Al-Khwarizmi: Jurnal Pendidikan Matematika dan Ilmu Pengetahuan Alam
Maret-2022, Vol.10, No.1, hal.23-34
ISSN(P): 2337-7666; ISSN(E):2541-6499
https://ejournal.iainpalopo.ac.id/index.php/al-khwarizmi
DOI: http://dx.doi.org/10.24256/jpmipa.v10i1.1953

The Use of Miniature Joglo Houses in Learning to understand Plane and Solid Figure

Pemanfaatan Miniatur Rumah Joglo dalam Pembelajaran Bangun Datar dan Bangun Ruang

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Article History:
Received: 01-07-2021; Received in Revised: 23-01-2022; Accepted: 23-03-2022

Abstract

Learning with an ethnomathematical approach based on Realistic Mathematics Education (RME) can help students understand mathematical problems based on the culture they experience. This article examines the use of the Joglo House miniature props on planes and solid figures. This research is explorative with an ethnographic approach. The methods used are exploration, observation, documentation, and literature study. The results showed that the Joglo house can be used as an illustration in studying the elements and properties of planes and solid figures. Students can be directly involved in understanding the shapes of squares, rectangles, trapezoids, and cuboids. Students can also understand the concept of congruence well. Exploration of mathematical elements in the miniature of the Joglo House is highly recommended so that students are not fixated only on the stage of knowledge of geometric shapes

Keywords*: Mathematics Props, Ethnomathematic, Realistic Mathematics Education, Joglo House.*

Abstrak

Pembelajaran dengan pendekatan ethnomathematical berbasis Realistic Mathematics Education (RME) dapat membantu siswa memahami masalah matematika berdasarkan budaya yang dialaminya. Artikel ini mengkaji penggunaan miniatur rumah Joglo untuk memahami konsep bangun datar dan bangun ruang. Penelitian ini bersifat eksploratif dengan pendekatan etnografi. Metode yang digunakan adalah eksplorasi, observasi, dokumentasi, dan studi pustaka. Hasil penelitian menunjukkan bahwa rumah Joglo dapat digunakan sebagai ilustrasi dalam mempelajari unsur dan sifat bangun datar dan bangun datar. Siswa dapat terlibat langsung dalam memahami bentuk persegi, persegi panjang, trapesium, dan balok. Siswa juga dapat memahami konsep kekongruenan dengan baik. Eksplorasi unsur matematika pada miniatur Rumah Joglo sangat dianjurkan agar siswa tidak terpaku hanya pada tahap pengetahuan bentuk bangun datar dan bangun ruang saja.

Kata Kunci*: Alat Peraga Matematika, Etnomatematika, Realistic Mathematics Education, Rumah Joglo.*

Introduction

Mathematics is one of the subjects studied from elementary to advanced levels [1]. In the formalist view, mathematics is the study of abstract structures defined axioms using symbolic logic and notation[2]. One of the fields of study in mathematics is geometry. Geometry is a part of mathematics that is very close to students because almost all visual objects around students are geometric objects[3].

Abstracts in mathematical studies become one of the problems in teaching and learning activities. The next problem is that the teacher tends to be monotonous in delivering the material so that students become less interested and think mathematics is a difficult subject [4]. Sudarwanto and Ibn Hadi stated that interest in learning mathematics was the first step in the emergence of interest and motivation to learn [5]. Another problem based on research by A. Hidayat, Zulhendri, and B. Casandra, the use of appropriate learning media is the most common difficulty for teachers in learning mathematics[6].

The presence of learning media is very helpful for students who are in the concrete operational phase in understanding mathematical material that is abstract or unable to be explained in verbal language[7]. In this case, teaching aids function to explain or demonstrate a concept in the teaching and learning process [8].

In addition to teaching aids, mathematics learning is also needed that can facilitate students, one of which is the Realistic Mathematics Education

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[1] Dyah Erlina Sulistyaningrum, Puguh Karyanto, and Widha Sunarno, "Pengembangan Modul Berbasis Model Pembelajaran Arias Untuk Memberdayakan," *Jurnal INKUIRI* 4, no. I (2015): 104–16, https://doi.org/10.20961/inkuiri.v4i1.9576.

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[4] Eriza Dwi Yuniar and Ramlah, "Meningkatkan Kepercayaan Diri Siswa dalam Pembelajaran Matematika Di SMP Negeri 2 Teluk Jambe Barat," *MAJU* 8, no. 1 (2013): 0–12.

[5] Sudarwanto Sudarwanto and Ibnu Hadi, "Pengembangan Alat Peraga Pembelajaran Matematika Sekolah Dasar Untuk Meningkatkan Kemampuan Berpikir Matematis Siswa," *Sarwahita* 11, no. 1 (2014): 32, https://doi.org/10.21009/sarwahita.111.06.

[6] Adityawarman Hidayat, Zulhendri, and Bunga Casandra, "Analisis Kesulitan Guru Sekolah Dasar Dalam Menerapkan," *Prosiding Seminar Nasional Pendidikan FKIP* 2, no. 1 (2019): 528–228.

[7] Hamdan Husein Batubara, "Pengembangan Media Pembelajaran Matematika Berbasis Android Untuk Siswa SD/MI," *MUALLIMUNA: Jurnal Madrasah Ibtidaiyah* 3, no. 1 (2017): 12–27.

[8] Suwardi Suwardi, Masni Erika Firmiana, and Rohayati Rohayati, "Pengaruh Penggunaan Alat Peraga Terhadap Hasil Pembelajaran Matematika Pada Anak Usia Dini," *Jurnal Al-Azhar Indonesia Seri HUMANIORA* 2, no. 4 (2016): 297, https://doi.org/10.36722/sh.v2i4.177.

(RME) approach. The RME approach is rooted in Freudenthal's (1971) view of mathematics as a human activity. This involves the introduction of new mathematical concepts through paradigmatic examples set in the context of realistic situations [9]. The RME approach provides opportunities for students to rediscover and construct mathematical concepts based on realistic problems given by the teacher. Students build their knowledge so they will not easily forget. In addition, the atmosphere in the learning process becomes more enjoyable because it uses everyday [10]. RME is specifically associated with instructional design, where students must guide other students from informal to formal mathematical knowledge [11]. According to Yeni Yuniarti, one of the lessons that pay attention to the structure of students' thinking abilities or mental development of children is learning mathematics with Indonesian Realistic Mathematics Education (PMRI) [12]. PMRI is a learning approach that emphasizes human activities in which contextual learning is used in the situation in Indonesia [13].

The combination of mathematics and culture is referred to as ethnomathematics. According to Yuni Pusvita and Wahyu Widada, ethnomathematics is an activity that involves numbers, geometric patterns, calculations, and so on as mathematical knowledge that involves local culture [14]. Culture is a community habit that has been passed down from generation to generation and becomes the identity of an area [15]. With an ethnomathematical approach, it is hoped that it will make it easier for students to understand abstract shapes, flat shapes, and building spaces with the help of Joglo house miniature props.

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[9] Juhaina Awawdeh Shahbari and Irit Peled, "Resolving Cognitive Conflict in a Realistic Situation With Modeling Characteristics: Coping With a Changing Reference in Fractions," *International Journal of Science and Mathematics Education* 13, no. 4 (2015): 891–907, https://doi.org/10.1007/s10763-014-9509-1.

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[11] Helge Fredriksen, "Exploring Realistic Mathematics Education in a Flipped Classroom Context at the Tertiary Level," *International Journal of Science and Mathematics Education* 19, no. 2 (2021): 377–96, https://doi.org/10.1007/s10763-020-10053-1.

[12] Yeni Yuniarti, "Pendidikan Matematika Realistik Indonesia (PMRI) untuk Meningkatkan Pemahaman Konsep Geometri di Sekolah Dasar," *Jurnal Pendidikan Dasar Eduhumaniora* 3 (2010).

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[15] Arum Purba Sulistyani et al., "Eksplorasi Etnomatematika Rumah Adat Joglo Tulungagung," *Media Pendidikan Matematika* 7, no. 1 (2019): 22, https://doi.org/10.33394/mpm.v7i1.1537.

Learning by utilizing an ethnomathematical-based Realistic Mathematics Education (RME) approach namely learning related to everyday life with a blend of mathematics and culture. This combination will make it easier for students to understand mathematics [16]. According to Sulistiyani et al, the concept of ethnomathematics makes a major contribution to the improvement of mathematics learning, because it relates to students' experiences in everyday life that touch the realm of local arts and culture [17].

Arum Purba Sulistyani et al. [18], and Achmad Zulkifli and Ika Rahmawati [19] have found the concept of plane figure and solid figure in Joglo Tulungagung and Ponorogo houses. Continuing this, this article tries to develop the findings of the concept of plane figure and solid figure in the Joglo house using the help of miniature Joglo house props to help students understand the material of plane figure and solid figure in a concrete way.

Method

This research is exploratory with an ethnographic approach. This approach was chosen because this research relates to the culture that developed in the community in this case the Joglo House which is used to understand the concept of the plane and solid figure in learning mathematics. The method used is exploration, observation, documentation, and literature study. Exploration activities are carried out to describe specifically the parts that are in the miniature of the Joglo House which is related to the plane and solid figure. Furthermore, observations were made to find out what aspects were related to the concept of the plane and solid figure. To describe the miniature parts of the Joglo House, photo documentation was taken by focusing on the parts related to the plane and solid figure.

Results and Discussion

The traditional house is one of the concrete cultures[20]. The Joglo house is a local cultural icon from the island of Java which has many philosophies. One of the philosophies of the Joglo House is the roof that resembles a

[16] Tivani Sandra Witha, V. Karjiyati, and Pebrian Tarmizi, "Juridikdas Pengaruh Model RME Berbasis Etnomatematika Terhadap Kemampuan Literasi Matematika Siswa Kelas IV SD Gugus 17 Kota," *Juridikdas Jurnal Riset Pendidikan Dasar* 3, no. 2 (2020): 136–43.

[17] Sulistyani et al., "Eksplorasi Etnomatematika Rumah Adat Joglo Tulungagung."

[18] Ibid.

[19] Achmad Zulkifli; Ika Rahmawati, "Eksplorasi Rumah Adat Joglo Pada Materi Geometri di Sekolah Dasar," *JPGSD* 8, no. 3 (2020): 591–600.

[20] Djono, Tri Prasetyo Utomo, and Slamet Subiyantoro, "Nilai Kearifan Lokal Rumah Tradisional Jawa," *HUMANIORA* 24, no. 3 (2012): 269–78.

mountain, which means a mountain is a sacred place according to Javanese belief[21].

Figure 1. The Joglo House (*Source: www.kompas.com*)

Based on the findings of Sulistiyani et al, Achmad Zulkifli, and Ika Rahmawati in the Joglo house, there are geometric shapes, namely plane and solid figures [22,23]. Based on the miniature Joglo House as shown in Figure 2, it can be seen that there are several geometric shapes in the form of the plane and solid figure. Such as square, rectangular, trapezoidal, and beam shapes. The miniature Joglo House seen in Figure 2 was made using wooden sticks.

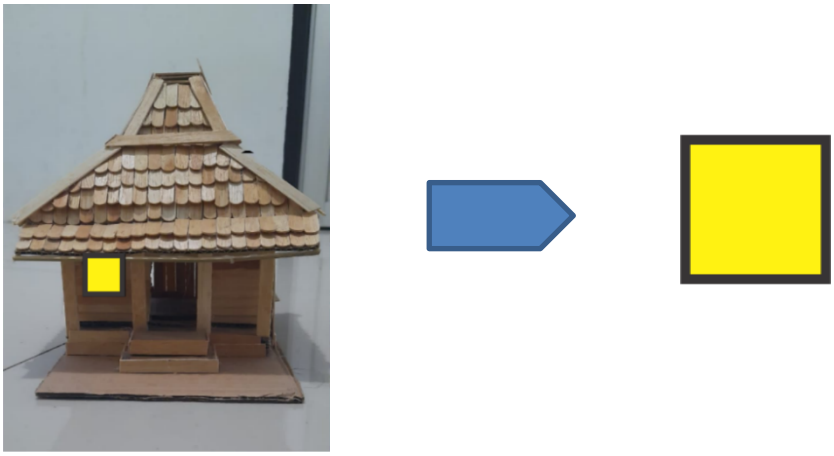

Figure 2. The Square in Joglo House (*Source: Author's Documentation*)

Based on Figure 2, the window represents as plane figure as square. From this representation, students can name the elements in a square, such

[21] Achmad Zulkifli; Ika Rahmawati, "Eksplorasi Rumah Adat Joglo pada Mater Geometri dI Sekolah Dasar."

[22] Ibid.

[23] Sulistyani et al., "Eksplorasi Etnomatematika Rumah Adat Joglo Tulungagung."

as sides, angles, vertex and diagonals. Students can also mention the properties of a square and directly measure the length of the side of the window, which is 2 cm (See Figure 2 and Figure 3).

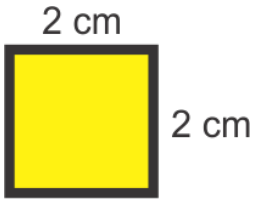

Figure 3. The Square 2 cm x 2 cm (*Source: Author's Documentation*)

Based on Figure 4, the door section represents as a plane figure as rectangle. From this representation, students can learning the properties of a rectangle and directly measure the length and width of the door, which is 7 cm and 3 cm.

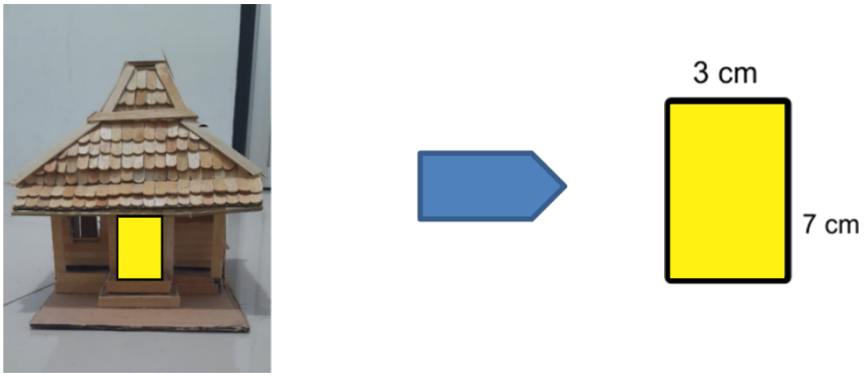

Figure 4. The Rectangle in Joglo House (*Source: Author's Documentation*)

Based on Figure 2 and Figure 4, students can understand the difference between a square and a rectangle. The difference in the concept can be obtained through the characteristics obtained directly from the shape of the windows and doors of the Joglo House.

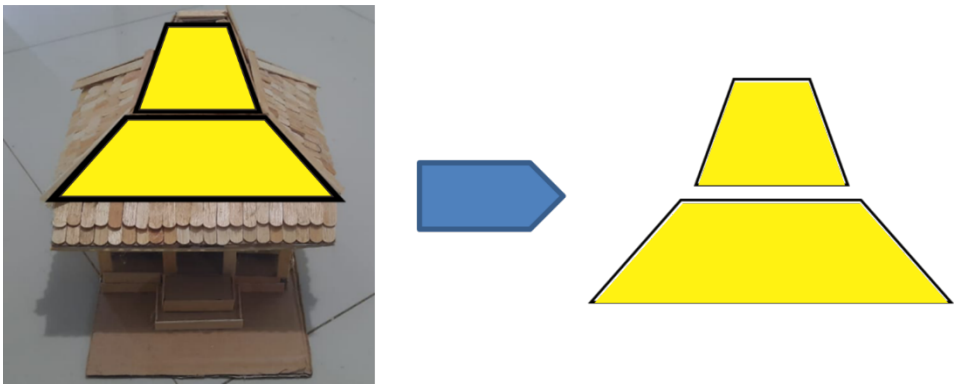

Figure 5. The Trapezoid in Joglo House (*Source: Author's Documentation*)

Based on Figure 5, the roof represents a trapezoidal. From the shape of the trapezoid, students can understand the elements and properties present in the trapezoid, then compare them with the elements and properties that are on squares and rectangles. Students can also measure directly the trapezoidal side, namely the upper side of 10 cm, the side of the base of 16 cm, and the inclined side of 8 cm (See Figure 5 and Figure 6).

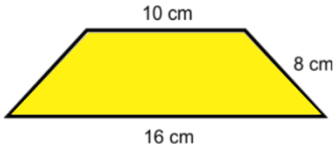

Figure 6. The Trapezoid (*Source: Author's Documentation*)

Furthermore, based on Figure 7, the mast section represents a beam. From this form, students can understand the parts of the beam as well as calculate the circumference and surface area of the beam.

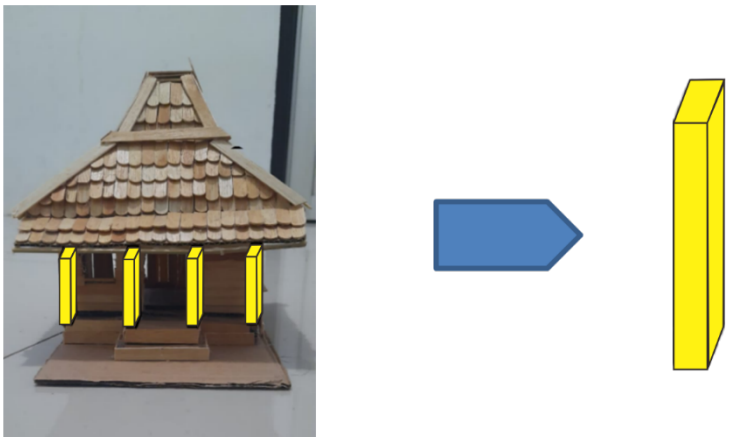

Figure 7. The Beam Representation in the Joglo House (*Source: Author's Documentation*)

Based on the representations that have been shown, students can better understand the elements and properties of the plane and solid figure. The use of media in learning tends to improve students' mathematics learning outcomes [24]. Further, Students' interest in mathematics will further develop through student involvement in mathematical objects using simple and inexpensive equipment [25]. Consider the following three examples that explain

[24] Muhammad Roy Aziz Haryana et al., "Virtual Reality Learning Media with Innovative Learning Materials to Enhance Individual Learning Outcomes Based on Cognitive Load Theory," *The International Journal of Management Education* 20, no. 3 (November 1, 2022): 100657, https://doi.org/10.1016/j.ijme.2022.100657.

[25] Thierry Dias and Jimmy Serment, "Learning by Doing in Mathematics.," 2015, https://orfee.hepl.ch/handle/20.500.12162/1698.

the concept of awakening and some of the traits found in a plane and solid figures.

Example 1. The plane figures P, Q, and R are square in shape with each area of 16 cm^2, 9 cm^2, and 4 cm^2. Calculate the circumference in figure 8.

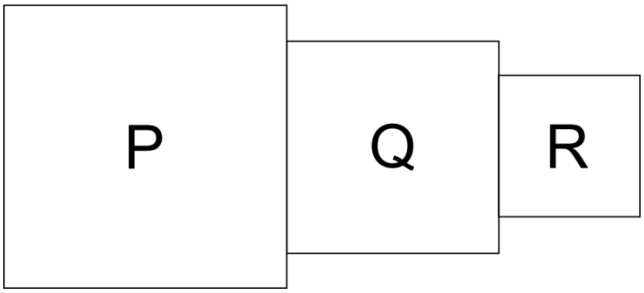

Figure 8. The Plane Figures PQR (*Source: Author's Documentation*)

Solve. It is known that the square area P = 16 cm^2, the square area Q = 9 cm^2, and the square area R = 4 cm^2. The length of the sides of each square in order is P = $\sqrt{16} = 4$ cm; Q $\sqrt{9} = 3$ cm; R = $\sqrt{4} = 2$ cm. See Figure 9.

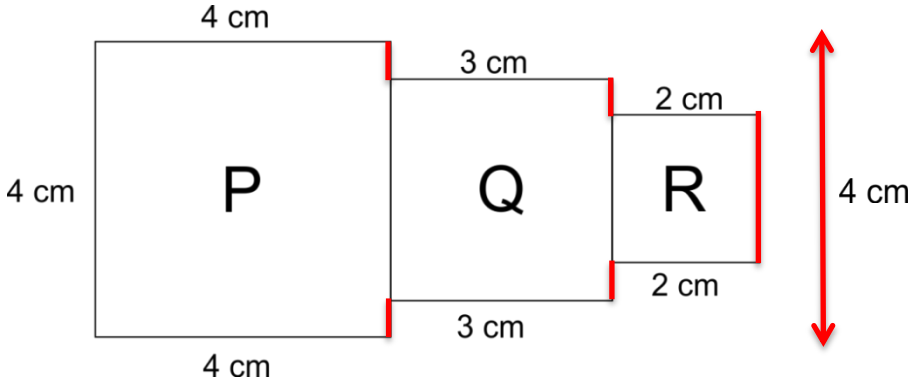

Figure 9. The Plane Figures PQR with Illustration (*Source: Author's Documentation*)

The sum of the lengths of the five red lines is equal to the length of the largest square side which is 4 cm. So that the circumference of the plane figure is 26 cm.

Example 2. The trapezoid ABCD is equivalen with PQRS. Determine the length of the RS!

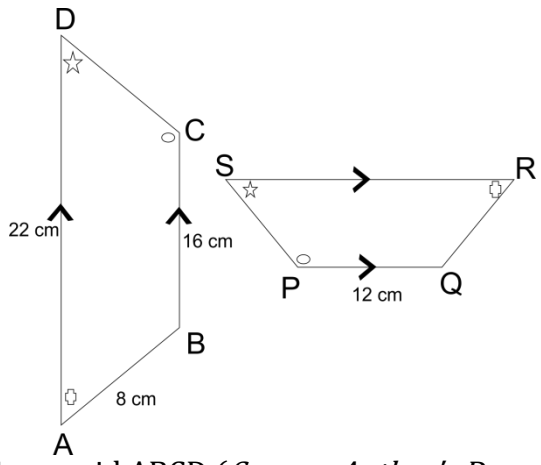

Figure 10. The Trapezoid ABCD (*Source: Author's Documentation*)

Solve. It is known that trapezoid ABCD is in conjunction with trapezoidal PQRS, hence RS ~ AD and PQ ~ BC. By the concept of comparison, obtained the length of the RS is 16.5 cm.

Example 3. Sebuah tugu berbentuk balok dengan alas berbentuk persegi berukuran 40 cm x 40 cm dan tinggi tugu 2 m. Tugu tersebut akan dicat dengan satu kaleng cat untuk 1 m^2. Berapa minimal kaleng cat yang dibutuhkan agar tugu dapat dicat seluruhnya?

Solve. See Figure 11.

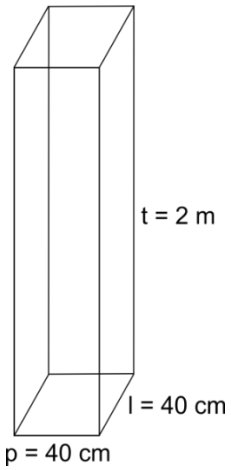

Figure 11. The Cuboid (*Source: Author's Documentation*)

Based on Figure 11, the surface area of the cube is 3.52 m2. because 1 m2 takes 1 tin of paint, it takes 4 tin to paint all surfaces of the monument

The Joglo Houses can be used as illustrations to understand the properties and elements contained in the plane and solid figures. Through the miniature, students can get to know the concepts of volume, circumference, and area. The involvement of students directly in learning geometry is visually, aesthetically, and intuitively attractive to students[26].

Based on Siti Annisah [27], concrete props are needed to provide students with an understanding of mathematical concepts. In line with that, Igor Verner dkk [28] and Fitri Nur Kholisa [29] stated that the ethnomathematics approach in learning makes it easier for students to understand the material because it is directly related to culture and daily activities. The teacher's as a facilitator in explaining the shape of the plane and solid figure based on the miniature of the Joglo house will be able to create a conducive learning atmosphere so that it is expected to improve students' mathematics learning outcomes.

Conclusion

This research has shown that the Joglo house can be used as an illustration in studying the elements and properties of planes and solid figures. Students can be directly involved in understanding the shapes of squares, rectangles, trapezoids, and cuboids. Students can also understand the concept of congruence well. Hal This is because the Joglo House is a realistic object that is directly related to the daily life of students. This study recommends the use of the concept of culture in learning mathematics with RME. Exploration of mathematical elements in the miniature of the Joglo House is highly recommended so that students are not fixated only on the stage of knowledge of geometric shapes.

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