24 (2), 2023, 467-480

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Ethnomathematical Analysis of Wapauwe Kaitetu Old Mosque Building: Between Myth and Science

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Abstract: This study aims to explore public perception of the existence of the Wapauwe Kaitetu mosque which involves mathematical concepts in building construction. Therefore, this research method is qualitative with a descriptive-exploratory approach. This research was carried out in Kaitetu village, Central Maluku with two subjects, namely community leaders and mosque guards who knew the existence of the Wapauwe Kaitetu mosque. The instruments used are interview guidelines and observation sheets. The mathematical objects in the Wapauwe Kaitetu mosque are: quadrilateral (square and trapezium); elliptical; triangle; circle; spaces (cubes, trapezoidal prisms, pyramids and tubes); compass; and deep congruences. Furthermore, myth (using telepathy as a means of communication with other dimensional societies) and science (building construction using good quality wooden frames and close connecting wood distances resulting in mosque buildings becoming sturdy and strong). Furthermore, it is suggested that further researchers can examine the ethnomathematical implementation of the Wapauwe Kaitetu mosque in the mathematics learning process.

Keywords: ethnomathematics, mosque construction, Wapauwe Kaitetu mosque, myth and science.

Abstrak: *Penelitian ini bertujuan untuk menggali persepsi masyarakat terhadap keberadaan dan konstruksi masjid Wapauwe yang melibatkan konsep matematika. Oleh karena itu, metode penelitian ini adalah kualitatif dengan pendekatan deskriptif-eksploratif. Penelitian ini dilaksanakan di desa Kaitetu, Maluku Tengah dengan subjek sebanyak dua orang, yaitu tokoh masyarakat dan penjaga masjid yang mengetahui keberadaan masjid Wapauwe. Instrumen yang digunakan adalah pedoman wawancara dan lembar observasi. Hasil penelitian menunjukkan bahwa objek matematika yang ada pada masjid Wapauwe adalah: segiempat (persegi dan trapezium); elips; segitiga; lingkaran; bangun ruang (kubus, prisma trapesium, piramida dan tabung); arah kompas; dan kebangkitan. Selanjutnya, mitos (menggunakan telepati sebagai alat komunikasi dengan masyarakat dimensi lain) dan sains (konstruksi bangunan menggunakan rangka kayu berkualitas baik dan jarak kayu penghubung dekat sehingga mengakibatkan bangunan masjid menjadi kokoh dan kuat). Selanjutnya disarankan agar peneliti selanjutnya dapat meneliti implementasi etnomatematika masjid Wapauwe dalam proses pembelajaran matematika.*

Kata kunci: *etnomatematika, konstruksi masjid, masjid Wapauwe Kaitetu, mitos dan sains.*

▪ INTRODUCTION

The life of the Indonesian people is definitely inseparable from the culture and customs that are believed and implemented for generations. This is the case with the people of Central Maluku, especially the Kaitetu community. Culture is a special way that human beings develop and have (a certain society) to adjust to the environment and be passed on from generation to generation, while mathematics is realized due to human

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DOI: http://dx.doi.org/10.23960/jpmipa/v24i2.pp467-480
Received: 25 April 2023
Accepted: 23 June 2023
Published: 28 June 2023

Furthermore, (Suherman, 2011) defines mathematics as the science of forms, structures, quantities and other related concepts, and divided into three areas, namely algebra, analysis and geometry. Meanwhile, according to Abdurrahman Mulyono that mathematics is a direction to find answers to problems faced by humans, how to use information, use knowledge of shapes and measures, use knowledge about counting and thinking in humans themselves to perceive and use relationships (Mulyono, 2003). Likewise, when building a building such as the old Wapauwe Kaitetu mosque.

Wapauwe Kaitetu mosque is located on the island of Ambon, precisely in the village of Kaitetu, Central Maluku regency. Historically, the old Wapauwe Kaitetu mosque was built as early as 1414, by the datuks. Furthermore, it becomes one of the cultural reserves and tourist destinations on the island of Ambon. So it is necessary to examine the sturdiness of the mosque building even though it has passed 6 centuries until now. An ethnographic approach is necessary for research like this.

Ethnography is a discovery strategy in which researchers study intact cultural groups in natural settings over long periods of time by collecting, primarily observational and interview data (Creswell & Poth, 2007b). Harris says that ethnography is a qualitative design in which researchers describe and interpret patterns of values, behaviors, beliefs, and language shared and learned from groups of various cultures (Harris, 1968). Ethnography has changed from an objective and realist description and orientation to the production of an open ideological culture (Koro-LJungberg, 2005).

The study of ethnomathematics and myths has been widely researched by people. This study categorized these studies into two categories. The first category of ethnomathematics on symbols, among others researched by Patma Sopamena & Juhaevah, 2019; Sopamena & Yapono, 2016 ; Ahmet Küçük 2014; Utami, Sayuti, & Jailani, 2019; Fauziah, Niniwati, & Wahyuni, 2020; Ergene, Ergene, & Yazıcı, 2020. Patma Sopamena said that on the symbols of traditional dance cakalele the Nuaulu tribe contains ethnomathematical characteristics, namely calculations (addition, multiplication, division, etc.) about the perpetrators of cakalele and the accessories they use; measurements are found in red beaver cloth, designs are found in accessories used by traditional actors; the play is within the cakalele dance itself; described in the history of cakalele dance and its supporters; and locating is where it's done. This is in line with what Alan Bishop said that mathematical activity can be universally found in every cultural group, namely: Counting, Locating, Measuring, Designing, Play, dan Explaining – CLMDPE (Bishop, 1988). Furthermore, Fauziah, et al said that existing in South Solok Regency The largest house sieve has a pavilium of 88.89% and is rectangular in shape, which has an ordinary bridge in the gadang house of 77.78% and which has a bridge up by 7.4%. Rumah Gadang has a room/room because the room/room is a place of privacy for people whether married or not, so 88.89% of gadang houses have rooms/rooms. And the number of cubicles/rooms varies depending on the house filter by 40.74%, by prime by 37.04%, and even by 11.11%. In addition, Lulu Muhammad Fauzi and Muhammad Gazali (Fauzi & Gazali, 2022) say that the determination of housing characters uses mathematical models in their calculations.

Furthermore, the second category related to mathematics learning is investigated by (Mania & Alam, 2021; Supriadi, 2019; Utami et al., 2020; Sunzuma & Maharaj, 2019, 2021a, 2021b; Johnson et al., 2022; dan Fendrikfendrik et al., 2020), and metacognitive abilities (Sutarto et al., 2022). Sunzuma & Maharaj in their research say that in-service

teachers have various definitions of ethnomathematical approaches and they are aware of ethnogeometric practices found in their cultural practices and experiences that can be integrated into geometry teaching and learning. Furthermore, the results of research by Sutarto, et al show that overall, ethnomathematics-based e-modules are valid, practical, and effective for improving students' metacognitive abilities on spatial material.

In addition, the third is a category related to myth and science and its relationship with ethnomathematics which is explored, among others, by (Lelapary, 2020; Yunita & Sugiarti, 2020; Utami et al., 2022; Alangui, 2020; Trinick & Meaney, 2020; Fernández-Oliveras et al., 2021). Trinick & Meaney (2020) stated that prospective teachers' understanding of ethnomathematical knowledge and practices associated with traditional navigation methods is disturbed by myths perpetuated by European colonizers. Based on these studies, no one has studied ethnomathematics related to myths and science about a sacred object. Therefore, this study examines the ethnomathematics of myth and science in the building of the Old Mosque of Wapauwe Kaitetu.

▪ METHOD

Types

The purpose of this study was to describe the ethnomathematics between myth and science in the old mosque of Wapauwe Kaitetu in Central Maluku. Therefore, this type of research is qualitative exploratory with an ethnographic approach, that is, research occurs naturally where phenomena occur, based on different assumptions, data is descriptive, and focuses on the processes that occur as well as detailed portraits of a cultural group (Creswell, 2015).

Participant

The subjects in this study were 2 people from community leaders and Wapauwe Kaitetu mosque guards by extracting data using interviews and observations and documentation. The criteria of the subject as a source of data taken are people who understand the history and form of the Wapauwe Kaitetu mosque which can be studied mathematically using ethnomathematics.

Research Design and Procedures

These research steps use an ethnographic procedure adopted from Spradley's ethnography, known as the Gradual Advanced Research Flow-GARF. GARF consists of 12 steps and must be followed strictly and in order from the first step to the twelfth step. The twelve steps of GARF are as follows: assigning informants, interviewing informants, making ethnographic notes, asking descriptive questions, conducting interview analysis, making domain analysis, asking structured questions, making taxonomic analysis, asking contrast questions, making component analysis, discovering cultural themes, and writing an ethnographic report (Spradley, 2007). The study did not follow twelve steps sequentially but a description of the mathematical elements of the Wapauwe Kaitetu mosque ritual using an ethnographic framework that includes all steps of GARF.

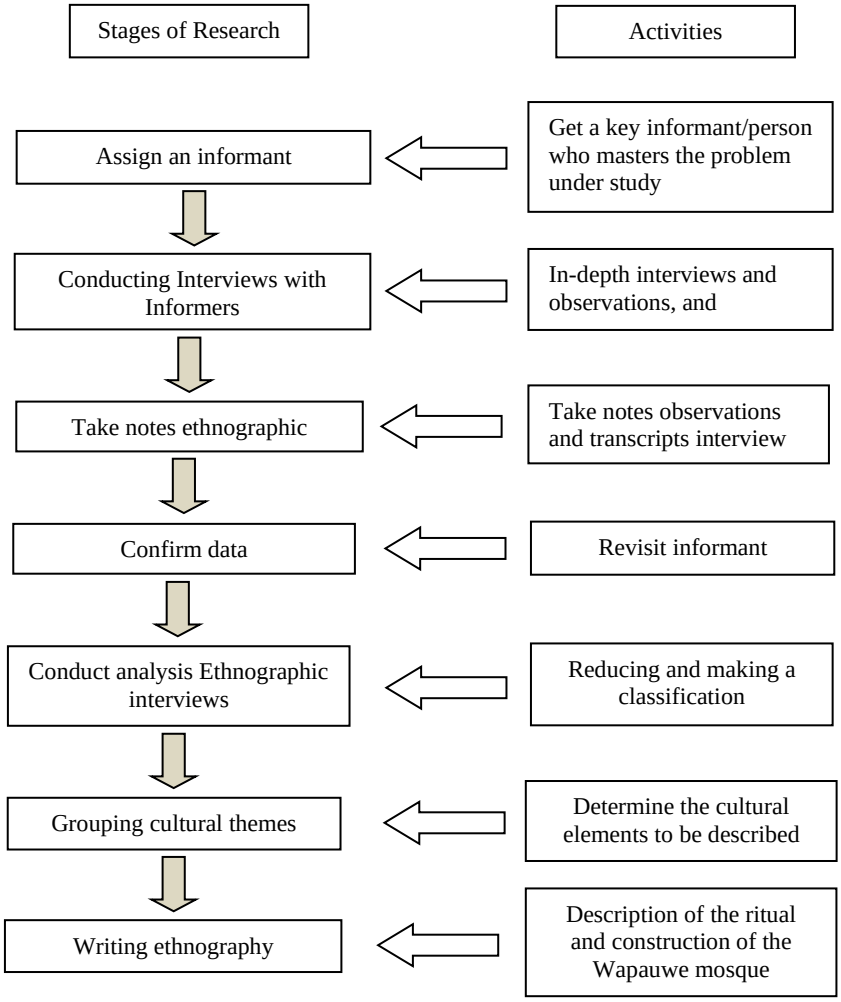


Figure 1 Step GARF (Spradley Modified, 2007)

Instrument

Researchers are the main instruments and are supported by supporting instruments, namely observation sheets, interview guidelines, and recording devices. Observations are made to describe something related to the Wapauwe Kaitetu mosque which then makes conclusions from the results of observations and is compiled in the form of an observation report. Furthermore, unstructured interviews are conducted with sources and documentation.

Data Analysis

Data analysis in this study was carried out in two stages, namely data analysis during the field and data analysis after data collection. Data analysis while in the field includes decision making on data study materials, planning data collection stages, and exploring relevant references during research. Data analysis after data collection, that is, by combining data from interviews, observations, and documentation. Next, explain the findings of the research results, and draw conclusions.

▪ RESULT AND DISSCUSSION

Profile and Mathematical Elements in the Wapauwe Kaitetu mosque Building

The old Wapauwe Kaitetu mosque is located in Kaitetu Village, Leihitu District, Central Maluku Regency. According to its history, which has been story for generations by the local people, the Wapauwe Kaitetu mosque was originally on the mountain since the 600s, which was built in 1414. Wapauwe Kaitetu mosque was founded by datuk-datuk one of which is Tuni ulama (hereditary people's story). According to the community, in 1664 when the Kaitetu people woke up in the morning at that time the mosque was already in the village so it was called the Wapauwe Kaitetu mosque. This the researcher obtained from the results of a researcher interview with one of the guards of the Wapauwe Kaitetu mosque. As the statement of the mosque guard as follows.

P: When was this Wapauwe Kaitetu mosque built?

S1: Actually, this Wapauwe Kaitetu mosque has been on the mountain since the year 1414, Then after the community had settled in this village in 1664, when the people got up early, this mosque was already in the village.

Figure 2. Photo of Wapauwe Old Mosque Building

The old mosque of Wapauwe has a main building with a two-story roof made of sago tree leaves which the Moluccan people generally call rumbia leaves. The top roof is pyramid-shaped, on the lower side of the pyramid is rectangular. This is the same as the research conducted by Muhammad Fadhil Fathuddin and Qodriana (Fathuddin, 2017; Qodriana, 2007). The top of the pyramid is given a pole, which the local people call the alif pole. The shape of the roof of the Wapauwe Kaitetu mosque building is two-roofed and if laid will be in the form of an isosceles trapezoidal prism.

The Wapauwe Kaitetu mosque is on land with a land area of approximately 320 m2. The building area of the Wapauwe Kaitetu mosque is 10 m x 10 m, with a priestly prayer place of 2 m x 3 m located integrated with the body of the mosque and there is a pulpit where the khatib delivers his sermon. It can also be seen that in the mosque building there is a well with a diameter of approximately 1 m and a place of ablution. In addition, the building's support poles total 12 rectilinear rods, with the size of the outer blanket of the pole 1 inch of an adult's hand or approximately 20 cm. The poles are located on each side of the building, which consists of: 2 central poles and 2 poles on the sides. In the middle of the building, there are 4 other poles to support the alif pole and the pyramid roof of the same diameter. The pillars of the mosque have been replaced in 1991 since the existence of the mosque building in 1414.

In addition, all the wood that connects the pole with the ribs of other parts does not use nails, pegs, or ropes but uses a hook between the woods. So that if the support parts and poles to be replaced by the community will be easily replaced by making hooks on replacement wood. The pillars of the mosque and all the wood used for the reinforcement of the mosque are made using traditional tools. The inside of the second roof overlaps looks a very neat wooden connection in the form of flat sides, such as squares and triangles. The parts are interrelated.

Figure 3. The inside of the Wapauwe Kaitetu mosque

Likewise, the hooks on the two-story roof, all the support poles (the four central poles) are connected to each other, that is, there is a connecting wood between the poles that looks solid. Each mast is associated with 9 connecting timbers, including; 4 connecting woods for the second overlapping roof, 1 connecting wood for the first overlapping roof, and 4 connecting woods between the support poles and the first overlapping roof. In addition, on the middle pole and each pole on the wall of the building is connected by one connecting wood that is adjacent to the other poles. As in the following image.

Figure 4. Wooden Anchoring and Connecting the Roof of the Wapauwe Kaitetu mosque

Wapauwe Kaitetu mosques are used by the community to perform prayers every day, except in the month of Ramadan (fasting). This is because the capacity of the mosque which is only 100 m2 in size is not able to accommodate the entire community so that the Wapauwe Kaitetu mosque will be closed for its prayers during the holy month of Ramadan, especially taraweh prayers.

Furthermore, another uniqueness of this Wapauwe Kaitetu mosque is that at the end of the first roof, there are four cardinal directions that read Allah and Muhammad in an elliptical Arabic writing. The north and south parts of the roof have the writing of Muhammad while in the east and west there are the writings of Allah and Muhammad.

Its meaning according to the informant is the name Muhammad and Allah signifies the cardinal direction. The writings, as in the following image.

Figure 5. Writings of Allah and Muhammad in the Four Corners of the Wind of the Wapauwe Kaitetu mosque

Based on the profile of the mosque that has been described by previous researchers, the sturdiness of the building is none other than the quality of the material, density, and wood segments, thus making people's perception of the "magical" mosque building can be explained scientifically. In addition, there are mathematical objects inside the mosque building. This is in line with what was conveyed by (Rosa & Clark, 2011).

Furthermore, the mathematical elements that can be seen from the construction of mosques, as outlined in the profile of mosques, include:

The land used for mosque buildings is approximately 10 m x 10 m. Based on these data, it means that the mosque building is on land in the form of a square (square) with a side length (s) = 10 m and an area of approximately = 100 m2. The area is obtained from the formula of the square flat building area, namely:

$$L\blacksquare = s\text{^}2 = 10m \times 10m = 100m\text{^}2$$

The main building of the mosque is cube-shaped because the base and lid (before the roof) are in the form of a square flat building. So we can calculate the volume of the mosque building, namely the volume of the cube = 10m x 10m x 10m = 1,000m3 with the formula of the volume of the cube.

$$V_{kubus} = s \times s \times s = s^3$$

The roof of the mosque is in the form of a 2-level overlapping roof. The roof can be described as follows:

The top tier of the roof is pyramid-shaped with a square-shaped base, and has openings at the bottom of the pyramid on the four upper sides. At the top of the pyramid is given a pole, which the people call the alif pole.

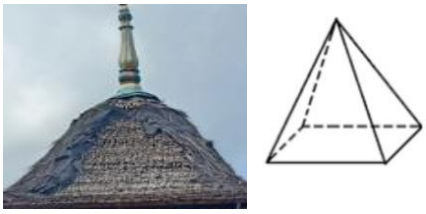


Figure 6. Top Roof of Wapauwe Kaitetu mosque

Based on these findings, it can be explained that a quadrilateral pyramid is a three-dimensional space bounded by a quadrilateral-shaped base side and a triangular-shaped upright side that meets at the cusp point. The roofs of the second and third levels are in the form of isosceles trapezoidal prisms. When the roofs of the first and second overlapping mosques are put to sleep, what is visible is the trapezoidal prism of the isosceles.

Figure 7. The roof of the Wapauwe Kaitetu mosque overlaps two forms of a isosceles trapezoidal prism

Based on these findings, the isosceles trapezoidal prism is a space construct bounded by the sides of the base and the upper is in the shape of an isosceles trapezoid and the upright side is rectangular. In line with research conducted by Saputra et al., (2022). There is a compass on the first overlapping roof, namely on the east and west it says Muhammad and on the north and south it says Allah and Muhammad. The cardinal directions can be described as follows.

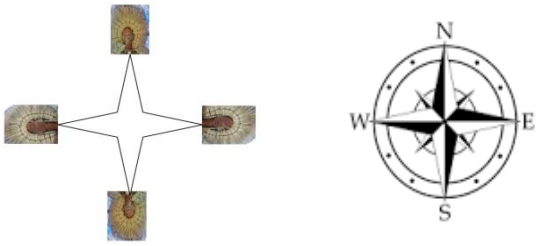
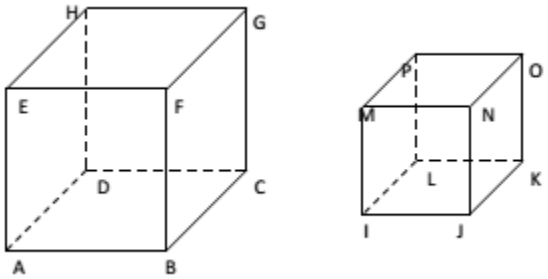


Figure 8. The cardinal directions on the roof of Wapauwe Kaitetu mosque

There is a rectangular prism on the inside of the second overlap and support and connecting pole hooks on the inside of the first overlap. If you look carefully, then building the formed prism is a cube, since it is estimated that the length of its sides is the same. But it is not yet known exactly the size of the length. As in the following image.

Figure 9. Cube shapes on the inside of the top roof and the first 4 corners of the roof

There are four cubes in each corner of the roof overlapping first, which allows the sturdiness of the building and the roof. The four cubes are congruent with the inside of the top overlapping in the shape of a pyramid. That is, based on the concept of deep congruences (denoted by "~") the corresponding side of the prism is congruent. For example, suppose the prism formed is ABCD EFGH (the inside overlaps top) and IJKL MNOP (four parts in the corners of the roof overlap below) following.



Prism deep congruences can be described as all the flat shapes that make up a prism that has corresponding angles of equal magnitude and corresponding sides having the same ratio. In the image above there are builds ABEF~IJNM, EFGH~MNOP, ABCD~IJKL, ADEH~ILMP, BCGF~JKON, and DCGH~LKOP. Therefore, the cubes contained in the four corners and the inside of the top roof of the mosque building are built. In line with the research conducted by Eri Saputra et al (Saputra et al., 2022).

There are many triangles that at every corner of the building that sustains the roof of the first overlap. The triangle's is the is the shortest distance of all hook connected to the support pole. As shown in the following figure.

Figure 10. Triangles on the first four corners of the roof

Based on the findings above, there are several triangles, including isosceles triangles, right triangles, blunt triangles, and taper triangles. In line with the research conducted by Eri Saputra et al (Saputra et al., 2022).

Beduk and the well of the Mosque Beduk and the well of the Wapauwe's mosque are cylindrical (tube) with a side of the beduk where the beduk blow is circular. The shape of the beduk can be seen as shown below.

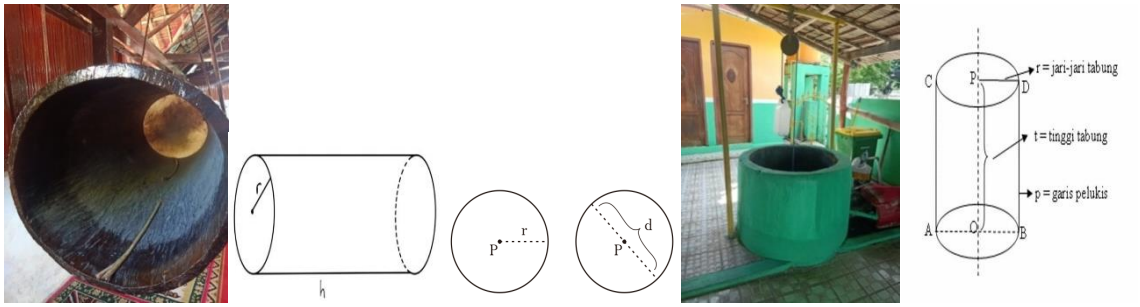


Figure 11. *Beduk* and the well of the Mosque

Based on these findings, it can be explained that the tube is a three-dimensional space building bounded by the side of the base and the upper side of a circular in shape, and the side of the blanket is in the shape of a rectangular arch. Based on the findings about the mathematical elements above, the mathematical objects in the construction of the Wapauwe Kaitetu mosque building contain the concepts of geometry, algebra, and arithmetic. This is in line with research conducted by Patma Sopamena & Juhaevah, 2019; Sopamena & Yapono, 2016 ; Ahmet Küçük 2014; Utami, Sayuti, & Jailani, 2019; Fauziah, Niniwati, & Wahyuni, 2020; Ergene, Ergene, & Yazıcı, 2020)

Ethnomathematics elements of myth and science in the old mosque of Wapauwe Kaitetu Central Maluku

Wapauwe Kaitetu mosque as the oldest mosque in Maluku and even in Indonesia certainly has many accompanying rituals, both in terms of buildings and worship activities. For example, in the strength of the mosque building, according to the community represented by the mosque guard figures, the mosque is old but still remains solid and strong so that it is considered the "magical". But scientifically or mathematically in this case it can be explained that the materials used to build Wapauwe by the datuks use quality materials. As the following statement by the keeper of the Wapauwe Kaitetu mosque:

P: about the wood of what are the pillars of this mosque building?
S: yes the wood for the pillars and walls of this mosque building is wooden red and nani black.

If so, it means that the thinking and knowledge of the datuks cannot be doubted about their quality. The quality of building materials, for example, using first-class wood (black nani and red wood). Likewise, the construction of mosque buildings that utilize wood with the shortest connection / distance (mathematically) between pieces of wood that allows the construction to become a solid building. This is supported by research (Dwi Cahyono, et al., 2018) that the mosque building is still included in the category of still good and suitable for use. Similarly, the construction of mosque buildings that utilize

wood with the shortest relationship / distance (mathematically) between pieces of wood that allows construction to become a sturdy building.

The construction of the Wapauwe building with a square building size where the lengths of all sides are equal in length allows for a balance between the ribs of the building. For example, masjid Wapauwe measures 10m. As stated by community leaders and Wapauwe Kaitetu mosque guards as follows:

P: approximately what is the size of this Wapauwe Kaitetu mosque building?
S: size of length approximately 10m.

In addition, the sides of the building that have only one main door and no other doors also allow the building to be solid. This results in the support and connecting poles having no chance of cracking due to the presence of dense restraints (walls).

Furthermore, when the process of replacing part of the Wapauwe Kaitetu mosque building is carried out with traditional rituals, namely by inviting datuks and siblings scattered on the eastern spooky island, namely gorom village. Invitations to the datuks by wooden telephone believed by the community for generations. As stated by Kaitetu community leaders as follows:

S: When we wanted to (will) dismantle the roof of the mosque in 1991, we invite "pela" (such as relatives/derivatives) from Gorom using a wooden telephone.

The wooden telephone is not visible in the masjid building, but the possibility that is interpreted is to use some kind of telepathy (cognitive psychology). Based on the results of the interview above, it shows that the Wapauwe Kaitetu mosque by the community has almost the same interpretation of the miracle of the mosque from the beginning of its establishment until now. This is in line with research conducted by (Lelapary, 2020; Yunita & Sugiarti, 2020). However, scientifically, especially in terms of applying the mathematical concept of short paths to building construction, the mosque building becomes sturdy and strong. Similarly, with the selection of good wood quality resulting in the frame of the mosque building becomes durable. This is in accordance with the existence of myths as part of ethnomathematics. This statement is in line with what is presented by D'Ambrusio, Clark, dan Rose that

The prefix ethno is today accepted as a really broad term that refers to the socialcultur context and thus includes language, jargon, and codes of behavior, myths, and symbols. The derivation of mathema is difficult,but tends to mean to elucidate, to know, to understands, and to undertake to to activities like ciphering, measuring, classifying, inferring, and modeling. The suffix tics is spring from techne, and he's he's and equivalent root as technique (Rosa & Clark, 2011).

▪ CONCLUSION

Based on the results of research and discussion, it can be concluded that the mathematical elements in the old mosque building of Wapauwe Kaitetu Central Maluku, among others: quadrangular (square and trapezoid); Elliptical; triangle; circle; spaces (cubes, isosceles, trapezoidal prisms, pyramids and tubes); deep congruences; area and volume; and compass/cardinal directions. In addition, the existence of public perception (myth) contained in worship rituals and mosque construction can be explained using the concept of consciousness (cognitive psychology), for example using telepathy. While in terms of science it can be explained that the sturdiness of the mosque is caused by the construction of buildings that use quality wood and there is the shortest path / distance in

the connection between building frames, besides that the mosque building only has one door.

Furthermore, the old Wapauwe Kaitetu mosque which has many mathematical elements can be used as a learning resource in mathematics learning, especially in the field of geometry. The old Wapauwe Kaitetu mosque can also be used as a perception material, example, and material in making HOTS-oriented problems. In addition, a lot of information about the Wapauwe Kaitetu mosque can be used as mathematics learning materials. Ethnomathematics in the Wapauwe Kaitetu mosque only describes mathematical elements and can only be used by local teachers and students. Therefore, ethnomathematical research like this needs to be carried out in other regional cultures, and this research can be used as a reference, for example in the development of teaching materials and the implementation of mathematics learning based on local and realistic cultures.

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