematics is fundamentally influenced by history, geography, and social environments, necessitating its connection to daily life or the culture of students. In elementary school, ethnomathematics-designed learning can enhance students' motivation to learn and encourage logical thinking (Sihombing & Simanjuntak 2020). In a broader context, Prabawati and Muslim (2022) posit that ethnomathematics involves the application of mathematics by a community or cultural group.

The integration of mathematics into societal culture is a crucial aspect that warrants exploration to facilitate easy comprehension among students, enabling them to apply mathematical concepts directly in their lives (Yudianto et al., 2021). Bart (2007) defined ethnomathematics as the mathematical notions, ideas, and practices that have been developed by various social groups. This viewpoint has led to an increase in the amount of anthropological research that focuses on the cognitive process and intuitive mathematical thinking which are both highly developed in minority cultural groups. According to Orey (2010) ethnomathematics is a program that aims to investigate how individuals from diverse cultural backgrounds have come to understand, comprehend, articulate, process, and ultimately use mathematical ideas, concepts, procedures, and practices that may help them solve problems relating to their everyday activities. Since ethnomathematics is closely intertwined with daily life, children would find it easier to discuss this topic if they focused on contextual and cultural issues (Sunandar et al., 2018). It is imperative to investigate these aspects to ensure that the concepts and knowledge embedded in culture are thoroughly examined before being incorporated into classroom teaching and learning processes.

The primary objective of ethnomathematics study is to formulate mathematical ideas that are easily comprehensible for students through the application of cultural contexts (Pitaloka & Susanti 2022). The field of study and program in ethnomathematics is relatively new. It could be characterized as the study of mathematical ideas and procedures in their cultural context. Bishop (1991) asserts that mathematics is a cultural product that has developed as a result of various activities. All of the counting, finding, measuring, designing,

playing, and explaining that has occurred is included in the cultural product. Culture seeps into daily existence through its knowledge and traditions. When people compare, classify, quantify, measure, explain, infer, generalize, and evaluate, they usually do so using material and cognitive resources that are unique to their culture (D'Ambrosio, 2006). Mathematics is a human cultural activity that has produced mathematical knowledge, procedures, and concepts.

The study on Ethnomathematics of the Traditional Palace of Dalam Loka in Sumbawa is supported by previous research that extensively explored ethnomathematics, as evidenced in studies such as those conducted by (Zhang et al., 2021); Ethnomathematical study of the Chinese Temple of Heaven Building which reveals mathematical concepts related to geometric elements, (Kholisa, 2021); For instance, an examination of ethnomathematics in the traditional Javanese joglo house in Pati revealed mathematical concepts related to geometric elements such as lines, angles, flat shapes (square, rectangle, trapezium, and triangle), the Pythagorean theorem, three-dimensional shapes (rectangular prism), congruence, and geometric transformations (translation, reflection, and rotation); (Nursyeli & Puspitasari 2021); Additionally, an investigation into ethnomathematics at the Cangkuang temple uncovered mathematical concepts within the realm of geometry.

In the research conducted by Richardo (2017) it was found that ethnomathematics significantly enhances students' understanding of mathematics by establishing connections between the subject matter and the real-world experiences of students, as well as incorporating local cultural art. This approach proves instrumental in enabling students to grasp mathematical concepts more effectively. Therefore, prospective mathematics teachers should recognize that incorporating ethnomathematics into the practice or explanation of mathematical concepts can elevate students' comprehension of mathematics.

Research on ethnomathematics in traditional house architecture has been conducted by several researchers, with one notable study discovering mathematical aspects in the Uma Lengge traditional house, revealing concepts related to geometry and spatial structures (Safitri et al., 2021). In an effort to advance this field, the current research aims to delve into pthe ethnomathematics of the *Istana Dalam Loka* traditional house, with the objective of exploring the deeper philosophical underpinnings of the structure. For the people of Sumbawa, the *Istana Dalam Loka* traditional house holds significance as a historical site. Beyond being a distinctive feature of Sumbawan tradition, it stands as evidence of the historical legacy of the Islamic kingdom, diligently preserving its cultural purity. To identify ethnomathematical values within the *Istana Dalam Loka* traditional house, an investigation into its unique form and architecture is essential. The selection of the *Istana Dalam Loka* traditional house is justified by its abundance of authentic examples of mathematical concepts. Choosing this traditional house as a practical and significant alternative for teaching mathematics aims to enable educators to facilitate students' understanding of mathematical ideas in a practical context. Another rationale for focusing on the *Istana Dalam Loka* traditional house is its continued use by the local community and its unique place in Sumbawa's history. The intriguing aspect of this research lies in the interdisciplinary examination of architectural art, culture, philosophy, and history compared to other studies. This study carefully investigates the *Istana Dalam Loka* Sumbawa Traditional House, taking

into account each component's architectural, cultural, philosophical, and mathematical aspects. This research deviates from previous studies that concentrate on form and typically do not cover every aspect of it. The investigation of architecture, culture, and philosophy by the researcher in comparison to other researchers is what makes this research intriguing. The purpose of this study is to characterize the connection between ethnomathematics research on traditional Sumbawa palace house structures.

Methods

Researchers utilized a qualitative research methodology for this study, employing an ethnographic approach. The ethnographic approach was applied throughout the research process, particularly as outlined by Fauzi et al. (2020): (1) Literature Review: Researchers conducted a comprehensive review of articles in journals or books relevant to the research. They sought articles related to various religions, ethnomathematics, and architectural structures; (2) Information Transmission: Researchers collected information by consulting individuals knowledgeable about the details of traditional houses, focusing on their philosophies, histories, and architectures; (3) Interviews: Interviews were conducted using validated interview sheets, adhering to ethical guidelines. Three types of informants were involved: key informants (traditional leaders), primary informants (elders), and additional informants (community members). These informants possessed deep understanding of the history, culture, and layout of the *Istana Dalam Loka* Traditional House. They were interviewed to gain insights into the main topics; (4) Documentation: Important findings or descriptions related to the research were documented by the researchers.

Data were gathered through observation, interviews, and documentation. Data analysis consists of three stages, namely 1) preparing and organizing data 2) describing, clarifying, and interpreting data into codes and themes, and 3) finally presenting data. Data collection techniques were conducted through participant observation and in-depth interviews over the course of one month. In participant observation, the researcher observes what is done and is involved in the activities of the research subject. The selected informants were individuals possessing comprehensive knowledge of the traditional house. The research subjects comprised three key informants, namely traditional leaders, and custodians of the *Istana Dalam Loka* Sumbawa traditional house. Additional informants included one member of the indigenous community. The three informants really understand the history, culture and layout of the Dalam Loka Palace Traditional House. Data analysis consists of three stages, namely 1) preparing and organizing data 2) describing, clarifying, and interpreting data into codes and themes, and 3) finally presenting data.

The research procedures or research steps in conducting ethnographic research are as follows in Table 1.

Table 1. Ethnographic research design

Research Stages/Steps	Activities
Ethnographic project selectin	a. Site Selection b. Selecting and determining key informants (traditional

Research Stages/Steps	Activities
	leaders), primary informants (elders), and additional informants (community members) is a crucial aspect of conducting ethnographic research within indigenous communities
Asking ethnographic questions	a. Identification what will be explored and what data to collect b. What mathematics materials can be explored with an ethnomathematics approach
Ethnographic data collection	a. Field observation b. Participant observation c. In-depth interviews using interview guidelines and standardized open-ended interviews d. Data collection
Making ethnographic notes	Take field notes and collect documentation
Analyzing the ethnographic data	Make field notes and collect documentation
Writing ethnographic	Writing results in the form of report

Results

The *Istana Dalam Loka* Traditional House stands as a historical testament showcasing the glory of the Sumbawa Sultanate during its era, situated in the Seketeng village, Sumbawa district, Sumbawa regency. This structure is regarded as a relic of the Sumbawa Sultanate, characterized by its distinctive traditional architectural features (Gambiro & Yamin 2018). The researcher conducted a comprehensive study focusing on various sections of the *Istana Dalam Loka* Traditional House, namely the upper section known as the "*loteng*" or "*Alang*," the middle section comprising the main structure referred to as the "*ruang Dalam Loka*" (Old Palace), and the lower section or foundation called the "Tabongan." Interviews were conducted with three key informants: the key informant (head of tradition), the main informant (elder of tradition), and an additional informant (community member of tradition).

Figure 1. Depicts the traditional house structure of *Istana Dalam Loka*.
(Personal Document)

The *Istana Dalam Loka* Traditional House stands as one of the oldest traditional houses in the city of Sumbawa, evident in its enduring beauty and unique architectural features. Established in 1885 during the reign of Sultan Muhammad Djalaluddin III, this cultural gem was officially designated as a cultural heritage site in 1932. The house is considered a relic of the Sumbawa Sultanate, boasting distinctive architectural elements that serve as a poignant reminder of the once-prosperous era of the Sumbawa Sultanate. The historical significance of the *Istana Dalam Loka* Traditional House is underscored by its recognition as a cultural landmark, highlighting its enduring importance in preserving the cultural heritage of Sumbawa. The structure's architectural charm remains intact, showcasing a blend of aesthetics and functionality that reflects the cultural and historical richness of the region. The year 1885 marked a pivotal moment in the establishment of this remarkable house, coinciding with the visionary leadership of Sultan Muhammad Djalaluddin III. The subsequent designation as a cultural heritage site in 1932 further solidifies the house's role as a custodian of Sumbawan history and tradition (Hidayati, 2021). The *Istana Dalam Loka* Traditional House serves as a testament to the architectural prowess of the Sumbawa Sultanate, capturing the essence of a bygone era when the Sultanate flourished. Its unique features and well-preserved state make it a living artifact that bridges the past and present, allowing contemporary observers to connect with the rich history of Sumbawa.

The mathematical concept that is evident in traditional houses is geometry, as manifested in various elements such as the windows, doors in each room, roof structures, stairs, pillars, chests, and historical artifacts within these traditional dwellings. Through careful observation of these traditional geometric principles can be discerned. The geometric aspects of traditional houses are prominently displayed in the design of their architectural features. The windows, doors, and roof structures all adhere to mathematical principles rooted in geometry. The arrangement and dimensions of these elements exhibit a precise application of geometric concepts, contributing to the overall aesthetic and structural integrity of the traditional house.

Based on the interview findings, researchers analyzed the interview results of the first, second, and third informants. They obtained data regarding the names of the parts of the *Istana Dalam Loka* traditional house building, as follows: Researchers discovered information about the history, and philosophy of the traditional house building. The construction of this traditional house was led by Imam Haji Hasyim in 1885. In 1932, a new palace was built within the *Istana Dalam Loka* complex. However, since 1954, the palace structure suffered damage and was eventually abandoned by its occupants. Then, in 1979, the Directorate General of Culture undertook the restoration of *Istana Dalam Loka*. Finally, on April 2, 1993, the regent of Sumbawa at that time officially inaugurated *Istana Dalam Loka* as a museum.

The results of observation, interviews, and documentation indicate numerous mathematical concepts that can be derived from the structure of the *Istana Dalam Loka* traditional house, particularly in the realm of geometry. This further substantiates the assertion that the context of traditional house architecture can serve as a valuable learning resource for students by introducing geometric principles. The following is an ethnomathematics study of the *Istana Dalam Loka* traditional house, with a focus on the

geometric elements depicted in its structure. The geometric illustrations are situated within different sections of the traditional house. The premises of the Rumah Adat *Istana Dalam Loka* consist of eight distinct areas, namely: (1) the grand hall (lunyuk agung), situated at the front; (2) the secondary hall (lunyuk mas), located adjacent to the grand hall; (3) the inner chambers to the west and north, encompassing prayer rooms and the chambers where the king, princess, and attendants reside; (4) the chambers to the east, featuring four rooms designated for the married sons or daughters of the king. At the northern end, there is a chamber for the household caretaker; (5) the northern part (rear section), designated for assembly and discussions; (6) the kitchen; (7) the bathroom; (8) the bala bule, situated in front of the living room.

Based on the observational findings, the model employed in traditional houses is the elevated structure known as the "panggung" house, which stands on stone pedestals positioned above the ground surface. From a macro perspective, the *Istana Dalam Loka* Traditional House carries profound philosophical significance within its architectural design. Noteworthy aspects include: (1) a total of 99 pillars, symbolizing the divine attributes (Asmaul Husna); (2) a porch area supported by pillars, with 5 pillars on each side representing the five pillars of Islam; (3) the presence of 25 steps when ascending or entering the Traditional House, metaphorically denoting the 25 Prophets of Allah; (4) pineapple-shaped carvings beneath the staircase, signifying the four companions of the Prophet (Khulafaur Rasyidin) and seven additional pineapple carvings on the sides symbolizing the verses in Surah Al-Fatihah; (5) twin roofs symbolizing the connection between Allah and humanity; (6) 20 doors corresponding to the 20 obligatory attributes of Allah, and; (7) the presence of a "break" (a horse with a human head), representing the angelic realm.

The frontal section of the *Istana Dalam Loka* traditional house comprises the entrance door, the front pillars of the traditional house, the terrace of the traditional house, and the roof of the traditional house (refer to Figures 1a, 1b, 1c, 1d).

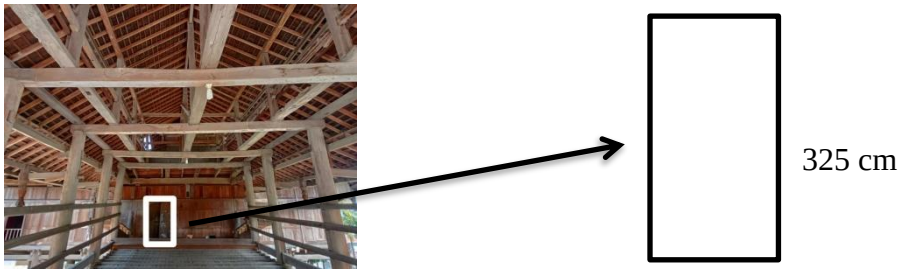


Figure 1a: Entrance of Traditional House

Upon careful examination from a geometric perspective, the ethnomathematics displayed at the entrance of the traditional palace within this locale represent a type of two-dimensional shape known as a rectangle. The formula for the area of a rectangle is expressed as Length (l) multiplied by Width (w), where the length (l) corresponds to the longest side of the geometric structure, and the width (w) denotes the shortest side of the rectangle. The solution is articulated as follows;

L = P x L = 3.25 x 0.92 = 2,99 m^2

K = 2 (P + L) = 2 (3.25 + 0.92) = 2 (4.17) = 8.34 m^2

Figure 1b. Depicts the frontal pillars of a traditional dwelling

The ethnomathematics manifested in the pillars at the front of the traditional house in this location exemplify a type of planar structure characterized by rectangular shapes. It consists of five rectangular pillars symbolizing the five pillars of Islam. The solution is as follows;

L = P x L = 5 x 3.3 = 16.5 m^2

K = 2 (P + L)= 2 (5 + 3.3) = 2 (8.3) = 16.6 m^2

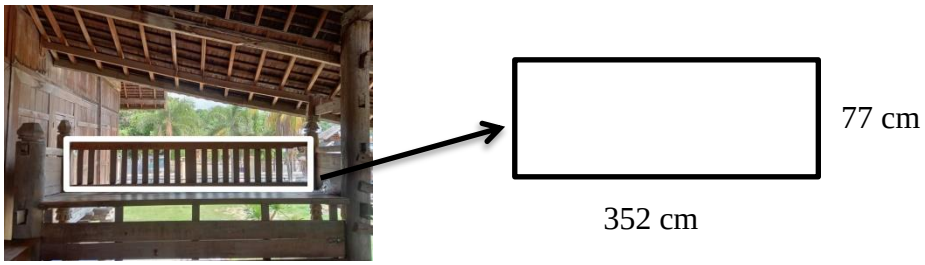


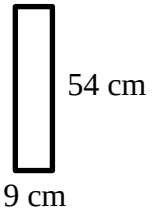
Figure 1c. Terrace

The ethnomathematical form observed in the traditional house terrace within this locale represents a specific type of plane geometry characterized by a rectangular shape. The resolution is articulated as follows;

L = P x L = 3.52 x 0.77 = 2.5025 m^2

K = 2 (P + L) = 2 (3.52 + 0.77) = 2 (4.29) = 8.58 m^2

The trali streets on the terrace of the traditional palace within this locale represent a specific type of flat structure that takes the form of a rectangle, featuring a total of 18 tralis, with the solution outlined as follows;



L = P x L = 0.54 x 0.09 = 0.0486 m^2

K = 2 (P + L) = 2 (0.54 + 0.09) = 2 (0.63) = 1.26 m^2

Figure 1d. Depicts the traditional house roof

The roof structure of traditional indigenous architecture represents a specific type of two-dimensional geometric shape, particularly the triangle with two equal sides, consisting of twin roofs. The twin palace roofs symbolize the Shahadatain and the Shahadat Rasul. To calculate the area of an isosceles triangle, the basic formula (1/2 x base x height) can be employed. Here, the base indicates one of the sides with a different length, while the height denotes the perpendicular distance from the base to the apex of the triangle. The solution is articulated as follows;

L $= \frac{1}{2}$ x 5 x 3 = $\frac{1}{2}$ x 5 x 3 = $\frac{1}{2}$x 15 = 7,5 m^2

K = s + s + s = 5 + 4 + 4 = 13 m^2

In the traditional house on the first floor, various elements can be observed, including doors, windows, pillars, stairs, cabinets, glass display cases, historical artifacts such as kantar and badong, frames, royal palanquins, as well as the offspring of the sultanate. Additionally, one can find a special storage container for valuable items known as kandaga or a dedicated chest (refer to Figures 2, 2a, 2b, 2c, 2d, 2e, 2f, 2g, 2h, 2i, 2j, 2k, and 2l).

Figure 2. Illustrates the first floor of a traditional house

The ground floor consists of several chambers, including (1) a spacious veranda located at the front, serving as an open space supported and demarcated by pillars on the left and right sides, each comprised of 5 pillars symbolizing the 5 pillars of Islam; (2) the grand hall, functioning as a venue for deliberations, receptions, and various significant royal activities, situated adjacent to the front veranda; (3) the royal chamber, serving as an exclusive space for the queen, ministerial wives, and important kingdom officials. It is adjacent to the grand hall and is delineated by wooden walls, with a ceiling and zinc brought directly from Singapore, painted in a light green hue. The beams atop the pillars are adorned with distinctive motifs native to Sumbawa; (4) the western inner room, which extends from south to north without wooden partitions. The successive functions of this room are, from the southernmost, a prayer room, followed by the king's assembly room (Repan), separated only by curtains. Adjacent to

it is the special room for the queen to receive guests, also serving as a chamber for handmaids, and the northernmost chamber is the sleeping quarters for the princess and handmaids; (5) the eastern inner room contains four chambers, designated for the married royal offspring, with the northernmost chamber reserved for the nanny; (6) the pantry, serving as a dedicated space for dining and hosting. During nighttime, this room also doubles as a sleeping area for handmaids.

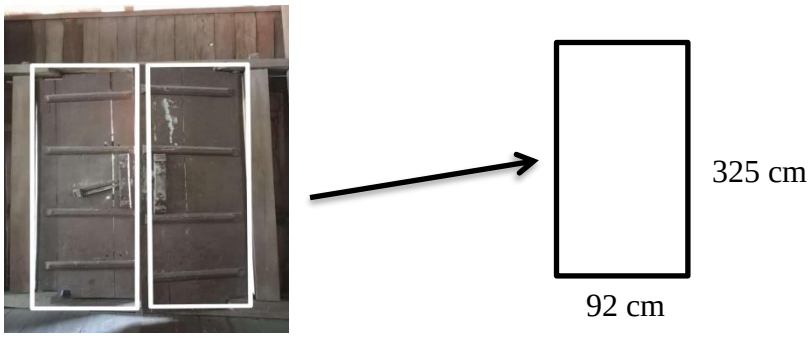


Figure 2a. Door

The traditional house of *Istana Dalam Loka* is rectangular and features 20 doors, each symbolizing one of the 20 attributes of Allah: (1) *Wujud*, meaning existence; (2) *Qidam*, signifying primordiality; (3) *Baqa*, representing eternity; (4) *Mukhalafatuhu Lil Hawadisi*, indicating dissimilarity from all creatures; (5) *Qiyamuhu Binafsihi*, denoting self-subsistence; (6) *Wahdaniyyah*, representing absolute unity; (7) *Qudrat*, meaning omnipotence; (8) *Iradat*, the attribute of will; (9) *Ilmu*, signifying omniscience; (10) *Hayat*, meaning life; (11) *Sama'*, representing hearing; (12) *Basar*, indicating sight; (13) *Kalam*, meaning speech or command; (14) *Qadiran*, representing omnipotence; (15) *Muridan*, signifying willfulness; (16) *Aliman*, representing omniscience; (17) *Hayyan*, indicating living; (18) *Sami'an*, signifying hearing; (19) *Basiran*, representing sight; (20) *Mutakalliman*, meaning speaking (Aulia, 2022). Viewed from an ethnomathematical perspective, the solution can be interpreted as follows;

L = P x L = 3.25 x 0.92 = 2.99 m^2

K = 2 (P + L) = 2 (3.25 + 0.92) = 2 (4.17) = 8.34 m^2

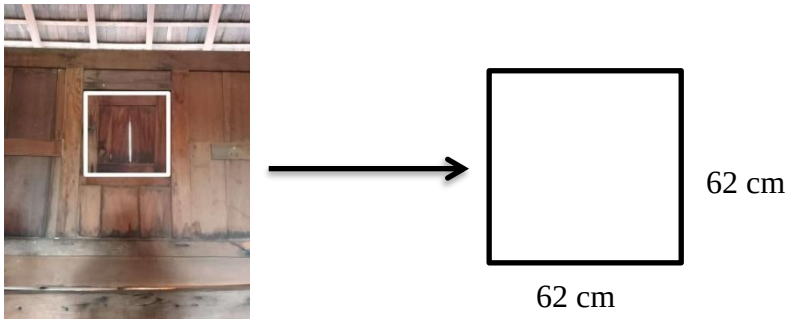


Figure 2b. Window

Upon careful examination of the geometric aspects, the ethnomathematics embodied in the windows of the traditional palace within this locale represents a specific type of two-dimensional figure characterized by a square shape. A square is formed by four equal-length sides and possesses four right angles. Notably, all sides are of equal length, and all angles are right angles. This distinctive geometric configuration adheres to the defining properties of a

square. The formula for the area of a square is denoted as L = s x s, with the solution presented as follows;

L = s x s = 62 x 62 = 3,844 cm^2 = 38.44 m^2

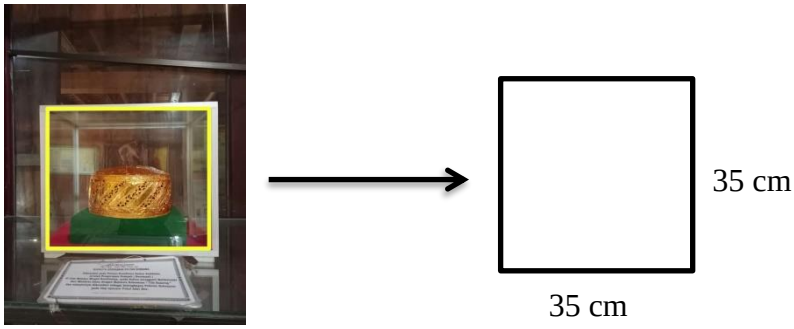


Figure 2c. Glass box

The ethnomathematical form of a glass box can be understood as a type of square shape when viewed from a geometric perspective. Within this glass box lies the grand crown of the Sultan of Sumbawa (known as cila bulaeng). This crown is worn during the Sultan of Sumbawa's coronation ceremony, following the oath-taking ceremony atop the Mimbar Masjid Kesultanan. Subsequently, the Sultan replaces his ordinary crown with the grand crown (cila bulaeng), which is then worn as part of the ceremonial attire during each Tokal Adat Rea ceremony. The resolution is as follows;

L = s x s = 35 x 35 = 1,225 cm^2 = 12.25 m^2

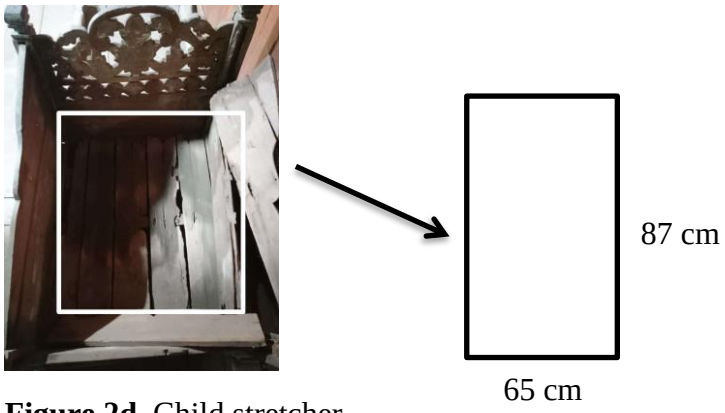


Figure 2d. Child stretcher

Upon careful examination from a geometric perspective, the ethnomathematics of this child's carry-on appears akin to a two-dimensional rectangle. This carry-on was utilized by the offspring of royalty during that era as a means of transportation and also as an accessory for ceremonies. The solution presented is as follows;

L = P x L = 0.87 x 0.65 = 0.5655 m^2

K = 2 (P + L) = 2 (0.87 + 0.65) = 2 (1.52) = 3.04 m^2

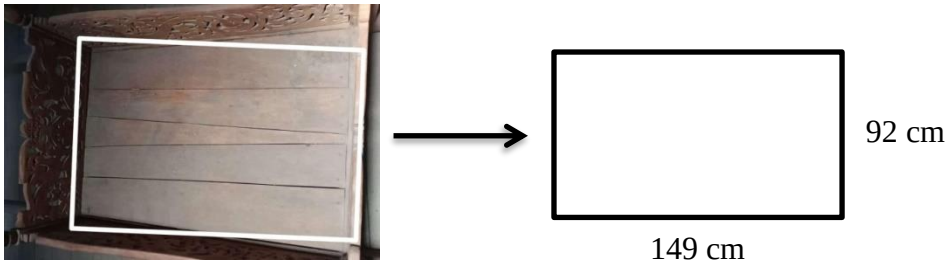


Figure 2e. Sultan's stretcher

After conducting geometric analysis, the royal palanquin can be understood through ethnomathematics as one type of rectangular prism. The palanquin was utilized by kings and queens during that era as a means of transportation and as an essential component in ceremonies. The resolution is as follows;

L = P x L = 1.49 x 0.92 = 1.3708 m^2

K = 2 (P + L) = 2 (1.49 + 0.92) = 2 (2.41) = 4.82 m^2

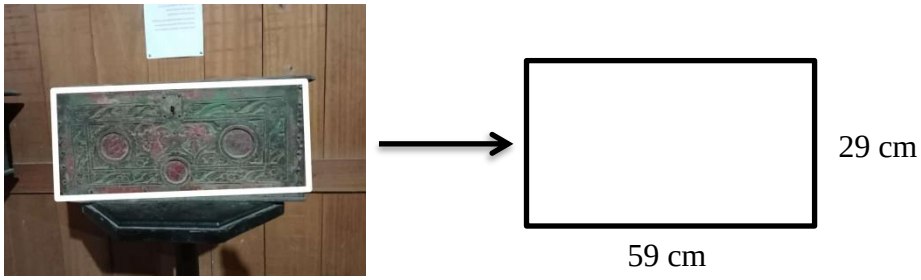


Figure 2f. Kandaga (crates)

The mathematical artifact known as the Kandaga (crates), when viewed from a geometrical standpoint, is associated with the rectangular shape. This trunk serves a specific function of storing valuable items such as traditional clothing, jewelry, and other valuables. The solution is outlined as follows;

L = P x L = 1.49 x 0.92 = 1.3708 m^2

K = 2 (P + L) = 2 (1.49 + 0.92) = 2 (2.41) = 4.82 m^2

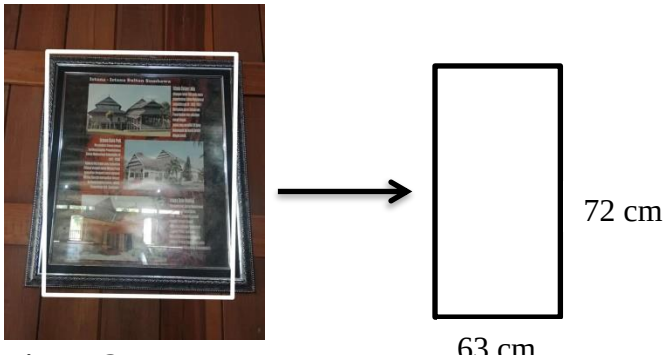


Figure 2g. Frame

After conducting geometric analysis, ethnomathematical forms within this framework can be understood as a specific type of plane figure, namely rectangles. The frames found in traditional palace houses serve the function of providing information through writing and images, such as: (1) illustrations of traditional houses through different historical periods; (2)

photographs depicting sultanates and their families; (3) drawings of historical artifacts. The manifestation of these forms is as follows;

L = P x L = 0.72 x 0.63 = 0.4536 m^2 K= 2 (P + L) = 2 (0.72 + 0.63) = 2 (1.35) = 2.7 m^2

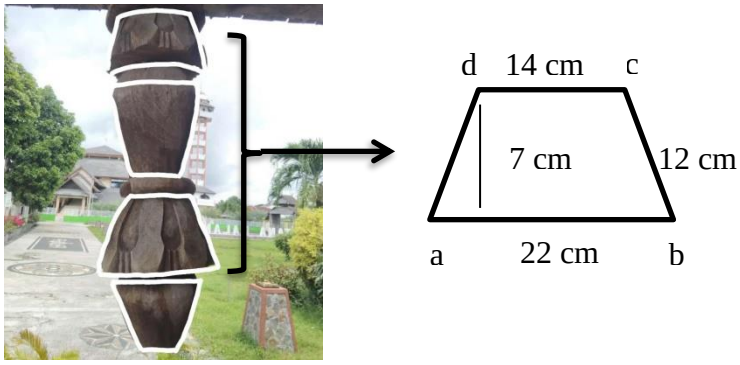


Figure 2h. pineapple decoration

After being analyzed geometrically, this decorative ethnomathematic form can be understood as a certain type of flat shape, namely a trapezoid. There are four pineapple-shaped decorations in traditional houses which symbolize the four companions of the prophet (Khulafaur rasyidin), namely: 1) Abu Bakar Ash Shiddiq; 2) Umar Bin Khattab; 3) Utsman bin Affan; 4) Ali Bin Abi Talib. Viewed from an ethnomathematical perspective, the solution can be interpreted as follows;

L = $^1/_2$ x (AB+CD) x t = $^1/_2$ x (22+14) x 7 = $^1/_2$ x 36 x 7 = 18 x 7 = 126 cm^2

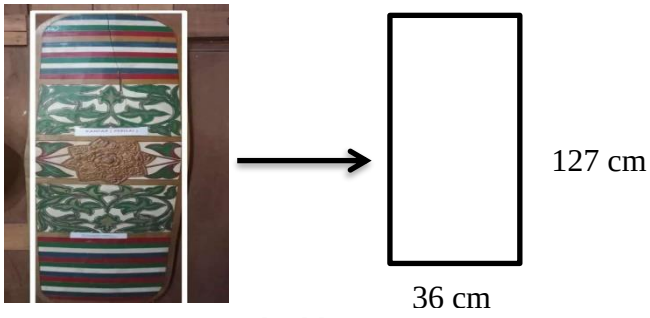


Figure 2i. Kantar (shield)

The geometric shape of the shield (kantar) in ethnomathematics exhibits a specific two-dimensional form resembling a rectangular figure. Shields during the Sultanate era were employed for self-protection in times of warfare against enemy attacks. This shape can be analyzed as follows;

L = P x L = 1.27 x 0.36 = 0.4572 m^2

K = 2 (P + L) = 2 (1.27 + 0.36) = 2 (1.63) = 3.26 m^2

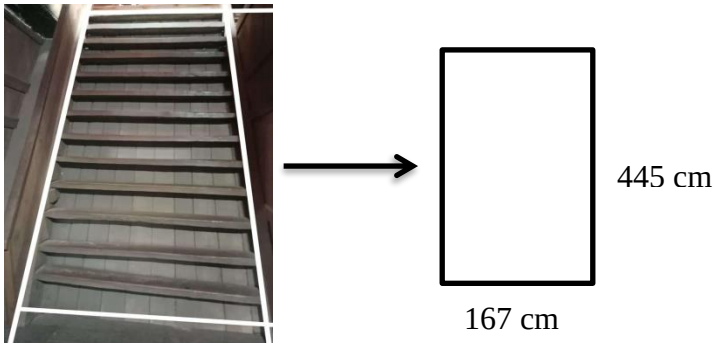


Figure 2j. Stairs

When examined geometrically, the ethnomathematics inherent in this staircase manifests a configuration resembling a rectangle, comprising 25 steps metaphorically representing 25 Prophets and Messengers. An analysis follows;

L = P x L = 4.45 x 1.67 = 7.4315 m^2

K = 2 (P + L) = 2 (4.45 + 1.67) = 2 (6.12) = 12.24 m^2

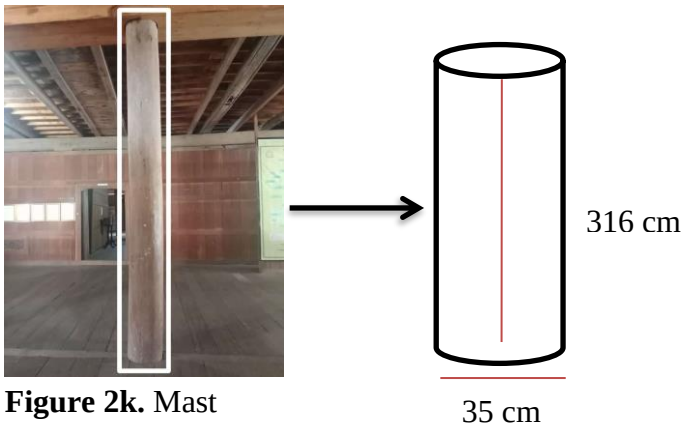


Figure 2k. Mast

A cylindrical pillar made of teak wood is designed to enhance the stability of a structure. In the traditional palace of *Istana Dalam Loka*, there are a total of 99 pillars symbolizing the 99 Asmaul Husna. The formula for the surface area of a cylinder is denoted by A = 2πr T+2πr^2, where 'r' represents the radius of the base or top of the cylinder, and 'T' signifies its height. Concurrently, the formula for the volume of the cylinder is given by V = base area (πr^2) x multiplied by the height (T).

Completion of tubes with volume and pole area formulas:

V_{tube} = La x t = $\pi \, x \, r^2$ x t = 3.14 x $(17.5)^2$ x 3.16 = 3.14 x 306.25 x 3.16 = 3,038.735 m^3

L_{tube} = 2 π r (r + t) = 2 x 3.14 x 17.5 (17.5 + 3.16) = 109.9 (20.66) = 2,270.534 m^2

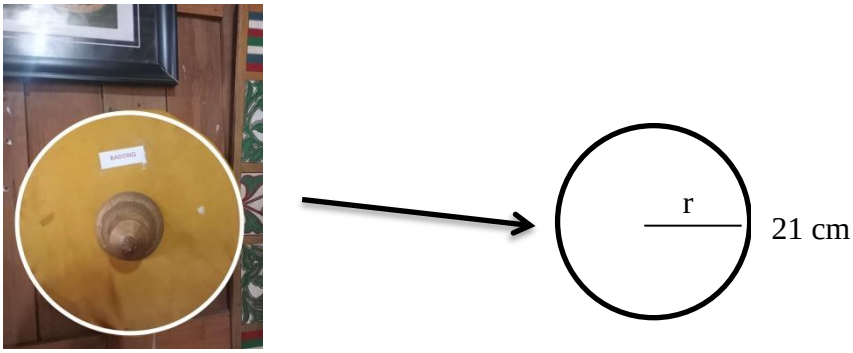


Figure 2l. Badong

The Badong is an object sitrated within the traditional palace of Loka, taking the form of a circle. It is regarded as a symbol of loyalty and benevolence, representing the reciprocal relationship between the populace and the ruler within the legal framework calculation are as follows;

Circumference of the circle = $2\ \pi\ r = 2\ x\frac{22}{7}\ x\ 21 = 2\ x\ \frac{22}{7}\ x\ 3 = 132$ cm

Area of the circle = $\pi\ x\ r^2 = \frac{22}{7}\ x\ 21\ x\ 21 = 22\ x\ 3\ x\ 21 = 1{,}386\ cm^2$

Therefore, the circumference of the circle is 132 cm, and its area is 1,386 cm^2.

Discussion

The various ethnomathematical and philosophical elements within several parts of the traditional house *Istana Dalam Loka*, which could be integrated into mathematics education. traditional house *Istana Dalam Loka* is a traditional mosque of the Sumbawa tribe located in Seketeng Village, Sumbawa District, Sumbawa Regency, West Nusa Tenggara. This building was constructed approximately 92 years ago. Locally known as Bale Rea, the architecture of Rumah Adat holds a significant position in Sumbawa's traditional design and has a long history, serving multiple functions within the community. This demonstration underscores how mathematics can be studied within the context of traditional houses. This aligns with Noto et al. (2018) who assert that mathematics, as a fundamental discipline, plays a crucial role in various fields of knowledge, both in reasoning and practical application, significantly contributing to the mastery of science, technology, and culture. Hence, mathematics education for students becomes more engaging and meaningful.

The mathematical concepts present in the architecture of the *Istana Dalam Loka* traditional house are evident in its two-dimensional structures. These structures include: (1) the entrance door of the traditional house (figure 1a); (2) the front pillars of the traditional house (figure 1b); (3) the terrace (figure 1c); (4) the roof (figure 1d); (5) windows (figure 2b); (6) glass boxes (figure 2c); (7) children's palanquins (figure 2d); (8) royal palanquins (figure 2e); (9) chests (figure 2f); (10) frames (figure 2g); (11) wardrobes (figure 2h); (12) shields (figure 2i); (13) stairs (figure 2j); and (14) baby cradles (figure 2l). This observation underscores the notion that traditional dwellings can serve as valuable sources for studying mathematical concepts. Noto et al. (2018) elaborated on the significance of mathematics as a fundamental discipline that plays a crucial role in mastering various fields of science, technology, and culture. Integrating mathematics learning within the context of traditional habitats can enhance the attractiveness and meaningfulness of the subject for students. According to Fauzi et al. (2020) the application of ethnomathematics in mathematics teaching involves connecting mathematical concepts with cultural contexts, utilizing existing cultural elements as focal points for mathematical learning.

The ethnomathematical study discovered in the traditional carved art of indigenous houses reveals distinct characteristics, particularly evident in the unique cultural ornaments of Sumbawa. The Sumbawan cultural identity is prominently displayed in the architectural features of their traditional houses, characterized by elevated platforms supported by 99

pillars adorned with cylindrical motifs. When interpreted, these motifs are found to share similarities with the attributes of Allah SWT (Asma'ul Husna). Additionally, these houses exhibit various rectangular doors and square-shaped windows. The cultural essence of Sumbawa is further exemplified through artifacts such as rectangular shields, frames, cabinets, chests, royal sedan chairs, glass boxes with square shapes, and circular-shaped cradles. These distinctive architectural and artistic elements reflect not only the cultural richness of Sumbawa but also reveal a symbolic connection to the divine attributes, as embodied in the elaborate carvings and structural components of their traditional houses. The incorporation of geometric shapes, specifically squares and circles, in both the structural and ornamental aspects of these houses contributes to the ethnomathematical understanding of the indigenous knowledge embedded in Sumbawan cultural practices.

Based on these findings, it can be argued that such outcomes can serve as a valuable learning resource for students. By harnessing cultural heritage such as the *Istana Dalam Loka* traditional house, which stands as one of the historical legacies in Sumbawa, students can derive benefits in the realm of ethnomathematics education. The *Istana Dalam Loka* traditional house presents observable geometric forms and architectural features within its structure, encompassing spatial configurations and planar shapes. Another advantage is that students can readily grasp geometric concepts and glean cultural and historical values embedded within it. This aligns with the perspective of Ruth (2023) and Rahmawati et al. (2023) who assert that ethnomathematics education fosters the development of mathematical problem-solving abilities and cultivates an appreciation for cultural heritage. The learning resources generated from the exploratory study of the *Istana Dalam Loka* traditional house include: (1) textbooks; (2) learning modules; (3) educational games; and (4) instructional videos.

Conclusion

The architecture of Sumbawa encompasses diverse designs in construction and ornamentation to create functional and aesthetically pleasing structures. Additionally, its unique model shapes are geometrically based. Unintentionally, the Sumbawan society has incorporated mathematics into their daily lives, evident in the forms and models of buildings featuring patterns, angles, spatial arrangements, triangles, squares, rectangles, and circles. These structures include various structural components: (1) front doors; (2) front pillars; (3) terraces; (4) grilles; (5) inner doors; (6) children's palanquins; (7) royal palanquins; (8) canopies; (9) frames; (10) pineapple decoration; (11) thresholds; (12) staircases. Additionally, there are two types of openings, namely: (1) windows; and (2) glass boxes. Furthermore, in roof designs, there are single isosceles triangles, circles on central pillars (badong), and cylinders on supporting pillars. Moreover, the various forms and functions of buildings and public spaces encapsulate noble values. This research demonstrates that Sumbawan architecture exhibits a refined taste, skill, and a deep-seated awareness of cultural customs inherited from their ancestors. Exploring ethnomathematics within the context of traditional dwellings or palaces can offer an intriguing framework for elementary school mathematics education. Engaging

students in comprehending mathematical aspects within cultural and traditional contexts enriches their learning experience profoundly.

Based on the findings of this study, it is recommended that future researchers expand the scope of their investigation to include a greater variety of mathematical concepts. Additionally, the creation of instructional modules could foster a deeper appreciation for mathematics among students, intertwining mathematical principles with cultural elements. These efforts could then be implemented within educational institutions as supplementary resources to enhance students' mathematical learning experiences.

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Conflicts of Interest

Regarding the publication of this manuscript, the author asserts the absence of any conflicts of interest. Furthermore, the author has diligently addressed ethical issues pertaining to plagiarism, violations, falsification and/or manipulation of data, duplicate publication and/or submission, and redundancy.

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