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Ethnomathematics Exploration of Cathedral Church of Christ the King Purwokerto

Fitria Zana Kumala^{1*}; Nur Rahmawati²; Wilda Nur Fauziyah³ ^{1,2,3}Tadris Matematika UIN Saizu Purwokerto, Indonesia Corresponding author's email: <u>fitriazana@uinsaizu.ac.id</u>

Abstract: This research aims to explore mathematical concepts in the Cadetral Church of Christ Raja Purwokerto. This research is a descriptive-qualitative study with an ethnographic approach. Data collection is done by observation, documentation, and interviews. The data obtained in this study were then analyzed through data reduction, data presentation, and drawing conclusions. This study's results indicate mathematical concepts in the Cathedral Church of Christ the King Purwokerto. These concepts are two-dimensional plane shapes (rhombus, square, rectangle, triangle, hexagon, circle) and three-dimensional plane shapes (cube, cuboid, cylinder, octagonal prism, triangular prism, hemisphere, cuboid without lid, half-cylinder without lid), folding symmetry, similarity, congruence, geometric transformation (reflection, translation, dilation), set, and the probability that can be used as a source of contextual mathematics learning.

Keywords: ethnomathematics; cathedral church of christ the king purwokerto; mathematics learning resources

A. INTRODUCTION

Mathematics become a challenge for educators in carrying out the learning process. Many educators need help teaching mathematics to students. This problem can be seen from the low ability of students to solve math problems. This can be proven by the results of a study conducted by the International Association for the Evaluation of Educational Achievement (IEA) in 2007, namely the Trend in International Mathematics and Science Study (TIMSS); the results obtained from class VIII Indonesian students were that they were ranked 36 out of 49 countries that took part in the activity earned an average score of 397, while the international average score was 500. In line with the Program for International Student Assessment (PISA) survey results, Indonesia ranked 61st out of 65 participating countries (Kehi et al., 2019).

The low comprehension ability of students to understand mathematics learning material is caused by several



Copyright © 2023 The Author This is an open access article Under the Creative Commons Attribution (CC BY) 4.0 International License things, one of which is that mathematics is considered an abstract subject. so contextual teaching materials are needed with resources learning from the surrounding environment. This is in line with the opinion (Rewatus et al., 2020) which explains that mathematics plays an important role because it is closely related to society's culture and the surrounding environment.

The low comprehension ability of students understand mathematics to learning material is caused by several things, one of which is that mathematics is an abstract considered subject, so contextual teaching materials are needed with learning resources from the surrounding environment. This is in line with the opinion (Rewatus et al., 2020), which explains that mathematics plays an essential role because it is closely related to society's culture and the surrounding environment.

Local culture-based mathematics learning is one of the innovations that educators can use. Ethnomathematics is the science that studies the combination of culture and mathematics (Faturrahman & Soro, 2021). Ethnomathematics is a method that can make learning mathematics more meaningful and contextual, which is closely related to local culture (Surat, 2018). Ethnomathematics is a mathematical science that conceptually emphasizes local culture, including the habits of students or the people around them. To provide an understanding to students that mathematics is not only present in the classroom and school but also in the surrounding environment and everyday life. Ethnomathematics is used to motivate and stimulate students, overcome boredom, and add new dimensions to learning mathematics (S. Sirate, 2012). One of the cultural elements close to students' daily life is a place of worship.

Banyumas is an area that has cultural diversity. One can be found in the Cathedral Church of Christ the King Purwokerto. The church was built to replace the old cathedral church because it was felt too narrow and could not accommodate the many people who worshiped. Mr. Soepardjo Rustam inaugurated the new cathedral building on May 30, 1998. The cathedral church building has a unique architecture because it has the Joglo Banyumas nuance with the trajumas standard or golden bridge as a form of acculturation between the Catholic church and Banyumas culture (Dicata, 2007).

Previous research related to ethnomathematics of places of worship includes research that has been conducted by (Hurit, 2022), which concluded that in establishing the Parish Church of Santo Alfonsus Mario De Liguori Lewotala, East Flores Regency, activities of measuring, placing, and designing were found, as well as in its architecture, concepts were found geometry about planes, shapes, and lines that can be used as learning resources. Furthermore, research on ethnomathematics in the Mandara Giri Semeru Agung Temple building was carried out by (Wahyu et al., 2018) learning materials obtained learning materials in the form of summaries of student worksheets on geometric transformations, similarity and congruence, and building flat sided spaces.

Research conducted by (Putra et al., 2020) concluded that the Soko Tunggal Mosque has a mathematical concept in plane geometry, namely the concepts of triangles, squares, rectangles, rhombuses, trapezoids, and circles, which are used as a source of teaching materials in the form of textbooks. Furthermore, in research conducted bv (Afifi et al., 2020), ethnomathematics in the Tri Dharma Hoo Tong Bio Place of Worship building which is used as teaching material for mathematics learning in the form of Student Worksheets on flat shape material and flat-sided rooms.

Based on previous research, there still needs to be more research on ethnomathematics in places of worship in the Banyumas Regency. There is no ethnomathematics research on places of worship for Catholics in the Banyumas Therefore, Regency. researchers are interested in exploring the church places of worship in Purwokerto because Christ the King Cadetral Church is the largest church in Purwokerto. whose architecture resembles a joglo and symbolizes unity with Banyumas culture.

B. MATERIALS AND METHODS

This study uses qualitative research with an ethnographic approach. The ethnographic approach is a study that discusses the life and culture of a society or ethnic group, namely language, customs, habits, art, law, and religion (Andarini et al., 2019). Ethnography is a research approach that focuses on discussing individuals' socio-cultural and sociological contexts, which are summarized through field observations in accordance with the research focus (Faturrahman & Soro, 2021). This research aims to explore mathematical concepts in the Cadetral Church of Christ Raja Purwokerto.

This research was conducted at the Cathedral Church of Christ the King Purwokerto, which is located at Jalan Church number 3, Karangjengkol, Sokanegara, East Purwokerto District, Banyumas Regency. The data source in this study was the informant, namely the church administrator of Christ Raja Cathedral in Purwokerto. Data were collected through observation techniques, interviews, and documentation. The data analysis technique used in this study follows the opinion of Miles and Huberman, namely the qualitative method of the data obtained. The data is processed through 3 stages: data reduction, data presentation, and drawing conclusions (Sadiyah & Suparni, 2022). Data reduction is made to take essential parts related to research. Furthermore, the presentation of data is carried out to review the overall picture of the results of the mathematical concepts obtained in the study. Furthermore, conclusions are drawn from the research conducted.

C. RESULT AND DISCUSSION

Cathedral Church of Christ King Purwokerto is the largest church in Purwokerto, which is located in the city center. Cathedral Church of Christ Raja Purwokerto was built at the beginning of Indonesian independence. One of the uniqueness of this church, which distinguishes it from other churches in

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Purwokerto, is the architecture of the building which resembles a joglo, a symbol of unity with Banyumas culture.

Based on the results of interviews conducted with Mr. Edi Santoso, the church administrator, he said that at first, the Cathedral Church of Christ King Purwokerto was small. However, there was a fire, so it was renovated and rebuilt with Joglo Banyumasan architecture. At the beginning of construction, the church did not have a balcony. There was only one floor. The balcony was built around 2012-2013 because there were many people, so the congregation could arrive outside the church during mass. Finally, it was decided to build a balcony.

Inside the church is a sacristy room, which is a room for the preparation of the priest before leading the service, usually for changing into robes. In addition, there are two confessional rooms, a sound room for the church's sound system operators, the Maria Chapel, and the Adoration Chapel. The Marian Chapel is used to pray through the intercession of the Blessed Virgin Mary. Whereas the Adoration Chapel in the Catholic religion believes that God is present through custom or mass, and there is a symbol. So, in the adoration chapel, there is nothing but symbols, while in the Maria chapel, there is a statue of the Virgin Mary.

Based on the results of data collection, it was found that there were several mathematical concepts implemented in the Cathedral Church of Christ Raja Purwokerto. These concepts include the following. 1. Geometry Concept

Table 1. Mathematical Concepts and Geometric Models





Congruence Concept

Table 2. Mathematical Concepts and Folding Symmetry, Similarity, and Congruence Models



3. Geometric Transformation Concept

In the Christ Raja Purwokerto Cathedral Church building, there is a geometric transformation concept in the form of reflections and translations found in the ornaments on the altar and the outer pillars of the church.

a. Reflection

Reflection is a change by moving a point with the properties of a flat mirror. The nature of the reflection is that the distance from the point to the mirror is the same as the distance from the image to the mirror, and the reflected geometries face each other (Wikaningtyas et al., 2022).



Figure 40. Reflection on the Altar Ornament



Figure 41. Reflection on Pillar Ornament



Figure 42. Reflection on the Main Door



Figure 43. Reflection on the Window

b. Translation

The translation is a movement or shift from a point to a specific direction in a straight-line plane so that every plane in a straight line will also be shifted in a specific direction and distance (Pujangga, 2019).



Figure 44. Translation on the Divider of the Main Room with the Marian Chapel Room

c. Dilation

Dilation is a transformation that changes the distance of points with a specific multiplier to a certain point. The specified multiplier is called the dilation factor or the scale factor, and the specific point is called the center of dilation (Istiqomah, 2020).



Figure 45. Dilation on the Church Lamp

4. Set Concept

At the Cathedral Church of Christ Raja Purwokerto, several types of poetry books accompany the singing at Mass: devotional books, thanksgiving books, and holy books. In addition to poetry books in Indonesian, there are also poetry books in Javanese. The difference from the poetry book lies only in the songs, while the Javanese poetry book combines these poems, only made in the Javanese version. Javanese poetry is sung once a month on the fourth Sunday or at the end of the month and accompanied by gamelan.



Figure 46. Poetry Books

Based on the types of poetry books in the church, the concept of assemblage can be found. A set is a collection of objects or objects that are clearly defined and measurable so that it can be determined unequivocally whether or not the object is included in a particular set. These objects are then referred to as elements or members, and the universe of conversation is known as the universe set (Maryati & Pratiwi, 2019).

For example, A is a collection of poetry books in the Cathedral Church of Christ the King, Purwokerto. Then it can be denoted as follows:

- A = {Kidung Aji, Puji Syukur, Madah Bakti}
- n(A) = 3

The three types of poem books are placed on each table. Based on the results of the interviews, the congregation's capacity was below 600, while there were 350 on the balcony. There was only one book for two people, so there were only 475 books each. Based on these data, the concept of the set can be found. Suppose B is a collection of Kidung Aji poetry books, C is a collection of Puji Syukur poetry books, and D is a collection of Madah Bakti poetry books. Thus, it can be denoted as follows:

> n(B) = 475 n(C) = 475 n(D) = 475

Inside the church are neatly arranged pews used to seat the congregation during Mass or worship. On each side of the right and left side of the pews, there are the names of Saints, where each seat only has one name. Thus, the names on the right and left are the same. A man saint is a male believer who has died and is believed by the church to have seen God directly in heaven. In comparison, woman saint is a female believer who has died and is believed by the church to have seen God directly in heaven.



Figure 47. Names of Saints and Santas on Church Pews

Based on Figure 47, the names of the Saints found on the pews of Christ

Raja Cathedral in Purwokerto are Ferdinandus, Priska, Anselm, Ignasius, Silvestus, Margaretha, Titus, Cosmas, Patrisius, Bonifasius, Yasinta, Mateus, Leonardus, Lusia, Antonius, Clarentia, Kristiana. Robertus. Josapha. Martinus, Gabriel, Hendrikus, Hironimus, Vincent, Mary, Stephen, Paul, Agnes, Augustine, Wilhelmus, Theresia, Bernard, Monika, Hylarus, Felicity, Alphonsus, Justin, Elisabeth, Mark, Pascalis, Michael, Leo the Great, Petrus, Maria Goretti, Pius, Frans Xavier, Regina, Dominic, Redemptus, Julius, Anastasia, Francisca, Rosa, Albertha, Richardus, Anna, Raphael, Basilius, Perpetua. Veronika, Theodorus, Yoh. Bathers, Luke, Peter, Agatha, Bernadeth, Joseph, John. Bosco, Hubertus, Julian, Brigita, Angela, Timothy, Charles, Fabrianus, Cecilia, Catherine, Motius, Brigita, Joachim, Cornelius, Martha, Antonius Ferdinandus, Prisca, Anselm, Ignatius, Silvestus, Margaretha, Titus, Cosmas, Patrisius, Boniface, Yasinta, Mateus, Leonardus, Lucia, Antonius, Clarentia, Kristiana. Robertus, Yosapha, Martinus, Gabriel, Hendrikus, Hironimus, Vincent. The number of names of Saints and Santas is 64.

Set E is the set of names of the men saints found on the pews in the Cathedral Church of Christ the King Purwokerto, while F is the set of the names of women saints on the pews in the Cathedral Church of Christ the King Purwokerto. Then it can be denoted as follows:

- E= {Ferdinandus, Anselm, Ignatius, Silvestus, Titus. Cosmas, Patrisius, Boniface, Mateus, Leonardus, Antonius, Robertus, Martinus, Gabriel, Hendrikus, Hironimus, Vincent, Stephen, Paulus, Wilhelmus, Augustine, Bernard, Hilarus, Alphonsus, Mark, Pascalis, Justin, Michael, Leo the Great, Petrus, Pius, Frans Xavier, Dominic, Redemptus, Yilius, Richardus, Raphael, Basilius, Theodorus, Yoh. Bathers, Luke, Peter, Joseph, John. Bosco, Hubertus, Julian, Timothy, Charles, Fabrianus, Motius, Joachim, Cornelius, Antonius}.
- F= {Priska, Margaretha, Yasinta, Lusia. Clarentia, Kristiana, Yosapha, Maria. Agnes, Theresia, Monika, Felicitas, Elisabeth, Maria Goretti, Regina, Anastasia, Fransiska, Rosa. Albertha, Anna, Perpetua, Veronika, Agatha, Bernadeth, Brigita, Angela, Cecilia. Katarina, Brigita, Martha}.

Based on these data, it can be seen that the number of men saint names found on the pews of Christ Raja Purwokerto Cathedral Church is 34, while the number of women saint names is 30. Thus, it can be denoted as follows:

$$n(E) = 34$$

 $n(F) = 30$



Figure 48. Robes

Furthermore, based on the interview results, the priest's robes in the sacristy room have red, purple, and ivory colors. However, ivory yellow is commonly used, purple is used before Easter, and red is used when celebrating large masses. Inside the room are three sets of robes of each color, according to the number of priests in the Cathedral Church of Christ Raja Purwokerto.

For example, G is the color set of the priest's robes in the Cathedral Church of Christ the King, Purwokerto. So, based on the concept of the set can be denoted as follows:

> G = {red, purple, ivory} n(G) = 3

While the robes for the acolytes (mass assistants), children who help the priest at Mass, are white and number 40. Let H be the set of acolytes' robes in the Cathedral Church of Christ the King, Purwokerto, n(H) = 40.

5. Probability Concept

At the Cathedral Church of Christ Raja Purwokerto, there is a particular room for the congregation to pray to Mother Mary. This place is called the Chapel of Mary. This room is separated from the church's main room, which is bounded by a glass wall with iron ornaments. The room is closed and airconditioned, with warm white lights that depict serenity. In that room, there is a statue of the Virgin Mary surrounded by red and pink roses. Usually, female worshipers, when they want to pray in the room, also bring flowers that are placed near the Virgin Mary statue.

Apart from that, in that room, there is also an electric candle that can be lit by inserting an Rp. 1,000 coin. Previously, the room's candles were real ones lit up when the fire burned. However, because children usually play it by lighting all the candles until they run out, they are replaced with electric ones.



Figure 49. Chapel of Mary

The researcher can find the concept of probability in the candle in the Chapel of Mary. Probability is the possibility of an event occurring (Permana W H, 2019). For example, the candle can be lit by inserting a one thousand rupiah coin, which will burn for 10 minutes for each candle. The number of candles contained in the machine is 30 pieces. The candles can be lit together, depending on how many coins are inserted. So, the incident of burning а candle is called an opportunity.

In the Marian Chapel, there are 30 electric candles. The candle can be lit by inserting a one thousand rupiah coin for one candle. If Anni puts in 5 coins, then the probability that the candle lights up is $P(A) = \frac{n(A)}{n(S)} = \frac{5}{30} = \frac{1}{6}$. So, the probability of a candle burning when people put five coins into the machine is $\frac{1}{6}$.

The results of the research on the square concept in this study align with the results of research conducted by (Hardiarti, 2017), who found the concept of a flat quadrilateral shape in several parts of the Muaro Jambi Temple, which are square and rectangular. Furthermore, in research conducted by (Faturrahman & Soro, 2021), the concept of a circle was found in the shape of the well of the mosque, and (Pertiwi & Budiarto, 2020) found a mathematical concept Mlaten of earthenware in the physical form of the mathematical concept of a circle. The concept of geometric shapes in the form of cubes was found in research conducted by (Lusiana et al., 2019) on the footwear of the Jamik Mosque of Bengkulu City in the form of boxes resembling cubes and on the courtyard monument building of the Great Mataram Mosque by (Sanyoto et al., 2021).

Then the geometrical concept of a hemispherical shape is found in the Ethnomathematics Exploration of the Jami' Jember Mosque, namely in the shape of the mosque's dome (Yudianto et al., 2021). The rhombus concept was found in research (Izah & Malasari, 2021) on the decoration of the floor of the Sunan Bonang Mosque. The concept of triangular prisms is found in the ethnomathematics exploration of the Banyuwangi paglak angklung (Hidayatullah, Nur. Hariastuti, 2018). Then research (Febriana et al., 2017; Nurhikmah et al., 2019) explain finding the mathematical concept of folding symmetry. Apart from that, another place of worship that contains the mathematical concepts of reflection, translation, uniformity, and congruence is the Tri Dharma Hoo Tong Bio place of worship (Afifi et al., 2020). Meanwhile, the set concept was found in research conducted (Maryati & Pratiwi, 2019) on traditional dances at the opening of the 2018 Asian Games. The concept of opportunity is in line with research conducted by (Merliza, 2021), who found the concept of opportunity in the process of shooting accuracy carried out by players rifle Locok in the traditional game of Lampung Province.

This research can be used as a complement to previous research that has examined ethnomathematics in places of worship in an area. This study examines ethnomathematics with a different object from previous research, where this study studied ethnomathematics exploration at Christ Raja Cathedral Church in Purwokerto as a source of learning mathematics. By exploring mathematical concepts in the Cathedral Church of Christ King Purwokerto, teachers can arrange contextual problems based on the concepts found so that students can take advantage of learning resources from the environment around students.

D. CONCLUSION

Based on the results of the study, it can be concluded that by exploring the Cathedral Church of Christ Raja Purwokerto, it can be seen that there are mathematical concepts contained in the Church of Cathedral Christ Raja Purwokerto. These concepts are twodimensional plane shapes (rhombus, square, rectangle, triangle, hexagon, circle) and three-dimensional plane shapes (cube, cuboid, cylinder, octagonal prism, triangular prism, hemisphere, cuboid without lid, halfcylinder without lid), folding symmetry, similarity, congruence, geometric transformation (reflection, translation. dilation), set, and the probability that mathematics educators can utilize as a resource for learning contextual From mathematics. ethnomathematics exploration at Christ Raja Cathedral, Purwokerto found mathematical concepts that can be used as a source of mathematics learning so that the mathematics learning process undertaken by students will be more meaningful because it uses contextual learning resources originating from the culture in the student's area of origin.

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