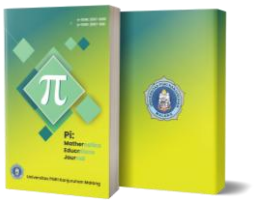
Pi: Mathematics Education Journal
e-ISSN: 2597-6915 p-ISSN: 2597-5161
Vol. 9, No. 1, 2026 | Pp. 51 – 62



Discovering Ethnomathematics in the Architecture of Samin Community in Jepang Bojonegoro

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ARTICLE HISTORY
Received:
October 6, 2025

Revised:
February 13, 2026

Published:
April 30, 2026

Keywords:
Ethnomathematics
Samin Society
Math Concept
Samin Bojonegoro

ABSTRACT
This study aims to analyze the mathematical values contained in the traditional house of the Samin community and determine the application to use the concepts in mathematics learning. Ethnographic approach and triangulasi method are used in qualitative research analysis. Data collection techniques were carried out by literature study, participatory observation, documentation and interviews. Triangulasi is used for data variation and validation while ethnografi is used to study and develop cultural understanding. The results showed that there are ethnomathematics concepts that are relevant to be applied to mathematics learning such as the shape of the roof, poles, doors, windows and the middle room. The discovery of the concept of flat shapes (square, rectangle, triangle, trapezoid), spatial shapes (block, prism), geometrict transformations (translation, rotation, reflection), and similarity. The mathematical concept in this research can be applied to the school curriculum from elementary to high school. Practical value, this research help students understand mathematics through their own enviroment and cultural. Cultural value, ethnomathematics based learning strengthens local identity and cultural presenvation. Use value, the math learning approach is more contextual, fun and relevant ro real life.

Ramadhan, K. A., Anggraheni, F. Y., & Ahmadi. (2026). Discovering Ethnomathematics in the Architecture of Samin Community in Jepang Bojonegoro. *Pi: Mathematics Education Journal*, 9(1), 51–62. https://doi.org/10.21067/pmej.v9i1.12972

1. Introduction

The samin community is a Javanese society that follows the doctrine of Saminisme, which is a philosophy of live tought by Samin Surosentiko. He came from Desa Ploso, Kecamatan Kedhiren, Kabupaten Blora born in 1859 [1][2] . The teachings were spread to various regions in East Java and Central Java such as Pati, Kudus, Bojonegoro [3][4]. The impact of Saminisme is reflected in their lifestyle, society, mutual cooperation, and traditional architecture. The construction, moving of houses, and implementation of

contruction are carried out collectively as a from of solidarity and togetherness of Samin Community [5].

The house of the Samin community presents the values of local wisdom that are filled with philosophical and cultural meanings. This house resembles a Javanese house in general, but there are differences in the number and arragement of poles that resemble *Srotong* or *Bekuk Lulang* [6]. Srotong houses are generally made of teak wood, consisting of a collar and poles (*soko*) that are connected to each other using a traditional system called *purusan*, except for some elements such as *reng usuk* and *singgetan*. The srotong houses system is divided into three main parts: the lower part (stone foundation), the middle part (*soko, goco, polangan, sunduk*), and the upper part (*dudur, pameret, tuwuh, uwuh*). The life of the Samin people uphold simplicity, equality, and harmony with nature, which can be seen in the design and layout of their houses [5]. A number of studies have discussed the Srotong Samin houses from architecture and culture [6][7], but studies that explicitly relate to ethnomathematics are still very limited. Whereas geometric structures, symmetrical patterns, traditional measurement systems used in houses constructional have great potential to be studiet in the context of local culture based mathematics learning. The Srotong houses not only fungctions as a place to live but also as a symbol and cultural values. The architecture of the house reflects the principle of simplicity by paying attention to harmony with nature and surrounding environment. The traditional values and structures of the Samin community contain mathematical elements that grow from the practical of daily life [8], in thus context the culture of the Samin Community has a connetion with the ethnomathematics approach.

Ethnomathematics is a field of study that examines the relationship between mathematics and culture [8]-[10]. According to [11], ethnomathematics is related to the study of cultural aspects through the process of comparing and integrating cultural values into mathematical concepts. Burkhardt emphasized that mathematics is a cultural construction that develops as a human activity [12]. Rosa & Orey also said that ethnomathematics can bridge formal mathematics with cultural practices so as increasing the relevance and meaning of learning [13]. Modern mathematics education requires students to became reliable problem solvers. Therefore, the learning process approach must start from the students' immediate environment. The use of local cultural contexts in learning makes mathematics material more contextual, interactive, and meaningful for students. The integration of local culture also helps foster a sense of identity, cultural pride, and preservation of cultural heritage [14].

Research on Samin houses has so far focused on their structure, cultural and philosophical significance, history, appearance, and their use in the past and present. As explained in [5][6][15], which discuss Samin houses in terms of architecture, cultural meaning, and appearance. Furthermore, based on this explanation, the Samin traditional houses, especially the Srotong house potential to be studied through an ethnomathematics approach.

2. Methods

This study employed a qualitative research design using an ethnographic approach and methodological triangulation. Qualitative research is naturalistic research conducted by means of interviews, observation and dokumentation [16]. The ethnographic approach was chosen to capture the cultural meanings embedded in Srotong house as part of the daily life of Samin community [17]. Data were collected through interviews, participatory observation, and documentation. The participants were selected using purposive sampling, based on their knowledge and involvement in Samin cultural practices related to tradisional housing. Three key informants were involved: 1) a community elder who understanding Samin philosophy and tradisional, 2) a local craftsman who is experienced in constructing

Srotong houses, and 3) a community member who occupies and maintains a Srotong houses. These participans were chose to ensure that the data represented both cultural and technical perspectives of the houses.

The research process began with the first step, participatory observation were conducted in Samin community settlement where the Srotong houses are located. The second, the researcher directly observed the physical structure of the houses, spatial layout, construction process, and daily activities related to its use. The third step was field notes and sketches were used to record geometrical patterns, proportions, and spatial arrangements that potentially represent mathematical concepts. Documentations were collected in the form of photographs of the Srotong house, floor plants, building sketches, and community records related to traditional architecture. These documents supported the identification of mathematical elements such as symmetry, measurement, and spatial relationships.

Data triangulation was applied by systematically comparing and cross-checking information obtained from interviews, observations, and documentation [18]. For example, explanations given by informants regarding the meaning and structure of the house were verified through direct observation and supported by visual documentation. Discrepancies between data sources were clarified through follow-up interpretation. This integration of multiple data sources increased the credibility and reliability of the findings. All data were then coded and analyzed to identify mathematical concepts embedded in the structure of the Srotong house, which were subsequently interpreted as potential contexts for mathematics learning in schools.

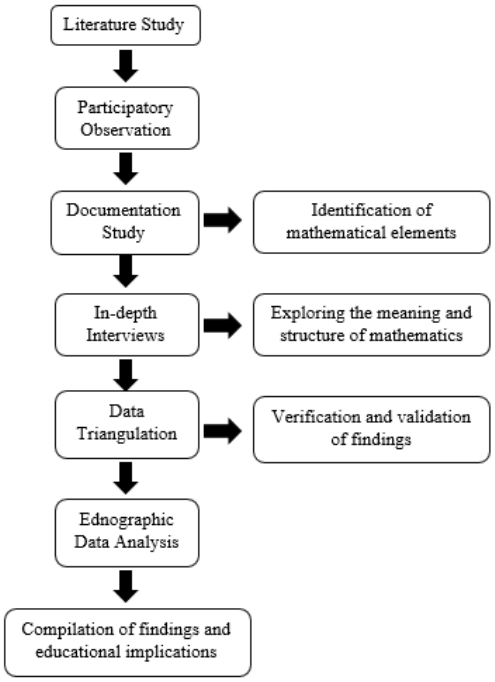


Figure 1. Flowchart of Research in Samin

3. Result and Discussion

The traditional house of the Samin community at first glance looks the same as the traditional Javanese Limasan or Joglo house, but it has a different structure and philosophy. This house is known as *Srotong* or *Bekuk Lulang*, whose architecture reflects the simplicity and life principles of Samin. Unlike the joglo house which display Splendor, the srotong house display more simplicy with the number of poles and a sloping roof. Based on observations and interviews, the roof shape of srotong house reflects equality, humility and harmony with nature. The peak of the roof cones upwards to symbolize the human

relationship with the God, the Creator, while the fields descend in directions to illustrate the harmony with others and the universe.

In general, the composition of house comes from teak wood, with basic rectangular shape measuring an average of 8x12 meters [5]. The building foundation is planted about 25 cm into the ground to provide stability. The number of supporting poles (*soko*) generally consists of four main poles (*soko guru*) and four additional poles. The average size of the pillars is 15×15 cm with a height 250-300 cm. Philosophically, the four main pillars reflect the four cardinal directions (east, west, north, south) which symbolize a straight and honest life from all directions. While the other poles symbolize perfection and harmony, relecting the balance between the inner and outer aspects, the physical and spiritual worlds, and the olderliness in living life with the principle: ”*ora milik sopo-sopo, nanging diduweni kabeh*” (not belonging to anyone, but owned by everyone).

Figure 2. Samin Community House

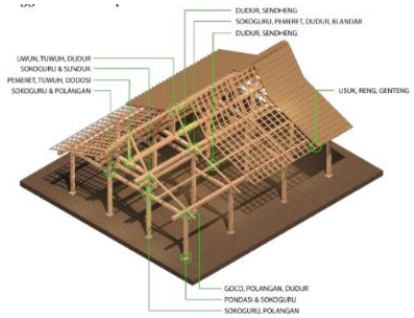
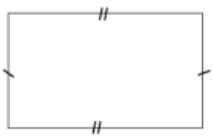


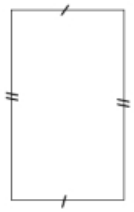
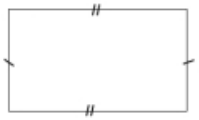
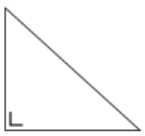
Figure 3. Srotong House Construction
Source: (Sunansyah & Yulita, 2017)

3.1 Concept of Two-dimensional Figure

Flat shape is one of the simple geometric elements seen in the construction of the Srotong Samin house. It appears on the roof, doors, windows and other parts. The door of a Srotong house is generally rectangular with a size of 160-170 cm and a width of 70-80 cm. this size is lower than modern standards, but it has a meaning: guests who enter the house will automatically bow, as a form of respect for the host and the teachings of life upholding simplicity and humility [6]. The windows of the house are also rectangular in shape which functions as a balance keeper and lighting to be more optimal. This is in line with the value of life that clings to nature. The roof of the house is a pyramid-shaped combination of triangles, rectangles and trapezoid which technically not only drains rain efficiently but also contains symbols of protection, balance and sustainability of life. This knowledge was obtained through observation, literature review and dialog with local residents. So it can be said that the geometric elements of the Srotong Samin house are not just building architects but contain cultural values and local wisdom that represent everyday life. This is a real form of mathematical concepts living and developing in the cutural structure of society [8][13] .

Table 1. Shape of Two Dimensional Figure in Samin Community Houses

No	Object Name	Illustration Shape
1	 (Main Door)	 (Rectangle)

2	 (Side Door)	 (Rectangle)
3	 (side Roof)	 (Isosceles Triangle)
4	 (Top Front Roof)	 (Trapezoid)
5	 (Lower Front Roof)	 (Rectangle)
6	 (Upper Roof Support)	 (Isosceles Triangle)
7	 (Side Roof Support)	 (Right Triangle)

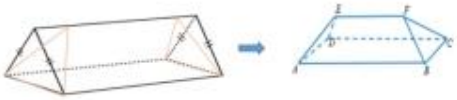
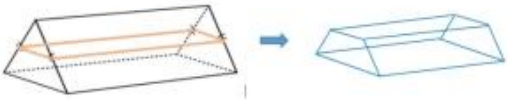
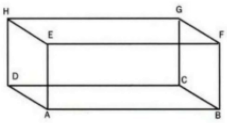
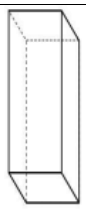
In the construction of the traditional houses of the Samin community, various forms of flat shapes were found that were related to mathematics learning materials at the elementary to secondary school levels. Through direct observation, there are physical elements such as doors, windows and roofs that form rectangles. This shape can be used in student math learning starting in grade four. The concept can be used to understand the area, perimeter and properties of rectangles. The lower front roof also reinforces understanding of the concept of similarity and comparison that can be used for grae eight material. Meanwhile, the side roofs are isosceles triangles, the middle pillars are isosceles triangles, angle properties, perimeter and area. The material can be used in learning mathematics starting from the fifth grade of elementary school. The trapezoid shape on the top roof of the front of the house is very relevant for seventh grade elementary school materials such as calsulating the area, perimeter of a trapezoid and understandings its properties. The combination of all flat shapes in the struture Srotong's hause can be an inspiration in learning the combined area of flat shapes contextually. This material can be taught in the eighth grade

of secondary school. At a more advanced level, the Srotong hause can be used as a medium for learning applied mathematics such as calculating construction or painting costs based on surface area.

3.2 Concept of Three-dimensional Figure

Space are three-dimensional geometric shapes that have space and content. It is limited by sides that are connected to each other, and has certain properties such as ribs, corner points, and side planes. In the Srotong traditional house of the Samin community, the concept of spatial form is evident, one of which is in the roof structure and the middle building. The pyramid-shaped roof of the house resembles a truncated rectangular pyramid, the sloping side planes of which meet at a top point and form ribs as the meeting of the sides. The central structure of the house is supported by main pillars called *soko*, which can be represented geometrically as a block shaped space. The number of Soko in Srotong houses is generally four or eight, which not only has a structure function, but is also full of philosophical meaning.

Table 2. Shape of Three-Dimensional Figure in Samin Community Houses

No	Object Name	Illustration Shape
1	 (Top Roof)	 (Truncated Triangular Pyramid)
2	 (Center Top Roof)	 (Truncated Triangular Pyramid)
4	 (House Body)	 (Cuboit)
5	 (poles/*soko*)	 (Cuboit)

Based on the observations, there are several forms of space that reflect the basic concepts of geometry. The main room appears to be shaped like a block, both from the wall structure to the supporting poles, which can be mathematically utilized to study volume, surface area, angles, and the third dimension. This concept is very relevant to be used as material starting from the sixth grade of elementary school, especially when discussing flat-sided spaces. In addition, the shape of the roof of the house, which is cut off on the right, left and top of the bottom, shows a structure resembling a truncated prism. This shape can be used as a real example in introducing the concept of a truncated prism, and used to calculate

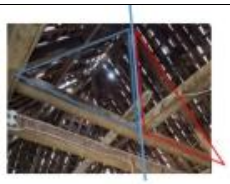
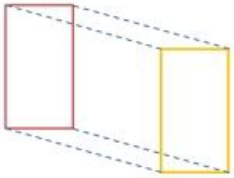
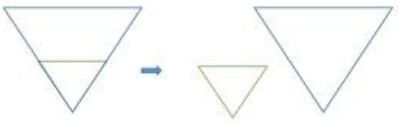
the volume and surface area of irregular spaces at the eighth grade level of junior high school as enrichment material or tenth grade of high school as advanced geometry space material.

In the context of ethnomathematics, the structure of this house reflects how the Samin people traditionally apply geometric knowledge. The part of the house that is built based on the balance of form and function can be a source of contextual learning. Cultural values, the philosophy of simple living, and the relationship between humans and nature can be learned from the concept of the Srotong house. The learning application can be in the form of project activities such as drawing a traditional house plan with scale, making a three-dimensional model of the traditional house building space, and calculating the volume and surface area of the roof and main room of the house. This approach supports local cultural context-based mathematics learning and is in accordance with the principles of Contextual Teaching and Learning and Realistic Mathematics [19].

3.3 Concept of Geometric Transformation

Geometry transformation in the Srotong house of the Samin community is an application of the geometry field which includes position or location, shape, and size. Geometry transformation is a process of change in a geometry field that includes changes in the position, shape, and size of a geometry object. This transformation includes four main types, namely translation (shift), reflection (mirroring), rotation (rotation), and dilation (scaling) [20].

Table 3. Shape of Geometric Transformation in Samin Community Houses

No	Object Name	Illustration Shape
1	 (Upper Roof Support)	 (Reflection X-axis)
2	 (Front door and side door)	 (Translations)
3	 (side Roof)	 (Dilation)

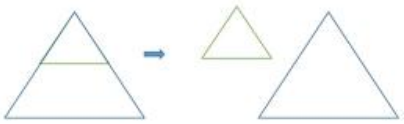
Based on the observation, the upper support part of the roof forms a reflection pattern on the X axis. The right and left roof shapes reflect each other symmetrically. The front door and side door show a translational process, as they have similar shapes and sizes with regularly shifting positions. Meanwhile, the side roofs show dilation, as they have the same shape but with proportionally enlarged or reduced sizes on the left and right sides of the

building. The even slope of the roof also indicates rotation in the formation of angles. The concept of geometric transformation is very relevant as learning material for grade nine of junior high school to senior high school [21].

3.4 Concept of Similarity

The concept of kesebangunan in the Srotong traditional house of the Samin people can be used to determine the comparison between two or more fields that have similar shapes but different sizes.

Table 4. Shape of Similarity in Samin Community Houses

No	Object Name	Illustration Shape
1	 (Side Roof)	 (Similarity)
2	 (Upper Roof and Side Roof)	 (Similarity)

Based on the observation results, similarity can be seen in parts of the house, such as the front door and the side door, or the pillars supporting the right and left parts of the house. the same shape and proportion but different in size. The characteristics of similarity such as equal angles and comparable side comparisons become a reference to assess whether the parts are congruent [22]. In the context of ethnomathematics, the Samin community has applied the concept of similarity intuitively and traditionally in order to maintain balance, structural strength, and building aesthetics that have been passed down from generation to generation. This concept is very suitable to be used as mathematics subject matter for grade nine junior high school, especially in the chapter of Kesebangunan and Kekongruenan. By linking learning to the local cultural context, students not only understand mathematical concepts in the abstract, but can also connect them to cultural heritage and real life [9][23]. This approach also supports the development of contextual-based learning and strengthens students' spatial understanding through direct observation of real objects [24].

3.5 Mathematical Values Contained in the Srotong House of the Samin Community

3.5.1 Practical Value

Practical values in the Srotong traditional house reflect the experience, local wisdom, and hereditary habits of the Samin people. Based on the results of observations, documentation, and interviews with residents, the Samin community, in addition to being able to use modern technical measures such as meters, can determine the size of each pole (*soko*), beam length, and roof height with high accuracy through traditional measurement systems. Traditional systems such as body measurements (*jengkal, hasta, depa*). This shows a very strong contextual mathematical thinking ability, despite not using standardized symbols or formulas.

In addition, the process of building a house is gradual and planned, reflecting the concept of timing and quantitative estimation. They also pay close attention to the calculation of auspicious days (*weton*) before starting construction. Reflecting the relationship between math and spiritual values, typical in Javanese culture. This shows that for the Samin people, math is not only a technical function, but also a part of the harmony of life and social order.

Philosophically, houses are built to fulfill the function of living in harmony with nature and society. The size of the house, the number of pillars, and the shape of the roof are not symbols of luxury, but the result of practical and functional calculations. It refers to the values of simplicity, togetherness, and independence. mathematics becomes a tool to realize a harmonious and sufficient life, in accordance with the principles of life of the Samin people: "*Urip iku mung mampir ngombe, ojo neko-neko"* (life is just stopping by to drink, don't be excessive) [25]. So, the practical value of mathematics in the Srotong house lies not only in the shape and size, but also in the way of thinking, the process of acting, and the values of life that are reflected in every detail of the building.

3.5.2 Cultural Values

In addition to reflecting practical skills in architecture, the Srotong traditional house contains cultural values, especially in terms of beliefs and traditions. Before the construction process begins, the community performs a bancaan ritual or places offerings as a symbol of asking for safety and blessings from nature and ancestors. Calculation of auspicious days (*weton*) based on the Javanese calendar system reflects hereditary culture. This shows that the concept of mathematics is not only logical-formal, but also integrated with the local belief system, as a form of spiritual ethnomathematics. The house construction process is carried out through mutual cooperation. Each member of the community has a role, demonstrating the values of collectivity and work efficiency, as well as the ability to organize time, energy, and resources mathematically but based on culture.

In the construction of the Srotong traditional house belonging to the Samin community, there are various forms of flat and spatial shapes that are relevant to mathematics learning materials from elementary school to high school and the application of ethnomathematics. Rectangles (on doors, windows, and walls) can be used for the material on the area and perimeter of flat shapes starting from the fourth grade of elementary school. Isosceles triangles and right triangles (on roofs and pillars) are used to introduce types of triangles and area/angle calculations in the fifth grade of elementary school to high school. Trapezoids (front roofs) can be used for the seventh grade of junior high school on the material on the properties and area of trapezoids. Combined flat shapes (the entire structure from the top) Suitable for the eighth grade of high school in the material on the combined area of flat shapes. Blocks (house body structure and pillars) are used in the material on volume, surface area, and three dimensions starting from the sixth grade of elementary school. Truncated prism (upper roof of the house) can be enrichment in the eighth grade of junior high school or the main material in the tenth grade of senior high school in the discussion of the volume and area of irregular geometric shapes.

Reflection (on the symmetrical shape of the upper roof to the X-axis), Translation (on the front and side doors), Dilation (on the left-right side roofs), Rotation (on the slope and orientation of the roof). These concepts are suitable for the ninth and tenth grades of junior high school according to the geometric transformation and symmetry material in the 2013 and Merdeka Curriculums [21]. Similarity can be seen in the similarity of the shape between the front and side doors, as well as the left and right support pillars, which show equal angles and comparable sides. This material is suitable for the ninth grade of junior high school in the material on Similarity. Application of Applied Mathematics. The concept

of calculating costs, material needs, and scale can be introduced in the tenth grade of junior high school in the context of applied mathematics and spatial geometry. This traditional house is a source of contextual learning in the ethnomathematics approach, because it reflects: Traditional measurements (using spans/hastas), Calculation of auspicious days (weton) for construction, Symmetry and proportion in building aesthetics, as well as, The philosophy of simplicity, harmony with nature, and mutual cooperation, all of which enrich meaningful mathematics learning.

3.6 The Context of Samin Houses in Mathematics Learning

Mathematics education in Indonesia is implemented based on eight national education standards, three of which include Graduate Competency Standards and the Content Standard. Graduate Competency Standards refers to the established criteria for graduates' qualifications, encompassing attitudes, knowledge, and skills. Referring to Regulation of the Ministry of Primary and Secondary Education (Permendikdasmen) No 10 of 2025 on Graduate Competency Standards, one of the competencies that secondary school graduates must possess is the ability to apply literacy and numeracy to solve problems in everyday life.

Graduate Competency Standards contain the main objectives of the entire educational process in schools. To achieve this, there needs to be standards that regulate the content that can be used to train all the competencies to be achieved as outlined in the content standards. The Content Standards defines the criteria regarding the scope of subject matter and level of competence required to achieve graduate competencies. Referring to Regulation of the Ministry of Primary and Secondary Education (Permendikdasmen) no. 12 of 2025, the scope of mathematics for junior secondary schools includes real number, ratios, algebraic equations and inequalities, relations and functions, solid figures, basic geometric concepts, data interpretation, and probability. All of these topics are intended to support the solving of relevant real-life problems. The Samin house, with its distinctive shape structure, provides meaningful contexts for learning solid geometry and basic geometry concept. The shape of the doors and the roof, which are constructed according to specific rules, can helps students understanding the concept s of area and perimeter of plane figures as well as similarity. The roof supports and the arrangement of the doors in the Samin house can also facilitate students' understanding of geometric transformations. Others architectural components of the Samin house can further serve as source of contextual problems related to polyhedral geometry.

In addition to serving as a platform for students to solve problems, its alignment with content standards can create a learning environment that supports graduate competence. This can certainly inspire mathematical problems for students in that region to learn mathematical problems for students in that region to learn mathematical concepts, especially geometry. Setyabudi describe similar things related to the shape and morphology of traditional Samin houses [5].

4. Conclusion

Based on the research results, it can be concluded that the Srotong traditional house of the Samin community in Dusun Jepang, Margomulyo Village, Bojonegoro Regency, contains many ethnomathematic concepts that are relevant to be integrated into mathematics learning. The structure of the Srotong house, such as the shape of the roof, pillars, doors, and floors, reflects the application of mathematical concepts such as flat shapes (squares, rectangles, triangles, trapezoids), spatial shapes (cubes, prisms), geometric transformations (translations, rotations, reflections), and similarity. Although the Samin community builds houses without using formal mathematical formulas, their practices show an understanding

of the principles of geometry and measurement that are passed down from generation to generation.

These findings indicate that ethnomathematics values contained in local culture can be used as a source of contextual and meaningful learning. Integration of mathematical concepts from Srotong traditional houses into the curriculum can be done starting from elementary school to high school. Elementary school, flat and spatial shapes can be introduced through parts of the house. Middle school and high school, the concepts of area, volume, symmetry, and geometric transformation can be associated with the structure and pattern of the traditional house. In practice, this approach helps students understand mathematics through their own environment and culture. From a cultural perspective, ethnomathematics-based learning strengthens local identity and the preservation of cultural heritage. Meanwhile, in terms of usability, this approach makes mathematics learning more contextual, fun, and relevant to students' real lives, thus increasing learning motivation and natural absorption of materials.

This study focuses only on analyzing mathematical concept that can be integrated into the Samin hauses contextual and their application in mathematics learning. The approach used is ethnomathematics to analyze this suitability, but empirical results related to its effectiveness in learning can be an area for further research.

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