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Ethnomathematics Study: Learning Geometry in the Mosque Ornaments

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Abstract— **In general, many Indonesian students have difficulty learning mathematics. Mathematics is widely used and developed by humans to solve problems in everyday life. However, mathematics is rarely taught as a culturally related subject. The mosque is a cultural embodiment whose ornaments use a lot of geometric motifs. Ethnomathematics studies the relation between mathematics and culture. This research aims to explore the geometry concepts on mosque ornaments, determine how to construct mosque ornaments using geometry concepts, and create contextual geometry problems based on mosque ornaments. The research employed a qualitative approach with an ethnographic method. The research location was the Grand Mosque of Bandung, West Java, Indonesia. The researchers act as an instrument of data collection. The triangulation technique is used to generate valid data, which was carried out through observations, interviews, and literature studies. Data condensation, data display, and concluding were used to analyze the research data. This research showed that the Grand Mosque of Bandung ornaments have geometry concepts, namely points, lines, angles, triangles, squares, rhombuses, kites, trapeziums, hexagons, circles, translation, reflection, rotation, and dilation. Mosque ornaments can be constructed using geometry concepts. In addition, contextual geometry problems can be created based on mosque ornaments. These results indicate that the ornaments of the Grand Mosque of Bandung are rich in geometry concepts. Therefore, mosque ornaments can be used as alternative learning media to overcome students' mathematical difficulties, especially in geometry material.**

Keywords— **Culture; ethnomathematics; geometry; mosque; ornament.**

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I. INTRODUCTION

Mathematics is one of the subjects that Indonesian students must master. However, in reality, many Indonesian students have difficulty learning mathematics. This difficulty can be seen in a large number of students who have experienced anxiety in learning mathematics [1]. One of the causes of this difficulty is that mathematics has often been taught without real connections to students' daily life [2]. Mathematics taught in schools is not contextual and does not relate to everyday life. Mathematics is still considered a subject that is free-culture influence [3]. As a result, mathematics learning becomes a transfer of knowledge, and students receive it without any reflection or understanding of how mathematics is used in everyday life [4].

Culture is a means for humans to adapt to their environment, whereas mathematics is realized as a result of human activity [5]. Mathematics develops as a result of various activities. Mathematics is based on human ideas, methods, and techniques for responding to their environment [4]. Mathematical ideas and practices appear in works of art, architectural concepts, activities, and artifacts from various cultures. Therefore, mathematics is a cultural product [6].

Regarding the problems of mathematics education in Indonesia, efforts need to link mathematics to culture. Teachers must choose activities based on real-world issues that are important to students. Mathematics teaching and learning in schools should start by connecting mathematics to students' experiences in everyday life. Cultures around students can be used as engaging learning media. Students will find it easier to observe and imagine what the teacher is explaining so that it can help them master mathematics better [7]. Thus, teachers need to apply the principle of cultural appropriateness in learning mathematics.

The main aim of mathematics education is to promote the development of new knowledge, and we must consider society and its cultural aspects to generate new knowledge.

The ethnomathematics program is based on this critique of mathematics education that exclusively focuses on mathematics content and pays less attention to cultural issues [8]. The study of the relationship between mathematics and culture is known as ethnomathematics [9]. Ethnomathematics is a concept that combines mathematics learning with culture to comprehend cultural values [10]. Ethnomathematics includes cultural backgrounds, experiences, activities, and the environment [11].

According to D'Ambrosio [12], ethnomathematics comes from the Greek words, *ethno*, *mathema*, and *techne*. *Ethno* refers to various cultural, social, and other environments, and *Mathema* refers to explaining understanding and teaching. *Techne* refers to a technique, method, and art. Therefore, by synthesizing these three words, we get ethnomathematics, which means a set of techniques for understanding the cultural environment developed by cultural groups. D'Ambrosio [13] stated that cultural groups, such as urban and rural populations, workers, professionals, children, indigenous peoples, and other groups, practice ethnomathematics.

Students' understanding of the world and how they view their own and others' experiences are influenced by culture. When students arrive at school, they bring ideas and concepts from their socio-cultural world with them [14]. Teaching mathematics needs to pay attention to the knowledge around students. Students will understand mathematics ideas more simply and effectively if they are connected to their socio-cultural environments and daily experiences. Mathematics will be more accessible to a larger number of students because they will be able to connect mathematical concepts to a variety of experiences and activities outside of the classroom [11].

Research in ethnomathematics is growing rapidly and provides significant benefits. Students' problem-solving ability increase with ethnomathematics [15]. Ethnomathematics can improve students' geometric, creative, and algebra thinking [16]. Students' understanding of mathematics can be improved by ethnomathematics [17]. External mathematical connections and student activities can both improve through ethnomathematics [18]. Learning mathematics using culture can improve the quality of teaching [19]. Therefore culture-based mathematics helps teachers develop teaching that can influence the development of students' mathematical knowledge.

Ethnomathematics also has the potential to create social justice. Ethnomathematics helps students feel accepted and more accepting of others. Mathematics must be the same for all students from various cultural backgrounds [20]. Using diverse cultures in the classroom helps promote student solidarity, respect, and cooperation [21]. Students can learn about all cultures in the class, such as family traditions, hobbies, work, crafts, and games. Using ethnomathematics in the class can show students that their culture and other people contribute to mathematics. Therefore, ethnomathematics needs to integrate into mathematics learning.

Indonesia has a great diversity of cultures, which can be explored as resources to solve problems in mathematics education and improve mathematics teaching and learning in general. Among this wealth of cultures are the cultures from the West Java region. Some studies have documented the exploration of mathematical concepts embedded in the cultures of West Java. Umbara *et al*. [22] explored symbolic measuring used in daily activities by the Cigugur indigenous people. Suprayo *et al*. [23] explored the mathematical aspects of the Suranenggala Kidul Village Farmers' culture in Cirebon. Hermanto *et al*. [24] exposed ethnomathematics in the Kampung Naga indigenous peoples. Yulianto *et al*. [25] reported ethnomathematics interpretations of Tariqa Qodiriyah Naqsyabandiyah Ma'had Suryalaya's Dhikr Jahar practice. Umbara *et al*. [26] explored the customs of Cigugur indigenous people when calculating the optimal time to begin house construction. These studies show that mathematical concepts embed in various cultural practices in West Java. However, none of these studies explored geometry concepts in the mosque ornaments.

The mosque manifests culture and results from the acculturation of Islamic culture and local culture. Mosque ornaments use a lot of geometric motifs. Indonesia is one of the countries with the largest Muslim population in the world, and West Java is also one of Indonesia's provinces with the largest Muslim population. Thus, a mosque is easy to find everywhere, making it a cultural environment that is close to students. The relation between mathematics and culture can be seen in the mosque ornaments. Mathematics learning will be more effective and meaningful if it is associated with mathematical application in the student's cultural environment. The student environment is a source of geometry knowledge [27]. Therefore, this research aimed to explore the geometry concepts on mosque ornaments, determine how to construct mosque ornaments using geometry concepts, and create contextual geometry problems based on mosque ornaments.

II. Materials and Methods

A. Research Design

Ethnomathematics research is qualitative research. The method used in this research is an ethnographic method, one type of qualitative research. This method follows ethnomathematics research aims, namely studying mathematical ideas contained in a culture. The research location is the Grand Mosque of Bandung, West Java, Indonesia. In this research, the ethnomathematical exploration begins with four general questions that are the principles of ethnography, namely "where to start observing?", "how to observe?", "what is it?", "what does it implies?". Table 1 presents an ethnomathematics study framework based on these four general questions.

TABLE I
THE ETHNOMATHEMATICS STUDY FRAMEWORK

Common Question	Initial Answer	Critical Point	Activity Specifics
Where to start observing?	Cultural practices, namely the ornaments of the Grand Mosque of Bandung, contain mathematical practices.	Culture	Conduct interviews with administrators who know about the Grand Mosque of Bandung and its ornaments.
How to observe?	Investigate the ornaments of the Grand Mosque of Bandung related to the practice of mathematics.	Alternative thinking	Determine the ideas on the ornaments of the Grand Mosque of Bandung related to the practice of mathematics.
What is it?	The result of alternative thinking on the previous process.	Mathematical philosophy	Identifying characteristics of the ornaments of the Grand Mosque of Bandung related to the practice of mathematics. It shows that the ornaments of the Grand Mosque of Bandung have mathematical character.
What does it imply?	An important value for mathematics and culture.	Anthropology	Describe the relationship between mathematics and culture on the ornaments of the Grand Mosque of Bandung. Describe mathematics concepts on the ornaments of the Grand Mosque of Bandung.

B. Research Data Collection

Researchers act as the main instrument in data collection in qualitative research. The triangulation technique is used to generate valid data. Researchers collect data through observations, interviews, and literature studies. The observation and interview guide in this study used semi-structured guidelines. Observations were carried out at the Grand Mosque of Bandung to determine the ornaments to be studied. Informant interviews as the research subject were carried out with administrators of the Grand Mosque of Bandung who know about the mosque and its ornaments. The interview revealed the spiritual and Sundanese cultural values of the mosque ornaments. The result of observations and interviews were documented in photos, recordings, and field notes. Literature studies sourced from journals complement the results of observations and interviews.

C. Research Data Analysis

Data analysis begins at the beginning of the research and throughout the research. The data analysis technique used in this research consisted of three continuous and repetitive activities. These activities consist of data condensation, data display, and concluding. Data condensation is selecting, focusing, or simplifying research data. Data condensation is carried out by selecting mosque ornaments that have been collected for further analysis. Data display is an organized collection of information that allows concluding. The form of data display uses pictures that show geometry concepts on mosque ornaments. Then the pictures are supplemented with explanations. From the beginning of data collection, the researchers have drawn temporary conclusions which will develop more clearly as the research progresses. The conclusion appears until the data collection is complete. The conclusion is then verified based on the research data that have been collected.

III. RESULTS AND DISCUSSION

A. Grand Mosque of Bandung

The Grand Mosque of Bandung (Fig. 1) is located in the center of Bandung City, precisely at Jl. Dalem Kaum No. 14 Bandung. This mosque is located in the city square area of Bandung. Initially, this mosque was named the Great Mosque of Bandung. The Grand Mosque of Bandung is a landmark of the city of Bandung and is a witness to the history of places of worship for Muslim leaders at the 1955 Asian-African Conference [28]. The mosque has been around for about two centuries until now. During that time, the mosque has undergone about eight renovations. Three renovations were carried out in the nineteenth century, four in the twentieth century, and one in the twenty-first century.

The Grand Mosque of Bandung was built in the early 19th century, precisely in 1812. The shape of the mosque building was originally a simple traditional stage, with wooden poles, walls of woven bamboo, a thatched roof, and a large pond as a place for ablution. This mosque was formerly known as *bale nyungcung* because of its sharp roof. Ahead of the Asian-African Conference, the roof of the mosque changed. *Bale nyungcung* is transformed into a dome shape like the roof of a mosque in the Middle East. However, in 1970, this dome was changed to a *Joglo* (pyramid-shaped) [29].

The last change to the Grand Mosque of Bandung occurred in 2001. The mosque was designed by four architects from the city of Bandung, namely Ir. H. Keulman, Ir. H. Arie Atmadibrata, Ir. H. Nu'man, and Prof. Dr. Slamet Wirasonjaya [28]. The renovations included repairing the old mosque, building a new mosque including an ablution area in the basement, building a connection between the old mosque and a new mosque, building twin towers, and arranging the mosque's courtyard. The renovation was completed in 2003 and inaugurated by the Governor of West Java H.R. Nuriana. Now the total land area is 23,448 m^2 with a mosque area of 8,575 m^2 and can accommodate 12,000 worshipers. After the renovation, the Great Mosque of Bandung changed its name to the Grand Mosque of Bandung [29].

After the renovation, the shape of the Grand Mosque of Bandung is a combination of Sundanese culture and Middle East culture. The entrance gate of the mosque is decorated with Sundanese ornaments in the form of fish scales motifs. The roof of the mosque is dome-shaped, like most mosques in the Middle East. The mosque has three domes. The main dome is above the old mosque, and two smaller domes are above the new mosque. The main dome has a diameter of 30 meters, and the top is decorated with Allah's words. The small dome has a diameter of 25 m which symbolizes the twenty-five Prophets [28]. On the left and right of the mosque are twin towers of 81 meters with a foundation depth of 18 meters. Thus, the height of the tower calculated from the foundation is 99 meters, which symbolizes *Asmaul Husna* (the beautiful name of Allah).

The Grand Mosque of Bandung has a width of 99 meters according to the number of *Asmaul Husna*. This mosque has five entrances as high as 5 meters made of teak wood from Jepara. At each door are written the Quranic verses, namely those of surahs (chapters) Al-Ikhlas, Al-Fatihah, Al-Falaq, An-Nas, and *ayat kursi* (the verse of the throne). This symbolizes that when entering the mosque, we should glorify the name of Allah. The mosque's mihrab is decorated with calligraphy of Allah, Muhammad, the creed, and the *surah* Al-Fatihah. Jepara carvings also adorn the pulpit of the mosque. The mosque has a *bedug*, one of the characteristics of mosques in Indonesia. *Bedug* is a percussion instrument that is sound to notify the time of prayer. Another Sundanese characteristic is found in the three levels of the roof of the mosque minaret. The three levels take the philosophy of the Sundanese people, namely *Tri Tangtu di Buana* or the three footings in the world. In Sundanese culture, this philosophy becomes a guide for humans to navigate life, namely Allah, the leader, and the teacher.

Fig. 1 Grand Mosque of Bandung

B. *Ornaments in the Grand Mosque of Bandung*

The ornaments in the Grand Mosque of Bandung have spiritual and Sundanese cultural values. Besides that, the mosque ornaments have geometry concepts. Here are some ornaments in the Grand Mosque of Bandung that can be used as media for learning mathematics in geometry.

The first ornament is located on the gate. Students can observe that on this mosque ornament, there are geometry concepts, namely points, lines, angles, squares, rhombuses, and hexagons. In addition, students can also observe that there are transformation geometry concepts on this mosque ornament, namely reflection, rotation, and dilation, as shown in Figure 2.

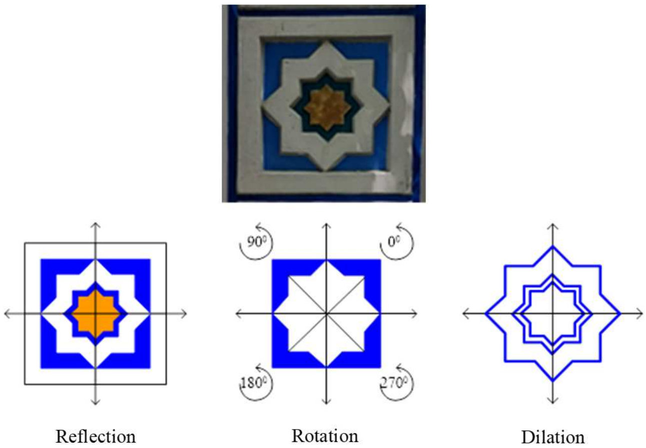

Fig. 2 Geometry transformation on the gate ornament

The gate ornaments can be constructed using geometry concepts in several ways. Here is one way that students can use in constructing the ornament. Draw a square, then the square is dilated (reduced) and named square ABCD. Determine the midpoints of the sides AB, BC, CD, and DA. The midpoints are labeled E, F, G, and H. Connect the four midpoints to form a square EFGH. An eight-pointed star is obtained. Then the eight-pointed star is dilated (reduced) twice. The parts of the ornament are subsequently colored. Obtained the stair railing ornament as shown in Fig. 3. Through this construction process, students can explain that the geometry concepts used in the construction of ornament on the gate are points, lines, angles, squares, rotations, and dilation.

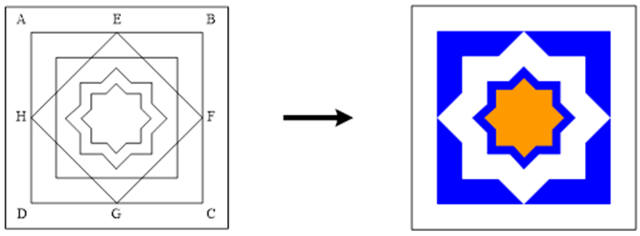

Fig. 3 Construction of the gate ornament

Furthermore, after the construction process of the gate ornament, the teacher can create a contextual geometry problem, for example, congruent triangles. Consider geometry problem 1 in Fig. 4. Given $BC \perp BD$, $DE \perp BD$, $\overline{BC} \cong \overline{DE}$, and $\overline{AB} \cong \overline{AD}$, prove $\Delta ABC \cong \Delta ADE$.

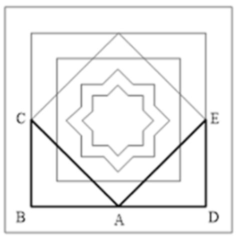

Fig. 4 Problem 1

The formal proof steps to prove $\Delta ABC \cong \Delta ADE$ are shown in Table 2.

TABLE III
PROOF FOR PROBLEM 1

Statements	Reasons
1. $\overline{BC} \cong \overline{DE}$, and $\overline{AB} \cong \overline{AD}$	1. Given
2. $\angle ABC \cong \angle ADE$	2. $BC \perp BD, DE \perp BD$
3. $\Delta ABC \cong \Delta ADE$	3. SAS postulate

The second ornament is located on the stair railing. Students can observe that on this mosque ornament, there are geometry concepts, namely points, lines, angles, squares, rhombuses, and hexagons. In addition, students can also observe transformation geometry concepts on this mosque ornament, translation, reflection, and rotation, as shown in Fig. 5.

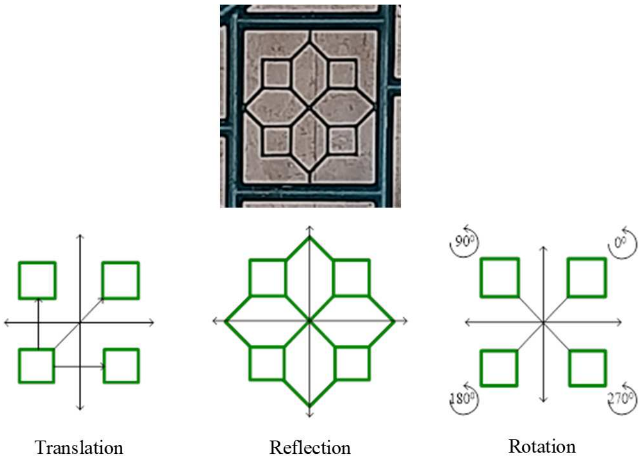

Fig. 5 Geometry transformation on the stair railing ornament

The stair railing ornaments can be constructed using geometry concepts in several ways. Here is one way that students can use in constructing the ornament. Draw a square and its diagonals. Furthermore, the square is rotated by 45^0 and produces the points of intersection with the original square. The points of intersection are labeled A, B, C, D, E, F, G, and H. Draw line segments through points A and F, B and E, C and H, and D and G. Color the ornament green. Obtained the stair railing ornament as shown in Fig. 6. Through this construction process, students can explain that the geometry concepts used in the construction of ornament on the stair railing are points, lines, angles, squares, and rotations.

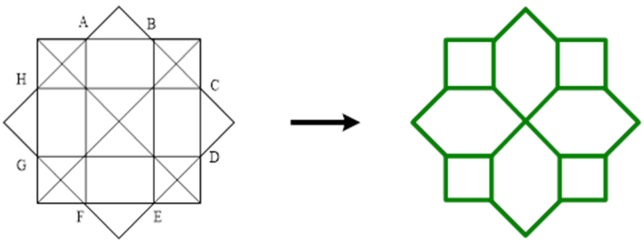

Fig. 6 Construction of the stair railing ornament

Furthermore, after the construction process of the stair railing ornament, the teacher can create a contextual geometry problem, for example, congruent triangles. Consider geometry problem 2 in Fig. 7. Given $\overline{CD}$ bisect $\overline{AB}$ at D, $\overline{AD} \cong \overline{BD}$, and $\overline{AC} \cong \overline{BC}$, prove $\Delta ADC \cong \Delta BDC$.

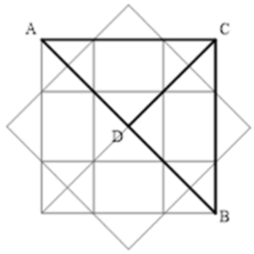

Fig. 7 Problem 2

The formal proof steps to prove ΔADC≅ΔBDC are shown in Table 3.

TABLE IIIII
PROOF FOR PROBLEM 2

Statements	Reasons
1. $\overline{AD} \cong \overline{BD}$ and $\overline{AC} \cong \overline{BC}$	1. Given
2. $\overline{CD} \cong \overline{CD}$	2. Identity (reflexive)
3. $\Delta ADC \cong \Delta BDC$	3. SSS postulate

The third ornament is located on the window. Students can observe that this mosque ornament has geometry concepts, namely points, lines, angles, triangles, squares, rhombuses, kites, and trapeziums. In addition, students can also observe that in this mosque ornament, there are transformation geometry concepts, namely reflection and rotation, as shown in Fig. 8.

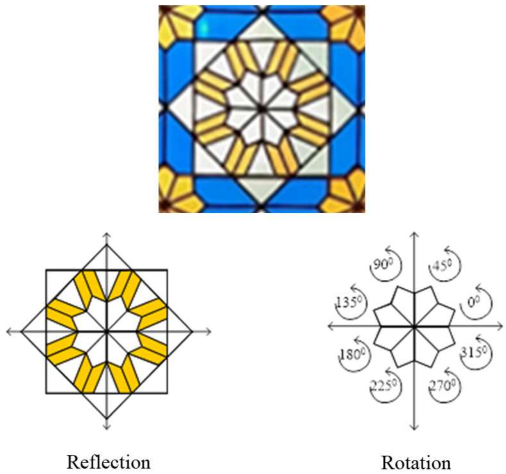

Fig. 8 Geometry transformation on the window ornament

The window ornaments can be constructed using geometry concepts in several ways. Here is one way that students can use in constructing the ornament. Draw a square and rotate it by 45^0. This rotation produces intersection points with the original square. The points of intersection are labeled A, B, C, D, E, F, G, and H. The square and the rotated square are subsequently dilated (reduced) and rotated by 25^0. The points of intersection of the dilated squares are labeled I, J, K, L, M, N, O, and P. Draw line segments through points I and M, J and N, K and O, and L and P to form eight kites. Draw line segments through points A and E, B and F, C and G, and D and H. Draw a pair of line segments parallel to the line segments AE, BF, CG, and DH. The parts of the ornament are subsequently colored. Obtained the window ornament as shown in Fig. 9. Through this construction process, students can explain that the geometry concepts used in the construction of ornament on the window are points, lines, angles, triangles, squares, kites, rotations, and dilations.

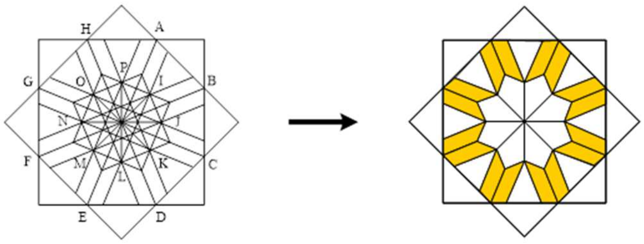

Fig. 9 Construction of the window ornament

Furthermore, after the construction process of the window ornament, the teacher can create a contextual geometry problem, for example, congruent triangles. Consider geometry problem 3 in Fig. 10. Given $\overline{CD}$ bisect $\overline{AB}$ each other at O such that $\overline{AO} \cong \overline{OB}$, and $\angle CAO \cong \angle DBO$, prove $\Delta AOC \cong \Delta BOD$.

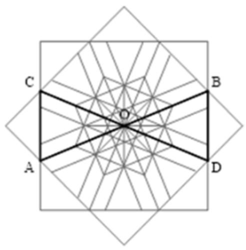

Fig. 10 Problem 3

The formal proof steps to prove $\Delta AOC \cong \Delta BOD$ are shown in Table 4.

TABLE IVV
PROOF FOR PROBLEM 3

Statements	Reasons
1. $\overline{AO} \cong \overline{OB}$ and $\angle CAO \cong \angle DBO$	1. Given
2. $\angle AOC \cong \angle BOD$	2. Vertical angles are congruent
3. $\Delta AOC \cong \Delta BOD$	3. ASA postulate

The fourth ornament is located on the dome ceiling. Students can observe that on this mosque ornament, there are geometry concepts, namely points, lines, angles, squares, rhombuses, kites, and circles. In addition, students can observe transformation geometry concepts on this mosque ornament, translation, reflection, rotation, and dilation, as shown in Fig. 11.

The dome ceiling ornaments can be constructed using geometry concepts in several ways. Here is one way that students can use in constructing the ornament. Draw a circle and a square and their diagonals inside the circle. Furthermore, the square and its diagonals are rotated by 30^0 and 60^0. This rotation produces intersection points. The points of intersection are labeled A, B, C, D, E, F, G, H, I, J, K, and L. Draw line segments through points A and I, A and E, B and J, B and F, C and K, C and G, D and L, D and H, E and I, F and J, G and K, and H and L. Twelve squares and kites formed.

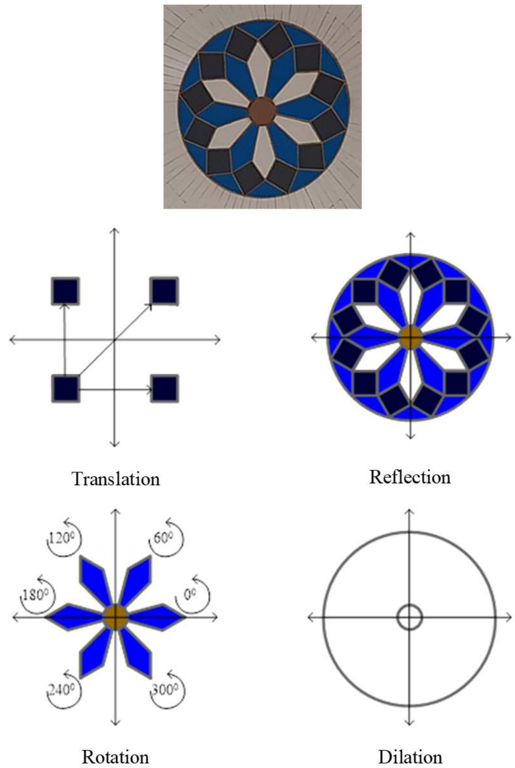

Fig. 11 Geometry transformation on the dome ceiling ornament

Furthermore, the original circle is dilated (reduced). The parts of the ornament are subsequently colored. Obtained the dome ceiling ornament as shown in Fig. 12. Through this construction process, students can explain that the geometry concepts used in the construction of ornament on the dome ceiling are points, lines, angles, squares, kites, circles, rotations, and dilations.

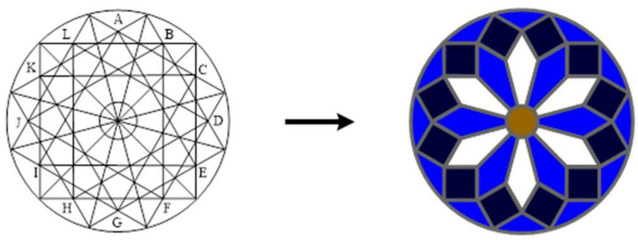

Fig. 12 Construction of the dome ceiling ornament

Furthermore, after the construction process of the dome ceiling ornament, the teacher can create a contextual geometry problem, for example, congruent triangles. Consider geometry problem 4 in Fig. 13. Given $\overline{AB} \cong \overline{CD}$, and $\angle ABD \cong \angle CDB$, prove $\Delta ABD \cong \Delta CDB$.

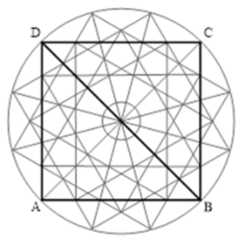

Fig. 13 Problem 4

The formal proof steps to prove $\Delta ABD \cong \Delta CDB$ are shown in Table 5.

TABLE V
PROOF FOR PROBLEM 4

Statements	Reasons
1. $\overline{AB} \cong \overline{CD}$ *and* $\angle ABD \cong \angle CDB$	1. Given
2. $\overline{BD} \cong \overline{BD}$	2. Identity (reflexive)
3. $\Delta ABD \cong \Delta CDB$	3. SAS postulate

The results showed that the exploration of geometry concepts on the ornaments of the Grand Mosque of Bandung had enriched knowledge and can be a starting point for learning mathematics related to cultural contexts. The ornaments of the Grand Mosque of Bandung have a relationship between mathematics and culture, and the mosque ornaments are rich in geometry concepts. In addition, the mosque ornaments have spiritual and Sundanese cultural values.

The spiritual and Sundanese cultural values can employ as guidelines in life. Character education is important for students to face life's challenges, and character education needs to develop according to the cultural background of students. Therefore, the use of spiritual and Sundanese cultural values on the ornaments of the Grand Mosque of Bandung can support the development of student character education.

Ornaments in the Grand Mosque of Bandung have geometrical concepts, namely points, lines, angles, and plane shapes (i.e. triangles, squares, rhombuses, kites, trapeziums, hexagons, and circles), and transformation geometry (translation, reflection, rotation, and dilation). Through the mosque ornaments, students can recognize the plane shapes, know their properties, and understand the relationship between the plane shapes. Through mosque ornaments, students can also identify four types of transformation geometry and their properties. Students can observe that the translated ornament motif does not change in shape and size; the reflected ornament motif does not change in shape and size, but changes in direction; the rotated ornament motif does not change in shape and size; and the dilated ornament motif does not change in shape but changes in size.

Ornaments in the Grand Mosque of Bandung can be constructed using geometry concepts. The construction process of mosque ornaments is a contextual problem that can be developed in learning mathematics. Students can construct mosque ornaments and explain geometry concepts in the construction process. Students can construct the mosque ornaments in several ways, and students can also make new mosque ornaments. In addition, the teacher can create contextual geometry problems based on the ornaments of the Grand Mosque of Bandung. Students have the opportunity to solve real-life problems when they learn through contextual problems. This is appropriate for ethnomathematics' purpose of bringing mathematics closer to reality [3]. Thus, the ornaments in the Grand Mosque of Bandung can use as media for learning mathematics.

Mathematics can be found in many places. Islamic architectural designers have created a variety of stunning ornaments. Geometric ornaments have developed a lot in mosque architecture. These ornaments demonstrate at the same time a blend of beauty and intelligence. Islamic architectural designers have a role in developing mathematical knowledge. This is in line with D'Ambrosio's statement that everyone has developed unique and often different mathematical knowledge incorporated into the cultural system as they interact, immigrate, and create new contexts. This is evident in how various groups sort, measure, quantify, use numbers, combine geometric shapes, and classify objects [20]. Every culture experienced and practiced it. As a result, various human cultural environments influence mathematics [30]. Therefore, every member of various cultural groups contributes to mathematical knowledge.

Geometry is a branch of mathematics that studies points, lines, planes, and spaces. Geometry is a social product, and a mind constructs that humans have developed in communities worldwide [31]. Therefore, geometry is a concept familiar to many people from childhood. Geometry is one of the important subjects in the Indonesian curriculum, which is taught from elementary school through college [32]. Geometry aids students in analyzing and explaining the world around them [33]. Geometry is seen as a tool for resolving real-world problems, and it has the potential to make mathematics more attractive [34]. According to Jones [35], Geometry helps students develop visualization, perspective, intuition, critical thinking, conjecturing, problem-solving, logical argument, deductive reasoning, and proof abilities.

In reality, many Indonesian students have difficulty learning geometry [32], [36], [37]. Students have difficulty understanding geometry concepts because geometry learning is presented textually with pencil and paper and is not related to the student's context [32]. The curriculum demands teachers to be creative in creating teaching materials that are innovative, varied, interesting, contextual, and appropriate to the level of student needs. Geometry and culture are related, making school geometry close related to the environment and culture in which it is taught [38]. Geometry learning should begin with the concrete model, continues with pictures, and end with abstract concepts [39]. Thus, ethnomathematics-based learning is in line with the curriculum.

One way to connect mathematics with the real world is through mosque ornaments. Geometry concepts are widely applied to mosque ornaments. Thus, mosque ornaments can be used as media in learning mathematics. Mathematics learning can be started by presenting ornaments related to the geometry concepts to be studied. Students can be encouraged to observe, explore, and construct geometry concepts based on these ornaments. Furthermore, the teacher can confirm the geometry concepts that students have obtained from these activities. In addition, students can solve geometry problems based on the mosque ornaments. Mathematics learning becomes more interesting and fun. Mathematics learning can improve students' mathematical understanding. As a result, these mosque ornaments can be seen as an alternative to help students' mathematical difficulties. However, the use of ornaments in mathematics learning in Indonesia is still limited.

Several researchers have investigated the use of ornaments in learning mathematics in geometry material. Verner *et al.* [40] studied seventy-one mathematics teachers from various cultural backgrounds in Israel to teach geometry in a cultural context. As a result, teachers gradually developed the ability to teach geometry using an ethnomathematical approach. Teachers recognize the need for reform in geometry teaching, and Geometric ornaments are appropriate for teaching geometry using an ethnomathematical method. Shahbari and Daher [41] conducted studies on thirty tenth-grade students (aged 15-16) whom all had mathematics difficulties. As a result, using Islamic geometric ornaments in learning mathematics can improve the student's proving process. Furthermore, there is a significant difference in the students' average scores before and after the learning process. Thus, these studies indicate that learning mathematics using ornaments makes mathematics learning more effective and helps improve students' mathematical understanding.

Mathematics is present in many real-life situations, and mathematics and culture do not stand alone. The mathematics curriculum needs to be developed so that mathematics and culture are congruent. Teachers need to learn about the culture of their students so that they can adapt the culture to learning mathematics [26]. The use of ethnomathematics in learning will improve students' ability to use mathematics in their social lives outside of school [42] - [45]. The mosque is one of the cultural environments that are close to Indonesian students. In general, mosques are decorated with geometric ornaments, and Mosque ornaments are rich in geometrical concepts. Thus, mosque ornaments can use as an alternative media in learning mathematics to overcome students' mathematical difficulties, especially geometry [43].

IV. Conclusion

The Grand Mosque of Bandung's ornaments contains spiritual and Sundanese cultural values that might aid in the development of student character education. Ornaments in the Grand Mosque of Bandung are also rich in geometry concepts. The geometry concepts on this mosque ornament include points, lines, angles, plane shapes, and transformation geometry. This mosque ornament can also be constructed using geometry concepts. In addition, contextual geometry problems can also be created based on the ornaments of the Grand Mosque of Bandung. Thus, the teachers can use this mosque ornament as an alternative media for learning mathematics, especially geometry. Students can learn mathematics through mosque ornaments in their cultural environment. Connecting mathematics to the mosque ornaments around students will make learning mathematics more interesting and fun and increase students' understanding. Therefore, using mosque ornaments is expected to overcome students' mathematical difficulties and improve students' mathematical abilities.

This research is one step towards increasing ethnomathematics studies in Indonesia, especially in mosque ornaments. Research on geometric ornaments, whether from Islamic culture or other cultures, is still very open. This qualitative research is still limited to exploring the geometry concepts of mosque ornaments, and further research can explore other mathematical concepts on mosque ornaments. In addition, further research can use quantitative research to see the effectiveness of mosque ornaments as media in learning mathematics, especially in geometry material.

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