Journal on Mathematics Education
Volume 16, No. 2, 2025, pp. 383-406

Bridging geometry and cultures for junior high school level: *Rumoh Aceh* design from a computational thinking perspective

Nur Azmi[1], Salmawaty Arif[2,*], Hizir Sofyan[3], Rini Oktavia[2]

[1]Graduate School of Mathematics and Applied Sciences, Universitas Syiah Kuala, Banda Aceh, Indonesia
[2]Department of Mathematics, Universitas Syiah Kuala, Banda Aceh, Indonesia
[3]Department of Statistics, Universitas Syiah Kuala, Banda Aceh, Indonesia
*Correspondence: salmawaty@usk.ac.id

Received: 20 November 2024 | Revised: 13 March 2025 | Accepted: 11 April 2025 | Published Online: 13 April 2025

Abstract

Recent discourse in mathematics education emphasizes the need for culturally relevant pedagogy and the integration of higher-order thinking skills, yet limited research explores the intersection of ethnomathematics and computational thinking within school curricula. This study addresses this gap by proposing a novel instructional framework that incorporates computational thinking into the ethnomathematical exploration of *Rumoh Aceh*—a traditional Acehnese house—within the context of junior high school geometry education in Indonesia. The research aims to enhance students' understanding of geometric concepts such as lines, angles, shapes, and spatial structures through culturally grounded learning experiences. Using the four core components of computational thinking—decomposition, abstraction, pattern recognition, and algorithmic thinking—the geometric design of *Rumoh Aceh* is analyzed to reveal its mathematical significance. Data collection was conducted through ethnographic methods, including observation, interviews with local experts, and documentation analysis. The findings demonstrate that applying computational thinking to cultural artifacts fosters students' ability to recognize geometric patterns, simplify complex problems, and develop structured problem-solving strategies. Furthermore, the integration of cultural context enriches students' appreciation of their heritage while cultivating critical thinking and mathematical reasoning. This study provides empirical evidence supporting the pedagogical value of merging ethnomathematics with computational thinking, offering a meaningful and culturally responsive approach to mathematics education.

Keywords: Computational Thinking, Ethnomathematics, Geometry, Junior High School Level, *Rumoh Aceh*

How to Cite: Azmi, N., Arif, S., Sofyan, H., & Oktavia, R. (2025). Bridging geometry and cultures for junior high school level: *Rumoh Aceh* design from a computational thinking perspective. *Journal on Mathematics Education, 16*(2), 383-406. http://doi.org/10.22342/jme.v16i2.pp383-406

The junior high school stage represents a pivotal phase in the development of students' cognitive and academic competencies. During this period, learners begin to consolidate foundational knowledge across multiple subject areas and cultivate higher-order thinking skills, such as critical analysis and logical reasoning, which are vital for advanced education and lifelong learning. Among these disciplines, mathematics holds a central role, not only as a formal subject but also as a fundamental component of daily decision-making and social interactions (Björklund, 2008; Ernest, 2016; Freudenthal, 2002; Sfard, 2006). Nevertheless, mathematics is frequently viewed by students as abstract and disconnected from real-life contexts and cultural practices (Prahmana & D'Ambrosio, 2020), which can negatively affect engagement and motivation.

In the context of globalization and rapid technological advancement, education systems are increasingly expected to respond to the dual imperatives of fostering innovation and preserving cultural identity. One promising pedagogical approach is the integration of cultural heritage into formal education, particularly within the mathematics curriculum. Embedding ethnomathematical perspectives can enhance students' learning experiences by linking mathematical concepts to local knowledge systems, traditional practices, and socio-cultural realities (Disnawati & Nahak, 2019). This integration has been shown to promote deeper conceptual understanding and improve learning outcomes (Brenner, 1998; Gutstein, 2003). However, while the incorporation of ethnomathematics has received growing attention, there remains limited empirical investigation into how its application can be effectively combined with computational thinking—a structured approach to problem-solving rooted in logic and algorithmic processes. Understanding this intersection may offer valuable insights for designing culturally responsive and cognitively rich mathematics instruction.

The concept of ethnomathematics was first introduced in 1977 by Brazilian mathematician Ubiratan D'Ambrosio, who defined it as the study of mathematical practices embedded within the cultural traditions of diverse groups, including laborers, artisans, farmers, and indigenous communities (D'Ambrosio, 2016). Ethnomathematics investigates the ways in which mathematical thinking and problem-solving are manifested in specific cultural settings (Greer, 2009), thereby offering a framework for delivering mathematics education that is both contextually meaningful and culturally relevant. Beyond pedagogical utility, it also promotes the development of cultural literacy and character education (Barton, 1996). From a scholarly standpoint, ethnomathematics is often regarded as a branch of the cultural anthropology of mathematics and mathematics education, emphasizing the intersection between culture and mathematical reasoning.

Indonesia, known for its vast ethnic and cultural diversity, has emerged as a global leader in ethnomathematics research, particularly in the domain of geometry instruction. Between 2011 and 2021, the country produced the highest volume of scholarly publications on ethnomathematics worldwide (Kyeremeh et al., 2023), underscoring the immense potential for developing mathematics curricula rooted in traditional cultural practices. Numerous studies have documented the presence of mathematical concepts in various Indonesian cultural contexts, including wedding rituals (Utami et al., 2019), life-cycle ceremonies such as birth and death (Prahmana et al., 2021), agricultural systems (Pathuddin et al., 2023), culinary traditions (Pathuddin & Nawawi, 2021), batik patterning (Hendriyanto et al., 2021; Faiziyah et al., 2020; Prahmana & D'Ambrosio, 2020), mosque architecture (Purniati et al., 2020), and traditional performing arts namely *Wayang* (Prahmana & Istiandaru, 2021). These culturally embedded mathematical practices provide a rich foundation for designing learning experiences that are both locally grounded and mathematically rigorous.

At the junior high school level, the integration of ethnomathematics into the mathematics curriculum serves as a pedagogical strategy to bridge the disconnect between abstract mathematical content and students lived experiences. By contextualizing learning through cultural practices, this approach enhances students' engagement, understanding, and motivation. Empirical studies have demonstrated that incorporating ethnomathematical elements into geometry instruction can significantly improve students' spatial reasoning abilities (Sukestiyarno, 2023). Moreover, the development of culturally responsive instructional tools based on ethnomathematics has been shown to support students in discovering geometric principles through exploration and contextual analysis (Setiawan et al., 2021).

This integration provides a meaningful opportunity to align mathematical instruction with real-world and culturally grounded experiences, thereby fostering deeper conceptual understanding (Kyeremeh et al., 2024). Ethnocultural artifacts—such as traditional crafts, architectural motifs, and ceremonial designs—can be strategically selected as instructional models based on their inherent mathematical features, including symmetry, repetition, spatial composition, philosophical symbolism, and algorithmic structures. These characteristics naturally intersect with key elements of computational thinking, such as decomposition, abstraction, pattern recognition, and algorithmic reasoning. Consequently, the fusion of ethnomathematics and computational thinking not only preserves and revitalizes cultural heritage but also cultivates students' critical thinking and problem-solving skills in mathematics. Pedagogical approaches like ethno-modeling and ethno-computing offer practical frameworks for implementing such integrative strategies in the classroom (Cheng, 2024; Anwar et al., 2024).

Computational thinking (CT) has emerged as a foundational 21st-century skill, essential for all learners regardless of discipline (Wing, 2006; Brackmann et al., 2016; Nouri et al., 2020; Helsa et al., 2023). Recognized for its interdisciplinary relevance, CT plays a central role in the development of problem-solving, logical reasoning, and decision-making abilities (Figueiredo & García-Peñalvo, 2017). It is now systematically incorporated across educational curricula in mathematics, science, and the humanities worldwide (Dagienė & Sentance, 2016; Eguíluz et al., 2020). Conceptually, CT integrates algorithmic, engineering, and mathematical modes of reasoning, encompassing skills such as abstraction, pattern recognition, decomposition, and algorithmic thinking (Lye & Koh, 2014).

In the context of mathematics education, the incorporation of CT facilitates deeper understanding and clearer communication of mathematical ideas. It enables students to internalize fundamental concepts while enhancing both cognitive and non-cognitive learning outcomes (Chen et al., 2017; Rojas López & García-Peñalvo, 2018). Several studies suggest that embedding CT into mathematics curricula fosters an appreciation of the interconnections among disciplines and their relevance to everyday life (Figueiredo & García-Peñalvo, 2017). Notably, a strong relationship has been observed between CT and problem-solving abilities in geometry (Hanid et al., 2022), highlighting the potential for CT to be enriched through culturally grounded mathematical practices found in ethnomathematics.

One exemplary cultural artifact that illustrates this intersection is *Rumoh Aceh*, the traditional house of the Acehnese people. Architecturally distinct, *Rumoh Aceh* reflects the adaptation of geometric and environmental principles to regional climatic conditions and cultural philosophies (Sahputra et al., 2020). Educational applications of *Rumoh Aceh* as a cultural model have preserved its traditional construction systems, materials, and symbolic meanings, while adapting them to contemporary pedagogical contexts. Its architectural structure prominently features triangular geometry, which is not only aesthetically striking but also structurally functional (Putra & Ekomadyo, 2023). These geometrical elements provide a valuable resource for introducing students to geometric reasoning within culturally meaningful contexts, thereby supporting both ethnomathematical inquiry and the development of CT.

Given these considerations, this study seeks to examine how CT can enhance students' problem-solving abilities by deepening their understanding of geometry through the cultural lens of *Rumoh Aceh*, a traditional Acehnese house. CT, as outlined in the literature (Lee et al., 2014; Brackmann et al., 2017; Yilmaz Ince & Koc, 2021), encompasses key components such as decomposition, pattern recognition, abstraction, and algorithm design. In this context, CT is employed as an analytical framework to investigate cultural elements embedded in *Rumoh Aceh* and translate them into geometric constructs. Decomposition involves breaking complex architectural elements into simpler geometric components, while pattern recognition identifies recurring structural or ornamental features. Abstraction helps isolate the most relevant mathematical features from cultural details, and algorithm design allows for systematic approaches to modeling and analyzing these features. The integration of CT with cultural architecture not only facilitates a structured approach to understanding traditional forms but also promotes innovation through digital modeling and simulation, thereby enabling the development of aesthetically pleasing and modern adaptive designs grounded in cultural heritage.

Introducing CT into junior high school mathematics education offers significant pedagogical benefits, particularly in fostering students' problem-solving and analytical thinking skills. The incorporation of ethnomathematics provides a culturally rich context through which CT concepts can be taught more meaningfully. By engaging with culturally rooted examples, such as those found in *Rumoh Aceh*, students learn to deconstruct complex problems, focus on essential components, and develop step-by-step procedures for solving them. This approach cultivates critical thinking competencies that are transferable across disciplines and applicable to real-world challenges. Furthermore, the integration of CT with ethnomathematics bridges the gap between abstract mathematical concepts and practical applications, enhancing the relevance and depth of geometry instruction. As a result, mathematics education becomes more interactive, contextually grounded, and aligned with students' cultural identities and lived experiences.

METHODS

Data Collection

Data for this research were collected through observation, interviews, and documentation involving local experts and educators. Observations and interviews related to *Rumoh Aceh* were conducted from July to December 2022 across several well-known traditional houses in different regencies of Aceh Province, namely: *Rumoh Aceh* Tjut Nyak Dien (an Indonesian heroine) in Aceh Besar Regency, *Rumoh Aceh* Tjut Nyak Meutia (an Indonesian heroine) in Aceh Utara Regency, *Rumoh Aceh* at the City Museum of Lhokseumawe, and Rumoh Aceh at the official Aceh Museum in Banda Aceh City. In addition to direct interviews with staff members at these sites, data were also obtained through in-depth interviews with academics from the Aceh Cultural Council (*Majelis Adat Aceh* or MAA) and other Acehnese cultural experts. These interviews provided information on philosophical values, functions, geometric shapes and terminologies, structural elements, and the overall architecture of the buildings. Therefore, all data used for the ethnomathematics component, particularly in the application of CT aspects, are considered primary data. Conversely, the data related to decorative ornaments were derived from secondary sources. However, these ornaments are only briefly introduced and not included in the main procedural analysis.

Research Procedure

Ethnography, as a qualitative research method, seeks to uncover the cultural meanings, values, and behavioral patterns of a community through immersive engagement (Spradley & McCurdy, 2012). In alignment with this approach, the present study explores the sociocultural dynamics of the *Rumoh Aceh* community, emphasizing lived experiences, traditional knowledge systems, and architectural practices. Data collection involved prolonged engagement, including in-depth observations, semi-structured interviews, and participatory interactions with key informants in their natural settings (Abid, 2017).

The primary aim of this ethnographic inquiry is to investigate the cultural context underlying the construction and symbolism of *Rumoh Aceh*. The cultural data obtained were then examined through the lens of CT, utilizing key elements such as contextualization, cultural validation, holistic interpretation, descriptive mapping, and culturally embedded mathematical orientation. This interdisciplinary approach allows for a nuanced understanding of how traditional architectural elements reflect mathematical structures and problem-solving processes.

The study employed a modified ethnographic design, drawing on validated frameworks from prior research. The methodological structure was guided by four principal ethnographic questions: (1) "Where is it to look?"—to determine the appropriate cultural setting; (2) "How is it to look?"—to define the strategies and techniques for cultural observation; (3) "What is it?"—to identify and classify cultural artifacts and practices; and (4) "What does it mean culturally?"—to interpret cultural meanings from a mathematical and computational standpoint (Utami et al., 2019; Pathuddin & Nawawi, 2021; Prahmana et al., 2021; Pathuddin et al., 2023). The ethnographic design used in this study is presented in Table 1.

Table 1. Ethnographic research design

General question	Initial answer	Starting point	Specific activities
Where is it to look?	Geometric elements in *Rumoh Aceh* from a CT perspective	Geometry	In-depth interviews with Aceh Cultural Council and Aceh cultural experts to gather information about *Rumoh Aceh's* geometric shapes and philosophies.
How is it to look?	Using CT aspects to review geometric elements in *Rumoh Aceh*	Alternative thinking and CT	Identifying geometric elements in *Rumoh Aceh* using the four components of CT.
What is it?	Parts of *Rumoh Aceh* have geometric shapes and patterns	Philosophical mathematics	Analyzing components such as decomposition, abstraction, pattern recognition, and algorithms in *Rumoh Aceh's* construction relevant to junior high school level geometry. This highlights the mathematical nature of *Rumoh Aceh's* construction from a CT perspective.
What does it mean culturally?	Enhancing CT and mathematical skills	Anthropology	Explaining how *Rumoh Aceh's* construction integrates and reflects mathematical and cultural knowledge within the framework of CT.

The ethnographic analysis in this study concentrated on contextualizing the cultural elements of *Rumoh Aceh* and exploring their mathematical relevance through the lens of CT. This analysis aimed to identify culturally embedded geometric structures and interpret them using CT's conceptual framework. Five key aspects guided this investigation:

1. Cultural contextualization: studying the cultural significance of the geometric designs of *Rumoh Aceh* and how these elements reflect the traditions and values of the Acehnese community.
2. Cultural validation: ensuring the authenticity and relevance of geometric interpretations within the Acehnese cultural context, maintaining the authenticity of the analysis.
3. Holistic perspective: reviewing the geometric and cultural elements of *Rumoh Aceh* as an integrated whole, rather than as separate or standalone components.
4. Mathematical description: describing the shapes and geometric patterns found in the construction of *Rumoh Aceh* using mathematical terms. This aims to provide a deeper understanding of the application of geometric concepts in real life.

5. Cultural orientation in mathematics: emphasizing the importance of integrating cultural elements into mathematics education to provide contextual and meaningful learning experiences for students, making it more relevant to real life.

This ethnographic and CT-based analysis aimed to explore the intersection between geometry and ethnomathematics, demonstrating how local cultural contexts can serve as powerful platforms for mathematics learning. The methodological steps undertaken in this identification process are outlined in Table 2. The integration of the ethnographic framework with the principles of computational thinking provided a structured approach to examining the synergy between cultural heritage and geometric concepts in *Rumoh Aceh*. This approach supports the development of students' computational thinking abilities while simultaneously fostering cultural appreciation and contextual understanding in mathematics education.

Table 2. Identification of geometric elements in *Rumoh Aceh* using CT

CT Aspect	Step	Process	Objective
Decomposition: Developing the skill of breaking down large amounts of information/data into smaller parts so that these parts can be understood, solved, and evaluated separately, making it easier to understand the complexity of a problem.	Breaking down the complex structure of *Rumoh Aceh* into simple geometric components.	Identifying basic elements like rectangles, trapezoids, and triangles, analyzing each separately to understand the building	Facilitating a deeper understanding of building elements and supporting the learning process in middle school geometry topics.
Abstraction: Involves transforming concrete problems into a more general (mathematical) form, including eliminating irrelevant information and extracting important data generalizations.	Focusing on general geometric principles by ignoring less important details.	Calculating the area and perimeter of geometric elements on the house walls and other features while ignoring irrelevant decorative details.	Simplifying the problem-solving approach for quadrilaterals, triangles, and gradients through a general and efficient method
Pattern Recognition: Identifying recurring trends from a set of information. This involves recognizing consistencies and patterns in the collected data, which can help determining whether the design is producing appropriate data	Identifying and analyzing consistent geometric patterns in *Rumoh Aceh's* structure.	Analyzing repetitive shapes like rectangles in windows and doors, and geometric patterns in ornaments.	Understanding and applying geometric concepts in a culturally relevant context
Algorithm: Applying systematic thought processes to formulate and solve problems in a computationally feasible manner. It involves using logic, data structures, and abstractions to simplify and organize problems to make solutions more efficient and effective.	Developing systematic steps to solve geometric problems related to *Rumoh Aceh's* design.	Formulating algorithms to calculate the area of walls, roof, and floors of *Rumoh Aceh* using established geometric principles.	Assisting in mathematical problem-solving while integrating a deep understanding of plane area determination cultural context.

RESULTS AND DISCUSSION

Data Processing

All primary data collected in this study utilized original Acehnese terminology, including *tameh* (pillars), *reuweung* (spaces between pillars), *binteh* (walls), *binteh cato* (chessboard-patterned walls), *bubong* (roof), *tulak angen* (wind barrier), *rang* (additional wind barriers), and *aleue* (floor). These data were subsequently classified into four categories based on their alignment with the key aspects of CT: decomposition, abstraction, pattern recognition, and algorithmic thinking.

The decomposition aspect of CT was applied to analyze both geometric structures and ornamental features. Elements such as *binteh, bubong, tulak angen*, and *aleue* were categorized as primary geometric structures, while the following motifs were classified as decorative ornaments: *tapak cato* (chessboard patterns), *bungong seuluepok* (lotus flowers), *bungong seulanga* (cananga flowers), *bungong ie mawoe* (roses), *bungong pucok reubong* (bamboo shoots), *bungong mata uroe* (sunflowers), *bungong meulu* (jasmines), *on cirieh* (betel leaves), *reuneuk leuek* (dove feathers), *gigo buya* (crocodile teeth), *taloe meuputa* (spinning threads), and *gigo daruet* (grasshopper teeth).

For the abstraction aspect of CT, only essential geometric elements were considered by eliminating ornamental details. The analysis focused specifically on *binteh cato* and *rang*, allowing the identification of fundamental geometric principles embedded in their design. Finally, the pattern recognition aspect was applied to the structural components *bubong, binteh, tameh*, and *tulak angen*, where repetitive geometric and spatial patterns could be identified. Finally, the algorithmic thinking aspect was illustrated through the spatial arrangement of *reuweung* and the placement of *binteh* along the north-south and east-west orientations of the structure.

Geometric Plane Structures of *Rumoh Aceh* from a CT Perspective

The findings of this study indicate that the architectural structure of *Rumoh Aceh* offers a culturally rich context for promoting computational thinking skills through geometric problem-solving. By embedding elements of Acehnese traditional architecture into mathematical analysis, this study bridges cultural heritage with mathematical pedagogy.

The architectural components of *Rumoh Aceh*—namely *tameh, reuweung, binteh, binteh cato, bubong, tulak angen, rang*, and *aleue*—were examined through the lens of CT and aligned with foundational geometric principles suitable for junior high school mathematics.

1. *Tameh*, functioning as cylindrical pillars arranged in vertical alignment, serves as a concrete representation of cylindrical geometry.
2. *Reuweung*, defined as the space confined by four pillars, represents the edges and faces of three-dimensional geometric solids such as cubes and rectangular prisms.
3. *Binteh*, or the structural walls of the house, are adorned with *binteh cato*, a combination of rectangular, triangular, and trapezoidal elements. These can be mathematically analyzed using area formulas for the respective shapes.
4. *Bubong*, the pitched roof of the house, typically assumes a rectangular or trapezoidal surface, allowing for contextual applications of surface area calculations in classroom settings.
5. *Tulak angen* and *rang* serve as auxiliary structures that also embody geometric elements, reinforcing spatial awareness and structure-based learning.

These architectural components collectively demonstrate how *Rumoh Aceh* can be utilized as a cultural artifact to contextualize mathematical instruction. The integration of cultural and geometric understanding not only fosters students' appreciation of their heritage but also enhances their conceptual grasp of geometry in real-life applications. Figure 1 illustrates the geometric elements (a) embedded in the traditional construction (b) of *Rumoh Aceh*.

(a) (b)

Figure 1. *Rumoh Aceh*

This study's discussion centers on the application of four fundamental aspects of CT—decomposition, pattern recognition, abstraction, and algorithmic thinking—in analyzing the geometric features of *Rumoh Aceh* architecture. The decomposition process involved breaking down the complex structural design of *Rumoh Aceh* into fundamental geometric shapes, including rectangles, triangles, and trapezoids, thereby facilitating a clearer and more manageable understanding of its architecture. Through pattern recognition, the study identified recurring geometric motifs and symmetries, revealing a consistent spatial logic embedded within the traditional design. The abstraction phase further refined this analysis by isolating essential geometric principles, while intentionally omitting non-essential decorative details to focus on the core mathematical concepts. Finally, algorithmic thinking was employed to develop systematic procedures for solving geometric problems related to the structure, effectively integrating mathematical rigor with the cultural and contextual knowledge of *Rumoh Aceh*. This comprehensive application of CT not only illuminates the mathematical sophistication inherent in the traditional architecture but also offers a culturally grounded framework for enhancing geometry learning.

Decomposition of Plane Structures and Ornaments in *Rumoh Aceh*

In the junior high school mathematics curriculum, the study of geometry encompasses fundamental knowledge of shapes, dimensions, spatial relationships, and properties of both two-dimensional and three-dimensional figures within real-life contexts (Sidek et al., 2020). The decomposition aspect of CT can be effectively employed to help students analyze the geometric structures found in traditional architecture, such as *Rumoh Aceh*. By deconstructing architectural elements—such as walls, roofs, and decorative features—into basic geometric forms (e.g., rectangles, triangles, and trapezoids), students not only learn how to compute area and shape properties but also develop analytical thinking by breaking down complex visual and spatial problems into simpler, manageable components.

This pedagogical approach, when integrated with culturally relevant contexts, enriches students' understanding of geometry while simultaneously cultivating essential 21st-century skills, including critical thinking and computational reasoning. An analysis of *Rumoh Aceh* using the decomposition approach involved identifying specific plane geometric shapes embedded in its structure, as illustrated in Figures 2(a)–2(d), as follows:

1. Triangle: An isosceles triangle is prominently featured in the *tulak angen*, as shown in Figure 2(a). This triangular wall, located on the east and west sides beneath the roof, serves both a functional and symbolic purpose—acting as a directional guide toward the qibla in Islamic practice and

offering protection against strong winds. The area of this element was calculated using the standard formula for the area of a triangle.

2. Rectangle: Rectangular forms are evident in multiple components, including the *bubong* (roof) [Figure 2(b)], the north and south vertical walls [Figure 2(d)], and the *aleue* (floor) [Figure 2(e)]. These elements allowed students to apply the area formula for rectangles to determine their respective sizes.
3. Trapezoid: Trapezoidal shapes were found in four wall segments—two on the east side and two on the west—situated between the central walls of *Rumoh Aceh* [Figure 2(c)]. The area of each trapezoid was calculated using the formula for trapezoid area, and the total surface area was obtained by summing the individual areas of these four components.

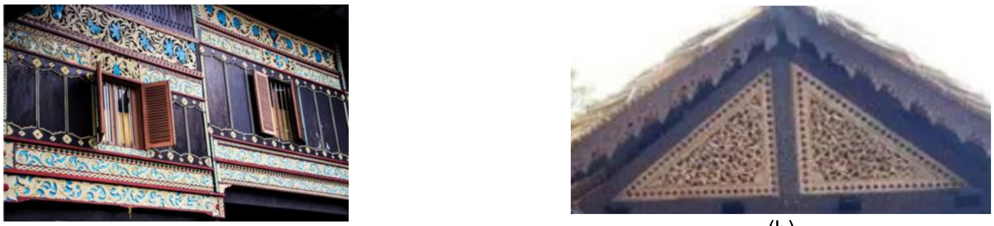
Figure 2. Decomposition of plane structures in the construction of *Rumoh Aceh*

By engaging students in these culturally rooted mathematical explorations, the decomposition of plane structures in *Rumoh Aceh* provides a meaningful context for understanding and applying geometric principles in mathematics education.

Geometric Elements in *Rumoh Aceh* Ornaments through Decomposition

Rumoh Aceh is renowned for its intricate and aesthetically rich ornaments, which encapsulate local cultural wisdom through the artistic integration of geometric elements. These ornamental designs reflect the Acehnese community's capacity to creatively transform fundamental geometric forms into meaningful visual expressions. A prime example can be found in the *tulak angen* ornament, which incorporates various shapes such as circles, triangles, rectangles, and curved lines. These elements are often subjected to geometric transformations—rotation, reflection, and translation—demonstrating the ability to merge mathematical concepts with traditional artistic practices.

The ornamental patterns that adorn the walls of *Rumoh Aceh* frequently feature advanced geometric structures, including arrangements of parallel and perpendicular lines, multiple polygonal forms, and symmetrical compositions. These patterns exemplify the use of decomposition in CT, whereby complex motifs are analyzed by breaking them down into simpler geometric components. Through this process, each decorative element is revealed not only as an artistic artifact but also as a manifestation of precise and structured mathematical reasoning (Figure 3).



(a) (b)

Figure 3. Ornaments on (a) *Binteh* and (b)*Tulak Angen* of *Rumoh Aceh*

A deeper exploration of the ornamentation, as depicted in Figures 4(a)–(l), highlights a broad range of designs rooted in geometric principles. These traditional Acehnese motifs can be decomposed into elemental geometric features such as angles, intersecting and parallel lines, triangles, circles, rectangles, rhombuses, and various transformation techniques. From a mathematical perspective, these ornaments serve not only as visual enhancements but also as pedagogical tools to bridge the gap between cultural art and geometric understanding.

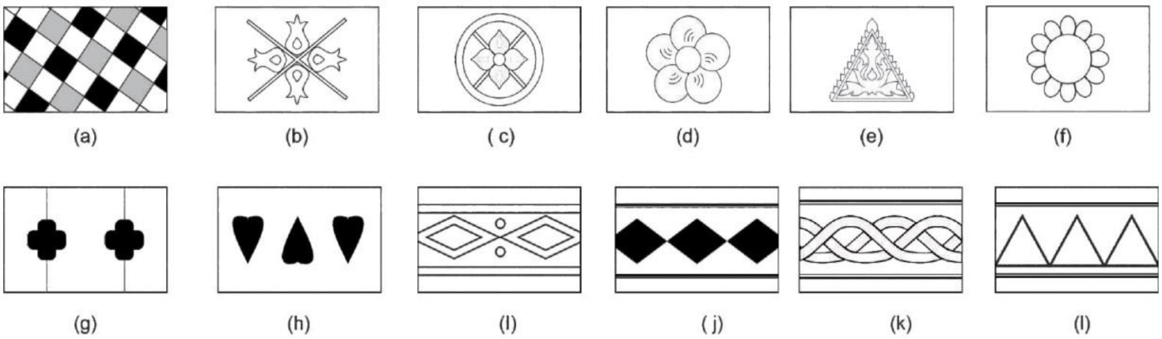


Figure 4. Patterns of ornaments

Each ornament bears a specific name and embodies distinct geometric properties, which can be analyzed through the lens of decomposition in CT, as summarized in Figure 5:

(a) *Tapak cato*: Composed of square or diamond configurations, this motif offers opportunities to explore internal angles and congruent side lengths.
(b) *Bungong seuluepok*: involves reflection or rotational symmetry, as well as the concept of perpendicular and intersecting lines.
(c) *Bungong seulanga*: displays central point symmetry, often found in floral patterns, and could be used to calculate the circumference or area of circles and arcs.
(d) *Bungong imawoe*: involves geometric transformations in the form of rotation on regular circles.
(e) *Bungong pucok reubong*: this ornament was identical to isosceles or equilateral triangles
(f) *Bungong mata uroe*: could be associated with circles and geometric transformations
(g) *Bungong meulu*: shows the use of four perpendicular lines or regular polygons.
(h) *On cirieh*: involves the rotation of triangles in geometric transformations.
(i) *Reuneuk leuek*: displays linear translation symmetry and dilation in the form of a diamond shape
(j) *Gigo buya*: shows linear translation symmetry in diamond shapes, as well as concepts of parallelism and similarity.

(k) *Taloe meuputa*: contains the concept of curves and parallelism in lines.
(l) *Gigo daruet* : illustrates the concept of parallelism in lines and equilateral triangles.

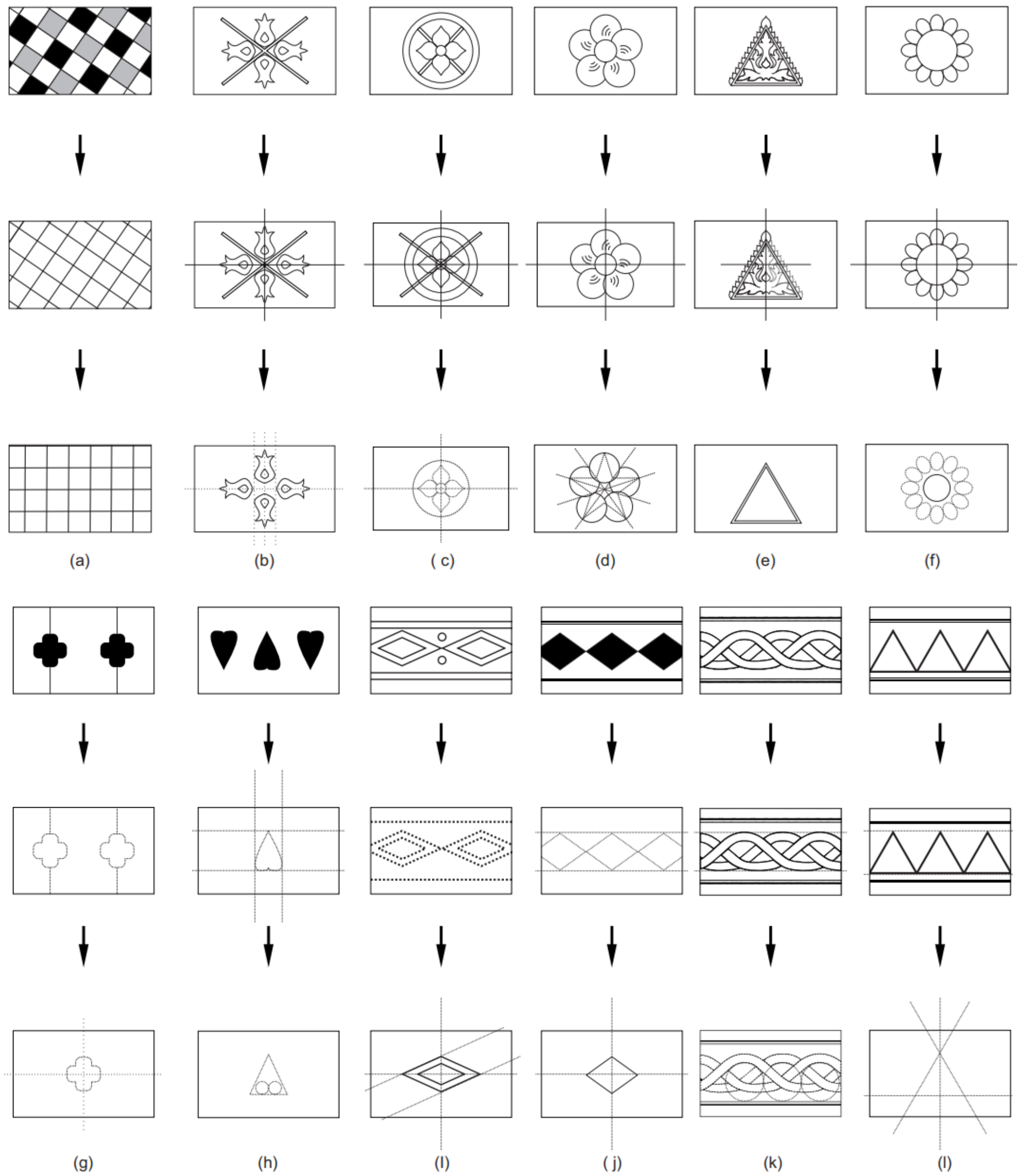


Figure 5. Decomposition of Aceh ornaments
Source: Novianti et al. (2022), Dhuhri (2018), and Aceh Cultural Council (MAA)

Abstraction of Plane Structures in *Rumoh Aceh*

The process of abstraction in mathematics involves simplifying complex objects by focusing on their essential geometric properties while omitting extraneous details. This method enables learners to model, analyze, and compute geometric quantities—such as area and perimeter—through the application of geometric formulas rather than direct measurement (Sidek et al., 2020). Within the architectural context of *Rumoh Aceh*, structural elements such as *binteh cato* and *rang* serve as authentic examples for implementing abstraction. In particular, *binteh cato* (checkerboard-patterned walls) can be mathematically modeled by decomposing the form into a composite of rectangles and triangles, while *rang* (wind barriers) can be examined using linear functions and equations of lines. These real-world applications of abstraction foster a meaningful connection between cultural heritage and mathematical learning through visual and contextual representations.

Abstraction in Binteh Cato (Checkerboard Walls)

Figure 6(a) shows the placement of the *binteh cato* within the wall structure of *Rumoh Aceh*, while Figure 6(b) represents its idealized geometric form. This structure consists of a central rectangular panel flanked by triangular end sections. Each *binteh cato* typically measures between 90–100 cm in length (*l*) and 20–30 cm in width (*w*). The triangular components at the top and bottom are isosceles right triangles with a height equal to half the width (i.e., $h = \frac{w}{2}$). By using standard dimensions of $l = 100cm$ and $w = 30cm$, the total area of a single *binteh cato* (*B*) can be computed by summing the area of the rectangle and the two triangles:

$$B = l\,w + 2\left(\frac{1}{2}\right)wh \ = 100(30) + 2\left(\frac{1}{2}\right) 30 \left(\frac{30}{2}\right) = 3450\ cm^2.$$

(a) (b)

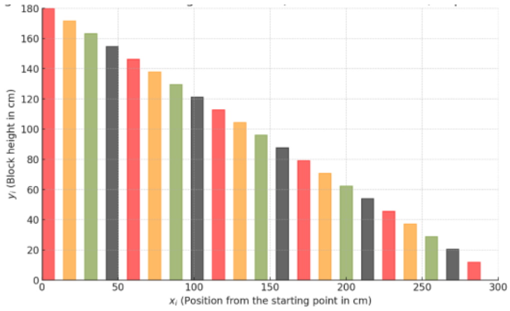
Figure 6. *Binteh Cato*

The total wall area of a *Rumoh Aceh* house is commonly based on the number of *reuwueng*, where each *reuwueng* typically contains 7 to 9 *binteh catos*. Consequently, students can compute the full wall surface area by applying the abstraction process to each structural unit, as further elaborated in the computational thinking algorithm section.

Abstraction in Rang (Wind Barriers)

Figure 7(a) illustrates the position of the *rang* within the *Rumoh Aceh* structure, presented as a linear arrangement of wooden beams, each measuring 8 cm width and spaced 6 cm apart. This arrangement creates a linear structure with a specific inclination. Through abstraction (CT) the height reduction along this structure can be simplified into an easily comprehensible mathematical model, as shown in Figure 7(b). The beam height (*y*) decreases from $y_1 = 180$ cm to $y_2 = 0$ cm over a length (*x*) of 300 cm, which can be calculated using the gradient (slope) concept as the ratio between the change in height and the total length of the arrangement: $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0-180}{300-0} = -0{,}6$. This results in the linear equation $y = -0{,}6\,x + 180$ which describes the decrease in beam height. Similarly, linear equations can be determined for the other *rang* positions. This abstraction approach enables middle school students to visually and mathematically comprehend linear patterns, allowing them to calculate the number of beams (*i*) that can be arranged within the 300 cm length as: $i \ = \frac{300}{8+6} = \ 21{,}43$ which is rounded to be 21 since *i* is an integer number. By applying the concept of CT abstraction, students can more easily connect contextual geometry with linear equations, thereby strengthening their understanding of basic mathematical modeling applicable in middle school geometry education.

(a)



(b)

Figure 7. The illustration of *Rang*

Pattern Recognition in Geometric Elements of *Rumoh Aceh*

Pattern recognition, a key component of CT, involves the identification of recurring elements or structures within a problem to enable the application of previously successful solutions to novel but analogous contexts (Lee et al., 2020). In this study, the focus is placed on identifying and analyzing recurring geometric patterns inherent in the architectural elements of the traditional *Rumoh Aceh*, including its walls, roof, and pillars. These elements exhibit consistent geometric configurations that can be systematically described using formal geometric terminology. For example, the front and back walls of the *Rumoh Aceh* typically consist of two congruent rectangles, while the side walls incorporate a combination of trapezoidal and rectangular shapes. The roof structure generally conforms to a rectangular form with symmetrical properties. The identification of these geometric patterns not only facilitates a deeper understanding of the spatial and structural design principles embedded in traditional architecture but also supports the development of instructional models that integrate ethnomathematical contexts into geometry learning. Furthermore, recognizing these patterns contributes to more effective planning and implementation of design modifications based on the geometric structures identified.

(a)

(b)

(c)

(d)

Figure 8. Patterns in (a) *Bubong*, (b) *Binteh*, (c) *Tameh*, (d) *Tulak Angen* in *Rumoh Aceh's* structure

Figure 8 presents the geometric patterns of *Rumoh Aceh,* examined using pattern recognition within the framework of CT:

1. Roof pattern: the roof comprises of two rectangular sections joined an angle of $\frac{2\pi}{3}$, constructed from woven leaves and rattan, with a thickness of 5-10 *cm*, allowing for ventilation suitable for

tropical climates. These sections are secured with fibers from the sugar palm tree (*taloe pawai*), which also serves as an emergency exit. Typically, roof dimensions range from 12 to 40 *m* in length and 5 to 8 *m* in width, maintaining a length-to-width ratio of 2:1.

2. Wall pattern**:** the patterns of the west and east walls are characterized by a combination of triangles at the top (Figure 9(a)) and rectangles at the bottom (Figure 9(b)), forming trapezoids. In the middle section both rectangles at the bottom (Figure 9(c)) and the top (Figure 9(d)) also form a rectangle. The length-to-width ratio of the central rectangle measures 3 *m* to 2.8 *m*, or approximately 15:14. The height ratio of the trapezoid's parallel sides measure 2 *m* to 3.8 *m*, or 10:19.

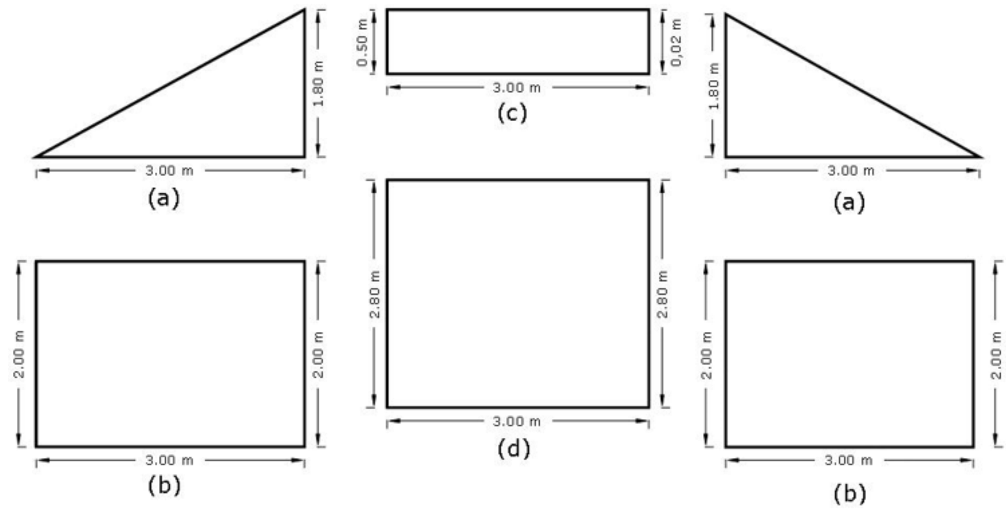


Figure 9. Geometry of the west and east walls

The north and south walls are rectangular and covered with *binteh cato*. In the decomposition analysis using CT, this pattern was broken down into components, such as the length and width of the rectangle, as well as the triangles at the top and bottom ends, as previously explained in the abstraction section. This pattern forms geometric elements, as shown in Figure 10. The dimension of each piece of this wall has height to width ratio of 3:1.

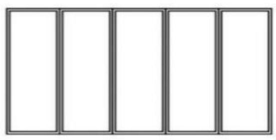


Figure 10. Geometry of the north and south wall

3. Pillar pattern: The pillars in *Rumoh Aceh,* known as *tameh,* are cylindrical and made from selected wood. The *tameh* are arranged in parallel, as shown in Figure 11, with high precision, making *Rumoh Aceh* renowned for being earthquake-resistant structure, evident from its resilience during the 2004 tsunami in Aceh. There are two main pillars serving as the foundation: *tameh raja* (king pillar), symbolizing strength and grandeur, and *tameh putroe* (queen pillar), which is typically placed behind *tameh raja*. *Tameh putroe* contains gold wrapped in red and white cloth, symbolizing the national flag and the philosophy that the Acehnese people cannot be subjugated by other nations.

(a) (b)

Figure 11. (a) *Tameh* and (b) *Tameh Putroe*

In the structural design of *Rumoh Aceh*, the configuration of pillars—referred to locally as *tameh*—exhibits consistent geometric and cultural patterns. Along the width (north-south) side of the house, the number of *tameh* is uniformly fixed at four. However, the number of *tameh* along the length (west-east) side varies in accordance with the social status of the homeowner. Residences belonging to nobility or royalty typically feature between 8 and 12 *tameh*, whereas those of commoners generally include 5 to 6. This variation reflects sociocultural hierarchies embedded within architectural form.

The vertical dimension of the *tameh* is divided into two principal segments: the front/back porch and the central porch (*rumoh inong*), with the height ratio of these sections consistently maintained at 3:4, respectively. Specific pillars, namely the *tameh raja* (king pillar) and *tameh putroe* (queen pillar), are strategically positioned within the *rumoh inong* area, following a culturally prescribed spatial arrangement illustrated in Figure 12. A typical *Rumoh Aceh* comprises 24 pillars, with the central ones designated for the *raja* and *putroe*.

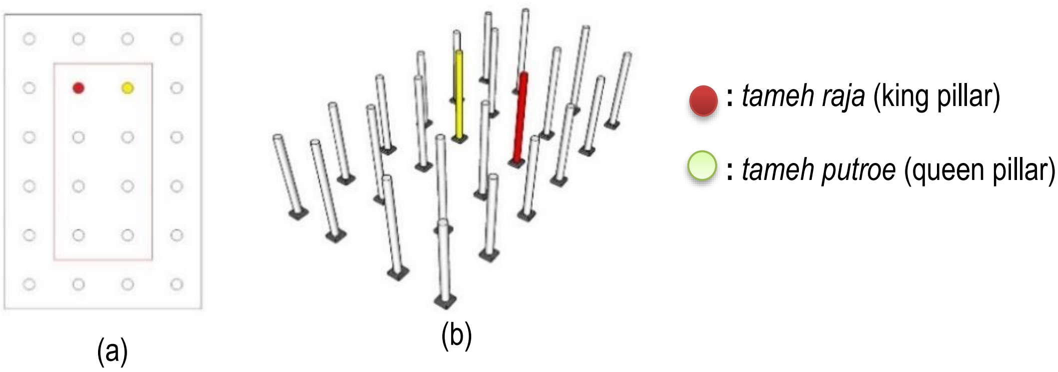


Figure 12. Placement pattern of *Tameh Raja* and *Tameh Putroe*

The determination of the placement for these royal pillars is governed by a rule-based calculation involving the total number of central columns. Specifically, the number of possible positions for the *tameh raja* and *tameh putroe* is derived from multiplying two central columns by the number of pillar rows. For example, a 4x4 pillar configuration allows four distinct placement possibilities for the *raja* and *putroe* pillars, whereas a 4x5 configuration yields six. In general, if n denotes the number of pillar rows along the house's length (west-east direction), and the total number of pillars is given by the product $4 \times n$, then the number of feasible placements for the royal pillars can be expressed mathematically as $2(n-2)$. This pattern reflects a harmonious integration of mathematical regularity and cultural symbolism in traditional Acehnese architecture.

4. Based on an analysis of the triangular shape of the *tulak angen* element in *Rumoh Aceh* from the perspective of pattern recognition in CT, the concepts of geometric similarity and congruence have been identified. Figure 13 demonstrates that triangles ΔABC and ΔDEF have congruent right angles ($\angle ABC = \angle DEF = \frac{\pi}{2}$) and corresponding sides of equal length (AB = FE), leading to $\angle ACB = \angle FDE$ dan $\angle BAC = \angle EFD$. This reflects the consistent recognition of geometric patterns in traditional architecture, reinforcing the relationship between structural elements and geometric aesthetics in the design of *Rumoh Aceh.*

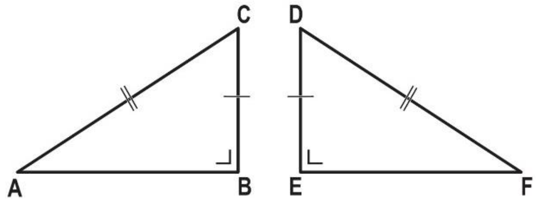


Figure 13. Geometry of the *Tulak Angen*

Furthermore, the geometric patterns found on the *tulak angen*, as illustrated in Figure 14, reveal key mathematical properties, including the similarity of triangles $\Delta ABC \sim \Delta DEF$ and the congruence of triangles $\Delta DEL \cong \Delta FEL$. These configurations form a consistent and repeating motif, reflecting a deliberate use of geometric principles in traditional design. Such patterns exemplify aspects of CT, wherein the spatial relationships and properties of shapes are systematically analysed and manipulated through geometric transformations, such as reflection, similarity, and congruence. This analytical framework not only emphasizes the aesthetic dimensions embedded within the traditional architecture of *Rumoh Aceh* but also facilitates a systematic exploration of its structural logic. By modelling these geometric relationships, learners and researchers can develop computational representations that extend beyond visual symmetry to uncover deeper mathematical regularities. Consequently, these patterns serve as both a pedagogical resource and a foundation for computational modelling, enabling the study of more complex configurations within traditional architectural contexts through a formal mathematical lens.

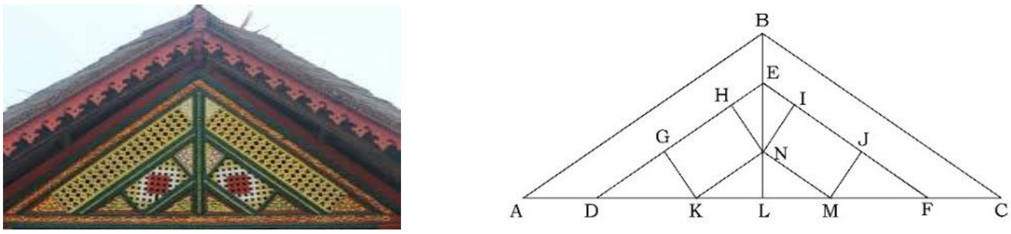


Figure 14. Geometric Patterns in *Tulak Angen* Ornaments

Algorithmic Thinking in *Rumoh Aceh* Geometry

Algorithmic thinking, a core component of CT, extends beyond mere programming or the use of software tools; it involves the formulation of step-by-step procedures—algorithms—that systematically solve problems. This process requires the recognition of patterns, application of logical reasoning, and decomposition of complex problems into simpler, more manageable components that can be solved or optimized through computational methods (Sidek et al., 2020).

The present study applies algorithmic thinking within the context of geometric problem-solving derived from the architectural features of Rumoh Aceh. By constructing algorithms that represent the geometric and cultural structures inherent in traditional Acehnese design, this approach bridges ethnomathematics and formal mathematics. It is particularly significant for junior high school mathematics education, as it allows students to derive solutions based on culturally embedded patterns and geometric principles.

The algorithms developed in this study serve a dual purpose: addressing mathematical challenges while simultaneously promoting cultural understanding. Moreover, they enhance students' analytical reasoning and support the integration of CT into multicultural and real-world learning contexts. Through this fusion of cultural heritage and algorithmic methodology, students gain both mathematical competence and an appreciation for the sociocultural dimensions of knowledge.

1. Algorithm for calculating the area of *Rumoh Aceh:* in Acehnese society, the size of traditional *Rumoh Aceh* houses is typically measured by the number of rooms or *reuweung*, which are columnar spaces bounded by four *tameh*. Each *reuweung* forms a block structure with dimensions of 2.75 *m* by 3 *m*. This concept of ruweung serves as the basis for determining the overall dimensions and area of the house (Figure 15).

Figure 15. *Reuweung*

Generally, each *reuweung* has the dimension of length (*p*) and width (*q*) is 2,75 *m* × 3 *m*. To calculate the area of *Rumoh Aceh* (*A*) by considering the number of *reuweung* (*r*), a computational thinking algorithm can be applied with the following steps:

a. Determine *r* based on the number of *tameh* $(4n)$ resulting in $r = 3(n-1)$,
b. Calculate the area of one *reuweung (R),* $R = pq = 8{,}25\ m^2$,
c. Therefore, the general area of *Rumoh Aceh* with *n tameh* is: $A = rR = 3(n-1)8{,}25\ m^2$.

2. Algorithm for calculating the area of the north and south walls of *Rumoh Aceh*: In discussing the algorithm (CT) for calculating the wall area, it can be determined based on *binteh cato* by applying the abstraction aspect discussed previously. The area of one *binteh cato* section is 3,45 *m*². Therefore, the wall area also be determined by knowing the number of *reuweung* in the north or south section. Each *reuweung* occupies one section of the north or south wall, with the *reuweung*

size being 2.75 *m*. Thus, the total wall area be calculated based on the number of *reuweung.* Consequently, the number of *binteh cato (c)* in one *reuweung* can be determined by:

$$c = \frac{p}{w} = \frac{2{,}75}{0{,}3} = 9{,}17;$$

which is rounded to be 9 pieces. By expressing the wall area (*D*) and the area of *binteh cato* (*B*), it can simplify as $D = 9B$.

The students can also determine the area of the north and south walls based on the *tameh* pattern information: if the *tameh* pattern is 4×4, then the number of *reuweung* in the north-south is *r* = 3; if the *tameh* pattern is 4×5, then *r* = 4; and if the *tameh* pattern is 4×6, then *r* = 5. So by recalling that *n* is the number of *tameh* of the house length in west-east directions, the number of *reuweung* in the north-south is: $r = n - 1$. Then the area of the north and south walls (*L*) can be calculated using the following formula:

$$L = (n-1)\,D = 9(0{,}345)(n-1) = 2{,}76(n-1)\,m^2.$$

Thus, using this algorithm, we can efficiently and systematically determine the wall area of Rumoh Aceh.

3. Algorithm for calculating the area of the west and east walls of *Rumoh Aceh*: in discussing the computational thinking algorithm for calculating the west and east wall areas of *Rumoh Aceh*, we can apply a geometric approach that divides the wall into several sections, as outlined in the decomposition section. The west and east walls consist of two trapezoidal sections and one rectangular section, as shown in Figure 16. The total area of the wall is calculated using the following formula when the shorter side of the trapezoid is denoted as *a*, the longer side of the trapezoid is *b*, the height of the trapezoid is *t*, the length of the rectangle is *u*, and the width of the rectangle is *v*.

Total area = area of trapezoid 1 + area of rectangle + area of trapezoid 2

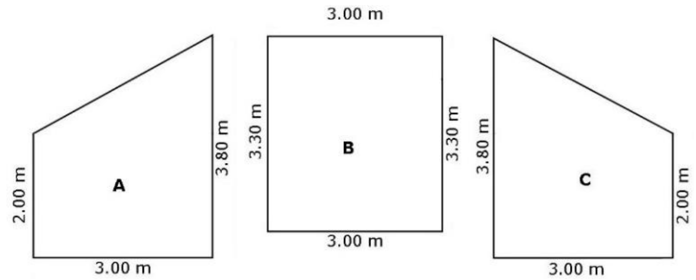


Figure 16. The geometry of the west and east walls

The area of the west and east walls of *Rumoh Aceh* (*E*), each can be calculated using the following formula:

$$E = 2\left(\frac{1}{2}(a+b)t\right) + uv = (a+b)t + uv.$$

Thus, the total area of the west and east walls of *Rumoh Aceh* can be systematically calculated using this algorithm, which breaks the walls into simpler geometric components and computes the area of each section before summing them.

The integration of the geometric design of Rumoh Aceh with the principles of Computational Thinking (CT) offers a meaningful and contextually rich approach to mathematics education, particularly for middle school students. Culture-based mathematics learning has been shown to enhance students' comprehension of abstract geometric concepts by grounding them in familiar and culturally significant contexts (Shahbari & Daher, 2020). Incorporating cultural elements into instruction not only increases students' engagement but also fosters a sense of relevance by connecting mathematical content to their everyday experiences (Sunzuma & Maharaj, 2021a).

Accordingly, the teaching of geometry should actively incorporate local cultural examples to make abstract concepts more accessible and relatable. In contexts where culturally relevant textbooks or geometric teaching aids are lacking, the local environment itself can serve as a vital educational resource (Sunzuma & Maharaj, 2021b). This culturally responsive pedagogical strategy not only enhances the development of CT skills—such as abstraction, decomposition, and algorithmic thinking—but also promotes a deeper understanding and appreciation of local cultural heritage. As such, integrating ethnomathematical contexts into the mathematics curriculum plays a dual role in both cognitive development and cultural preservation.

CONCLUSION

The findings of this study demonstrate that the geometric design of *Rumoh Aceh* can be effectively integrated with the principles of CT to enrich the contextual quality of mathematics education for junior high school students. The architectural elements of *Rumoh Aceh* correspond well with the four key components of CT—decomposition, pattern recognition, abstraction, and algorithmic thinking—each of which contributes to a deeper understanding of geometric concepts within a culturally meaningful framework.

Firstly, decomposition involves disaggregating the structural elements of *Rumoh Aceh* into basic geometric forms such as rectangles, triangles, and trapezoids. For example, the roof exhibits a rectangular configuration, the *tulak angen* represents a triangular shape, and the walls incorporate trapezoidal elements. Decomposing not only the main structure but also the ornamental components enable students to engage with geometry in a concrete and culturally relevant context, facilitating more meaningful learning experiences. Secondly, pattern recognition is evident in the recurring geometric motifs used in the house's construction. Examples include the repetition of rectangular units in the roofing, the combination of planar figures in the walls, and the systematic alignment of the *tameh* (pillars). These consistent patterns reinforce students' ability to recognize and apply geometric concepts, promoting both spatial reasoning and cultural contextualization. Thirdly, abstraction is applied by simplifying complex architectural features to focus on underlying mathematical principles. In the context of *Rumoh Aceh*, abstraction allows for the generalization of calculations—such as determining the area of the *binteh cato*—by omitting ornamental detail and concentrating on essential geometric properties. This process supports students in identifying core mathematical ideas embedded within cultural artifacts, such as formulating linear equations from the geometric structure of *tulak angen*. Lastly, algorithmic thinking is employed to construct systematic procedures for solving geometry-related problems found in the architectural design.

Algorithms developed to calculate the surface areas of walls, roofs, and *reuweung* exemplify how procedural thinking can be rooted in real-world, culturally embedded scenarios. These algorithmic processes not only address mathematical problems but also underscore the value of cultural context in problem-solving.

This study also offers valuable insights for educators and researchers aiming to develop culturally responsive mathematics instruction that nurtures both computational fluency and cultural identity. It highlights how the integration of ethnomathematics and CT, particularly through the geometric characteristics of *Rumoh Aceh*, can serve as a model for contextualized learning in junior high school settings. Using an ethnographic research approach, the study reveals how CT processes—decomposition, abstraction, pattern recognition, and algorithmic reasoning—are inherently embedded in traditional architectural practices. Finally, the design of *Rumoh Aceh* can serve as a pedagogical tool that bridges mathematical content with cultural heritage, thereby fostering an educational environment where students cultivate CT skills while developing a sense of cultural appreciation and respect. This research contributes significantly to the discourse on culturally relevant mathematics education, promoting the dual development of computational competencies and cultural identity in the classroom.

Acknowledgments

The authors express their sincere gratitude to the Aceh Cultural Council (MAA), local cultural experts, and mathematics educators for their invaluable insights and contributions to this research. Appreciation is also extended to the Graduate School of Mathematics and Applied Sciences, Universitas Syiah Kuala, and the Department of Mathematics Education, Institut Agama Islam Negeri Lhokseumawe, for their support

Declarations

Author Contribution	:	NA: Conceptualization, Writing - Original Draft, and Editing. SA: Conceptualization, Writing - Original Draft, and Editing. HS: Resources and Supervision. RO: Formal Analysis and Supervision.
Funding Statement	:	-
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	Additional information is available for this paper.

REFERENCES

Abid. (2017). Ethnography: Linking theory and practices. *Philosophy Study*, *7*(11), 601–605. https://doi.org/10.17265/2159-5313/2017.11.003

Anwar, V. N., Darhim, D., Suhendra, S., & Nurlaelah, E. (2024). Exploring the characteristics of digital pedagogy model for developing computational thinking in mathematical problem solving. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *8*(1), 137-149. https://doi.org/10.31764/jtam.v8i1.17419

Barton, B. (1996). Ethnomathematics: Exploring cultural diversity in mathematics. *American Ethnologist*, *21*(4), 922–923. http://doi.wiley.com/10.1525/ae.1994.21.4.02a00380

Björklund, C. (2008). Toddlers' opportunities to learn mathematics. *International Journal of Early Childhood*, *40*(1), 81–95. https://doi.org/10.1007/BF03168365

Brackmann, C., Barone, D., Casali, A., Boucinha, R., & Muñoz-hernandez, S. (2016). CT panorama of the Americas. *International Symposium on Computers in Education, SIIE 2016: Learning Analytics Technologies*, 1–6.

Brackmann, C. P., Moreno-León, J., Román-González, M., Casali, A., Robles, G., & Barone, D. (2017). Development of computational thinking skills through unplugged activities in primary school. *ACM International Conference Proceeding Series*, 65–72. https://doi.org/10.1145/3137065.3137069

Brenner, M. E. (1998). Adding cognition to the formula for culturally relevant instruction in mathematics. *Anthropology Education Quarterly*, *29*(2), 214–244. https://doi.org/10.1525/aeq.1998.29.2.214

Chen, G., Shen, J., Barth-Cohen, L., Jiang, S., Huang, X., & Eltoukhy, M. (2017). Assessing elementary students' computational thinking in everyday reasoning and robotics programming. *Computers and Education*, *109*, 162–175. https://doi.org/10.1016/j.compedu.2017.03.001

Cheng, C. (2024). Integration of mathematics history into junior middle school education: A pedagogical approach to enhance mathematical literacy. *Journal of Contemporary Educational Research*, *8*(3), 69–72. https://doi.org/10.26689/jcer.v8i3.6419

D'Ambrosio, U. (2016). Change in space, urban culture and ethnomathematics. *Human Rights in Language and STEM Education: Science, Technology, Engineering and Mathematics*, 207–219. https://doi.org/10.1007/978-94-6300-405-3_12

Dagienė, V., & Sentence, S. (2016). It's computational thinking! bebras tasks in the curriculum. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *9973 LNCS*(Bebras), 28–39. https://doi.org/10.1007/978-3-319-46747-4_3

Dhuhri, S. (2018). Islamic arts and the expression of theology: Acehnese traditional house, its ornamentation and figurative motifs. *Wacana Seni Journal of Arts Discourse*, *17*, 1-39.

Disnawati, H., & Nahak, S. (2019). Pengembangan lembar kerja siswa berbasis etnomatematika tenun Timor pada materi pola bilangan [Developing student worksheets based on Timor weaving ethnomathematics on number pattern material]. *Jurnal Elemen*, *5*(1), 64-79. https://doi.org/10.29408/jel.v5i1.1022

Eguíluz, A., Guenaga, M., Garaizar, P., & Olivares-Rodríguez, C. (2020). Exploring the progression of early programmers in a set of computational thinking challenges via clickstream analysis. *IEEE Transactions on Emerging Topics in Computing*, *8*(1), 256–261. https://doi.org/10.1109/TETC.2017.2768550

Ernest, P. (2016). Mathematics and values. *Trends in the History of Science*, 189–214. https://doi.org/10.1007/978-3-319-28582-5_12

Faiziyah, N., Sutama, Sholihah, I., Wulandari, S., & Yudha, D. A. (2020). Enhancing creativity through ethnomathematics. *Universal Journal of Educational Research*, *8*(8), 3704–3710. https://doi.org/10.13189/ujer.2020.080850

Figueiredo, J., & García-Peñalvo, F. J. (2017). Improving computational thinking using follow and give instructions. *ACM International Conference Proceeding Series, Part F1322*. https://doi.org/10.1145/3144826.3145351

Freudenthal, H. (2002). *Revisiting mathematics education*. Kluwer Academic Publishers. http://www.ebooks.kluweronline.com

Greer, B. (2009). *Culturally responsive mathematics education*. Routledge.

Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education*, *34*(1), 37–73. https://doi.org/10.2307/30034699

Hanid, M. F. A., Mohamad Said, M. N. H., Yahaya, N., & Abdullah, Z. (2022). The elements of computational thinking in learning geometry by using augmented reality application. *International Journal of Interactive Mobile Technologies*, *16*(2), 28–41. https://doi.org/10.3991/ijim.v16i02.27295

Helsa, Y., Turmudi, & Juandi, D. (2023). TPACK-based hybrid learning model design for computational thinking skills achievement in mathematics. *Journal on Mathematics Education*, *14*(2), 225–252. https://doi.org/10.22342/jme.v14i2.pp225-252

Hendriyanto, A., Kusmayadi, T. A., & Fitriana, L. (2021). Geometric thinking ability for prospective mathematics teachers in solving ethnomathematics problem. *IOP Conference Series: Earth and Environmental Science*, *1808*(1), 012040. https://doi.org/10.1088/1742-6596/1808/1/012040

Kyeremeh, P., Awuah, F. K., & Dorwu, E. (2023). Integration of ethnomathematics in teaching geometry: A systematic review and bibliometric report. *Journal of Urban Mathematics Education*, *16*(2), 68–89. https://doi.org/10.21423/JUME-V16I2A519

Kyeremeh, P., Awuah, F., & Orey, D. (2024). *Challenges regarding the integration of ethnomathematical perspectives into geometry teaching: The faculty reflection patrick*. *2*(Agustus), 94–100. https://doi.org/10.31235/osf.io/4q9m8

Lee, I., Grover, S., Martin, F., Pillai, S., & Malyn-Smith, J. (2020). Computational thinking from a disciplinary perspective: Integrating computational thinking in K-12 science, technology, engineering, and mathematics education. *Journal of Science Education and Technology*, *29*(1), 1–8. https://doi.org/10.1007/s10956-019-09803-w

Lee, T. Y., Mauriello, M. L., Ahn, J., & Bederson, B. B. (2014). CTArcade: Computational thinking with games in school age children. *International Journal of Child-Computer Interaction*, *2*(1), 26–33. https://doi.org/10.1016/j.ijcci.2014.06.003

Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12? *Computers in Human Behavior*, *41*, 51–61. https://doi.org/10.1016/j.chb.2014.09.012

Nouri, J., Zhang, L., Mannila, L., & Norén, E. (2020). Development of computational thinking, digital competence and 21st century skills when learning programming in K-9. *Education Inquiry*, *11*(1), 1–17. https://doi.org/10.1080/20004508.2019.1627844

Novianti, Y., Amalia, L., & Deni. (2022). Ornamen rumah adat Aceh utara dalam terminologi arsitektur [The north Aceh traditional houses ornaments in an architecture terminology]. *Jurnal Ilmiah Mahasiswa Program Studi Arsitektur Fakultas Teknik Universitas Malikussaleh*, *6*(2), 136–152.

Pathuddin, H., Kamariah, & Mariani, A. (2023). Ethnomathematics of Pananrang: A guidance of traditional farming system of the Buginese community. *Journal on Mathematics Education, 14*(2), 205-224. http://doi.org/10.22342/jme.v14i2.pp205-224

Pathuddin, H., & Nawawi, M. I. (2021). Buginese ethnomathematics: Barongko cake explorations as mathematics learning resources. *Journal on Mathematics Education*, *12*(2), 295–312. http://doi.org/10.22342/jme.12.2.12695.295-312

Prahmana, R. C. I., & D'Ambrosio, U. (2020). Learning geometry and values from patterns: Ethnomathematics on the batik patterns of Yogyakarta, Indonesia. *Journal on Mathematics Education*, *11*(3), 439–456. https://doi.org/10.22342/jme.11.3.12949.439-456

Prahmana, R. C. I., & Istiandaru, A. (2021). Learning sets theory using shadow puppet: A study of javanese ethnomathematics. *Mathematics*, *9*(22), 2938. https://doi.org/10.3390/math9222938

Prahmana, R. C. I., Yunianto, W., Rosa, M., & Orey, D. C. (2021). Ethnomathematics: Pranatamangsa system and the birth-death ceremonial in Yogyakarta. *Journal on Mathematics Education*, *12*(1), 93–112. https://doi.org/10.22342/jme.12.1.11745.93-112

Purniati, T., Turmudi, & Suhaedi, D. (2020). Ethnomathematics: Exploration of a mosque building and its ornaments. *Journal of Physics: Conference Series*, *1521*(3), 032042. https://doi.org/10.1088/1742-6596/1521/3/032042

Putra, R. A., & Ekomadyo, A. S. (2023). Transformation of architecture of *Rumoh Aceh*: An encoding process through semiotic. *Local Wisdom: Jurnal Ilmiah Kajian Kearifan Lokal*, *15*(1), 1–11. https://doi.org/10.26905/lw.v15i1.7632

Rojas López, A., & García Peñalvo, F. J. (2018). Learning scenarios for the subject methodology of programming from evaluating the computational thinking of new students. *Revista Iberoamericana de Tecnologias Del Aprendizaje*, *13*(1), 30–36. https://doi.org/10.1109/RITA.2018.2809941

Sahputra, Z., Meutia, E., Izziah, I., & Edytia, M. H. A. (2020). *Teknologi Konstruksi Arsitektur Rumoh Aceh Studi Kasus: Rumoh Aceh di Desa Meugit, Kabupaten Pidie, Aceh [Aceh House Architectural Construction Technology Case Study: Aceh House in Meugit Village, Pidie Regency, Aceh]*. 041–048. https://doi.org/10.32315/sem.4.041

Setiawan, H., Fauzan, A., & Arnawa, I. M. (2021). The development of geometrical learning devices based on *Rumah Gadang* ethnomathematics for grade VII junior high school. *Journal of Physics: Conference Series*, *1742*(1), 012003. https://doi.org/10.1088/1742-6596/1742/1/012003

Sfard, A. (2006). *Anna Sfard Participationist Discourse on Mathematics*. 153–154.

Shahbari, J. A., & Daher, W. (2020). Learning congruent triangles through ethnomathematics: The case of students with difficulties in mathematics. *Applied Sciences (Switzerland)*, *10*(14), 4950. https://doi.org/10.3390/app10144950

Sidek, S. F., Mohamad Yatim, M. H., & Said, C. S. (2020). Characterizing computational thinking for tertiary education learning. *Journal of Contemporary Issues and Thought*, *10*(2), 58–69. https://doi.org/10.37134/jcit.vol10.sp.6.2020

Spradley, J. P., & McCurdy, D. W. (2012). *Conformity and Conflict: Readings in Cultural Anthropology*. 411. https://books.google.com/books?id=B-OkPvuPzg0C&pgis=1

Sukestiyarno, Y. L., Nugroho, K. U. Z., Sugiman, & Waluya, B. (2023). Learning trajectory of non-Euclidean geometry through ethnomathematics learning approaches to improve spatial ability. *EURASIA Journal of Mathematics, Science and Technology Education, 19*(6), em2285. https://doi.org/10.29333/ejmste/13269

Sunzuma, G., & Maharaj, A. (2021a). In-service mathematics teachers' knowledge and awareness of ethnomathematics approaches. *International Journal of Mathematical Education in Science and Technology*, *52*(7), 1063–1078. https://doi.org/10.1080/0020739X.2020.1736351

Sunzuma, G., & Maharaj, A. (2021b). In-service Zimbabwean teachers' obstacles in integrating ethnomathematics approaches into the teaching and learning of geometry. *Journal of Curriculum Studies*, *53*(5), 601–620. https://doi.org/10.1080/00220272.2020.1825820

Utami, N. W., Sayuti, S. A., & Jailani. (2019). Math and mate in javanese primbon: Ethnomathematics study. *Journal on Mathematics Education*, *10*(3), 341–356. https://doi.org/10.22342/jme.10.3.7611.341-356

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33–35. https://doi.org/10.1145/1118178.1118215

Yilmaz Ince, E., & Koc, M. (2021). The consequences of robotics programming education on computational thinking skills: An intervention of the Young Engineer's Workshop (YEW). *Computer Applications in Engineering Education*, *29*(1), 191–208. https://doi.org/10.1002/cae.22321