ETHNOMATHEMATICS EXPLORATION OF THE ARCHITECTURE OF THE GREAT MOSQUE PEMALANG AS A SOURCE OF LEARNING MATHEMATICS IN THE 2013 CURRICULUM

Dewi Shinta[1] and Salafudin[2]
Institut Agama Islam Negeri Pekalongan[1,2]
dshinta057@gmail.com, salafudin@iainpekalongan.ac.id

ABSTRAK

Penelitian ini dilakukan untuk mengetahui: 1) Bagaimana etnomatematika yang ditemukan pada arsitektur Masjid Agung Nurul Kalam Pemalang? 2) Bagaimana hasil etnomatematika dalam arsitektur Masjid Agung Nurul Kalam Pemalang sebagai sumber belajar matematika selaras dengan Kurikulum 2013? Metode yang digunakan adalah kualitatif deskriptif dengan pendekatan studi etnografi. Teknik pengumpulan data dilakukan melalui wawancara, observasi, dan dokumentasi. Proses wawancara dilakukan untuk mengetahui nilai-nilai budaya pada arsitektur Masjid Agung Nurul Kalam Pemalang. Sementara proses observasi dilakukan untuk mengetahui konsep matematika pada arsitektur Masjid Agung Nurul Kalam Pemalang. Hasil penelitian ini menunjukkan bahwa terdapat konsep matematika berupa geometri bangun datar dan geometri bangun ruang. Unsur geometri tersebut adalah segitiga, persegi, persegi panjang, trapesium, lingkaran, kubus, tabung, dan limas. Sumber belajar matematika yang ada pada arsitektur Masjid Agung Nurul Kalam Pemalang selaras kurikulum 2013 termuat dalam materi pembelajaran matematika kelas VII SMP/MTs materi segiempat dan segitiga, kelas VIII SMP/MTs materi lingkaran dan bangun ruang sisi datar, kelas IX SMP/MTs materi bangun ruang sisi lengkung.

Kata Kunci: Etnomatematika, Masjjid Agung Nurul Kalam Pemalang, Sumber Belajar, Kurikulum 2013

ABSTRACT

This research was conducted to find out: 1) How is the ethnomathematics found in the architecture of the Great Mosque of Nurul Kalam Pemalang? 2) How are the results of ethnomathematics in the architecture of the Great Mosque of Nurul Kalam Pemalang as a source of learning mathematics in line with the 2013 Curriculum? The method used is descriptive qualitative with an ethnographic study approach. Data collection techniques were carried out through interviews, observation, and documentation. The interview process was conducted to find out the cultural values in the architecture of the Great Mosque of Nurul Kalam Pemalang. While the observation process was carried out to determine the ethnomathematics of the architecture of the Great Mosque of Nurul Kalam Pemalang. The results of this study indicate that there are ethnomathematics in the form of flat geometry and spatial geometry. The geometric elements are triangles, squares, rectangles, trapezoids,

circles, cubes, tubes, and pyramids. Mathematics learning resources in the architecture of the Great Mosque of Nurul Kalam Pemalang are in line with the 2013 Curriculum, contained in the mathematics learning materials for class VII SMP/MTs with quadrilaterals and triangles, class VIII SMP/MTs with materials on circles and flat-sided spaces, class IX SMP/MTs with building materials curved side space.

Keywords: *Ethnomathematics, The Great Mosque of Nurul Kalam Pemalang, Learning Resources, 2013 Curriculum*

INTRODUCTION

In the millennials today education is seen as a real need for human longevity. Education is a process of achieving balance and perfection through the process of science transfer, value transfer, energy transfer and character-building in all its aspects. According to Ahmadi and Ubiyati, education more emphasis is on practices that involve learning to teach. The practice of formal education extends from a preschool to high school which a curriculum and some supplementary materials, as well as mathematics. Nasution states that mathematics is linked to Sanskrit, particularly "medha" or "widya", which refers to intelligence, knowledge, and intelligence (Isrok'atun & Amelia Rosmala, 2018).

Math study has now used the 2013 curriculum by focusing on the modern pedagogical aspects of the use of the saintific method. But school math studies are sometimes fixed on monolised and textual learning. This leaves students feeling bored and saturated when studying math. Hence, educators and prospective educators must be able to provide new creations and innovations in delivering mathematical materials in order to make math learning meaningful. Stands on the philosophical foundations of curriculum 2013, one of which is rooted in local and national culture. Then math education there is a need for a way to connect between school mathematics and culture. One of the studies that can connect between mathematics and culture is through the ethnomath approach where students learn from, and learn through culture (Arief Aulia Rahman, 2018).

According to Ubiratan

D'Ambrosio ethnomathematics is the study of the relationship between mathematics and culture. It is often associated with "cultures without written expression". D'Ambrosio also explains ethnomath derived from the ethno, mathema, and tics. The ethno indicates cultural groups, such as ethnic groups within a country or social worker class, as well as language and everyday routines. Then mathema means to explain, to understand, and to manage the obvious by actually looking at calculations, measurements, classification, structure, and modeling patterns of phenomena. Finally tics means art technique. Thus, ethnomath is a reflection of cultural anthropology (cultural anthropology of mathematics) and mathematics from the standpoint of studies (Nailatusy Syifa & Salafudin, 2021). Ethnomath can be said to be a branch of the science that learned how mathematics adapted to culture. One of the cultural objects that can be source for learning mathematics is the mosque building.

In the Pemalang Regency, there is a unique and modern construction of the Great reed Mosque, the historical story of Mbah Nur Kalam. This mosque is located in Kauman Village, 23 Mochtar road Kebondalem, Pemalang district, Central Java. Here educators can invite learners to explore thoroughly every building and architecture available in the Great Nurul Kalam's bush mosque. Then the learners are invited to find mathematical concepts that match the mathematical materials in the 2013 syllabus.

In this study, researchers will undertake a process of exploration of ethnomathematics at the architecture of the Great Nurul Kalam's grassed mosque as a source for learning mathematics in accordance with mathematical materials in the 2013 curriculum. Researchers will dig up any mathematical concepts found in the architecture of this mosque, as well as how the mathematics of the mosque's architecture can serve as a source of learning through the application of examples of problems that match the mathematics found.

The study involves qualitative methods. Qualitative research is a

strategy that emphasizes the quest for meaning, understanding, concepts, characteristics, signs, as well as descriptions of a phenomenon, focus and multimethods, natural and holistic, prioritizing qualities, using several ways, and being narrative (Umar Sidiq, 2019). While researchers use the ethnographic approach with the goal of describing, analyzing, and interpreting group culture, over a long period of time, to include the beliefs, behavior, and language that the group uses (Nusa Putra, 2012).

Data sources obtained from primary and secondary data. Primary data is data collected directly by research participants through the process of documenting, observation, and interview with trusted sources. While secondary data are obtained from recovered historical documents or statements either of published or unpublished archives. Data analysis is done by the process of data collection, data reduction, data presentation, and concluding.

DISCUSSION

The Great Mosque Nurul Kalam Pemalang is one of the oldest mosques in the Pemalang Regency. The mosque has a historical meaning with the Islamic expansion on the island of Java, particularly the Pemalang Regency. According to the imperial seal of the Pasarean Agung Soeronatan, the history of the establishment of the mosque has two versions, as they relate to the history of Surakarta and Banten empires. The first account states that Mbah Nur Kalam, the third son-in-law of Sultan Kartasura, Amangkurat III, wanted to go to the Pemalang with his wife and son, Prince Nur Besari, to visit the deceased supreme leader Raden Jiwanegara "Patih Sampun". Upon reaching the Pemalang, Mbah Nur immediately visited the grave of her relative and decided to stay in Pemalang. He established a small surau that was used as a dissemination of Islam in Pemalang Regency. This account relates to the Pasarean Agung Soeronatan (descendant of Surakarta) canon, where Mbah Nur was buried.

The second story takes place in

the 18th century precisely 1815, the rulers of Banten sent Raden Tubagus Sabdo Renggono Kalam to face Kanjeng the Regent Pemalang in order to claim the inheritance of keris by the name "Setapak" left behind in the Penggarit Village, Taman District, the Pemalang Regency. Once the kris was were obtained, Raden Sabdo Renggono Kalam intended to return to Banten. But the boat he was riding didn't want to go, just circled around the north sea of Java. Eventually Raden Tubagus Sabdo Renggono Kalam decided to settle in a Pemalang then spread Islam and establish a small musala currently called the Great Mosque Nurul Kalam's Pemalang.

The large Mosque of Pemalang is located on the west of the construction square. The typical feature of this mosque is its towering tower of nearly 200 feet [60 m]. The architecture had such shapes as space and field geometry and used islami geometric motifs. It is dominated by modern architecture such as that of andesite rock, a combination of marble and homotile, and an ornament of aluminum clatters. This makes the mosque look unique and beautiful (Figure 1 and Figure 2).

Figure 1. Great Mosque of Nurul Kalam Pemalang

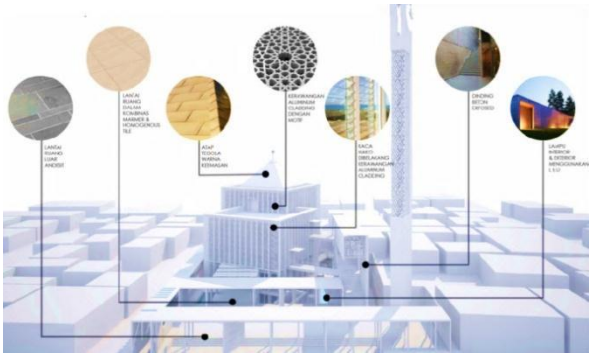


Figure 2. Visible Material Design

Math education found in everyday life-day students' sometimes differ from school math. Based on curriculum 2013 math learning must touch aspects of students' daily lives. So students need a curriculum that bridges the gap between the school math gap and culture-based mathematics. One of the cultural elements that can be used as a source

of studying mathematics is architecture at the Great Nurul Kalam's construction mosque. Students could easily find and understand the mathematical concepts of geometry on the architecture of a mosque. Here are the mathematical concepts found in the architecture of the Great Nurul Kalam Pemalang mosque.

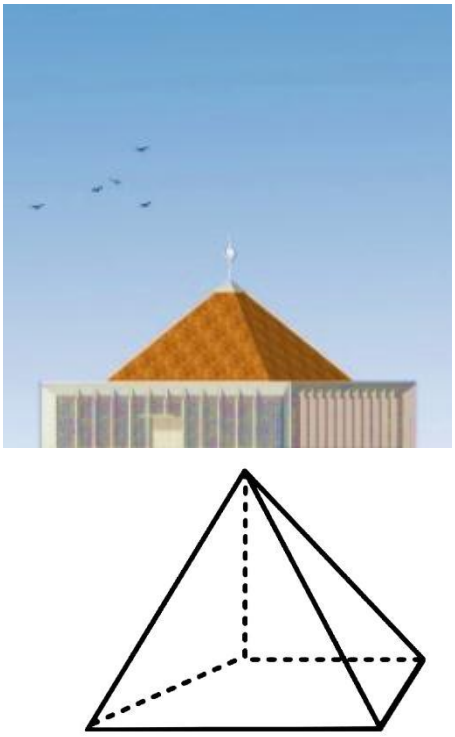


Figure 3. The roof of the Great Mosque of Nurul Kalam Pemalang

When it comes to the roof of the mosque, it has such a limas level. The roof with this limbic shape as a symbol of the vertical relationship breaking toward one point is impossibility on God's part. Specifically, the roof arrangement was adjusted to local wisdom and the traditions of pastoral societies. Whereas roof serve in principle as a protection heat and rain. If used as a source for mathematics study, the geometry of the space could be linked to classroom VIII Junior High School/MTs Class II sylabus subjects of the 2013 Curriculum 3.9 and 4.9. In application it may be given examples of such relevant issues as calculating the surface area of limas and locating the volume of limas.

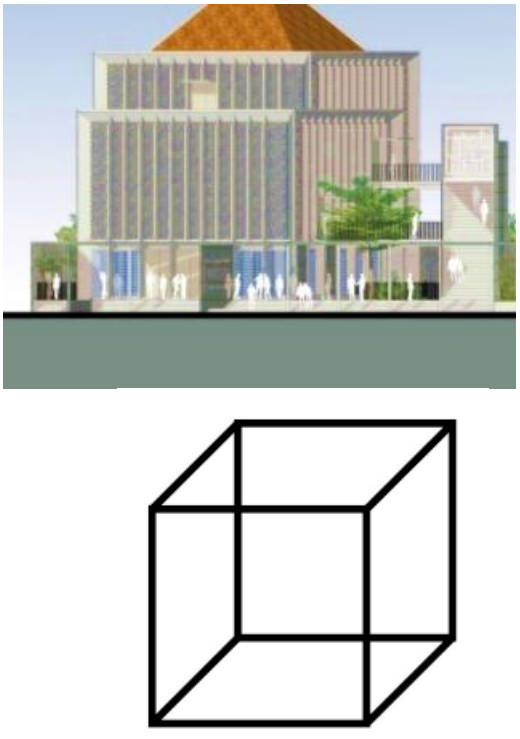


Figure 4. The main building of the

Great Mosque of Nurul Kalam, Pemalang

It has a square shape to look for a cube mass design with one main door on the front. So when worshipers go inside is directly confronted with the main salinity for men's services. While the women's temple hall is located in the basement and second floor. The wudlu men's area is in the north and the wudhu women's area is in the south. The geometry of the cube space may be linked to classroom VIII Junior High School/MTs class II sylabus math subjects 2013 KD 3.9 and 4.9 curriculum.

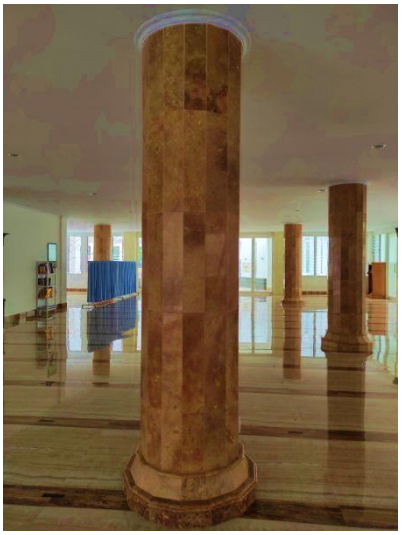


Figure 5. Inner Main Pole (Sokoguru) and Outer Mast

Figure 5 shows that the main mast or socket and the outer mast have the shape of a tube or cylinder. The mosque building is supported by 8 main pillars and 18 supporting poles on the outside of the mosque. The mosque pole is symbolized by the perception to uphold the religious pole in life which is the five times. The geometry concept of constructing the

curved side of space can be linked to class IX Junior High School/MTs sylabus math subject of the 2013 Curriculum 3.7 and 4.7.

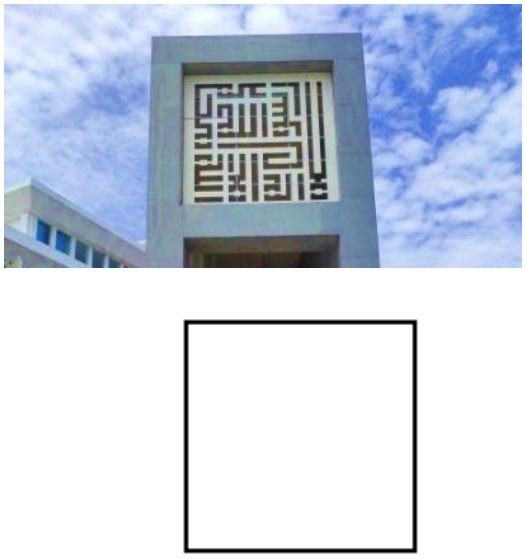


Figure 6. "Muhammad Rasulullah" Calligraphy Design with a Square Frame

Figure 6 shows that calligraphy reads "*Muhammad Rasulullah*" with a rectangular framed design. The design is implementation of a flat geometry concept. The square geometry concept may be linked to class VII Junior High School/MTs Semester II sylabus math subject of the 2013 Curriculum 3.11 and 4.11.

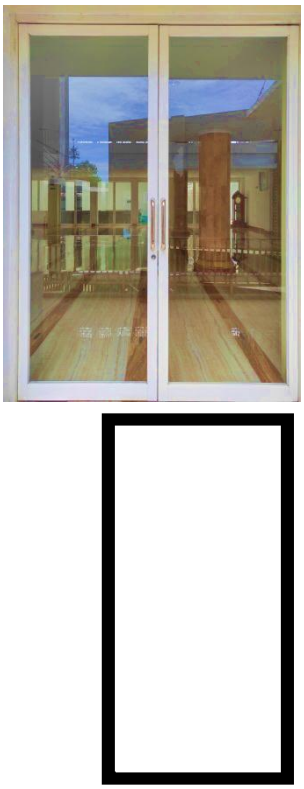


Figure 7. Entrance to the Great Mosque of Nurul Kalam Pemalang

Figure 7 that is the entrance to a mosque has the concept of building a rectangle. This level build geometry concept may be linked to class VII Junior High School/MTs class II sylabus math subject of the 2013 curriculum 3.11 and 4.11.

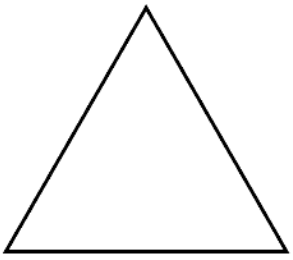


Figure 8. The roof of the mosque is seen from the side of a triangle shape

From the figure 8 when viewed from each side of the roof of the mosque has the shape of a flat triangle build. The triangular geometry concept can be linked to class VII Junior High School/MTs II sylabus math subject of the 2013 curriculum 3.11 and 4.11.

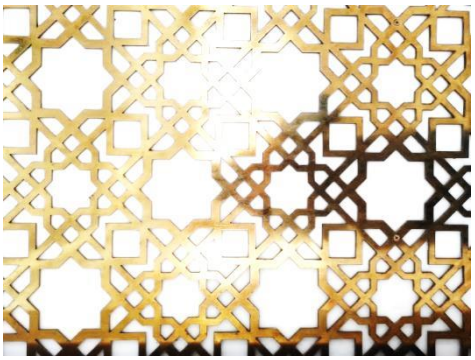


Figure 9. Islamic Geometric Ornament

Figure 10. Trapezoid in Islamic Geometric Ornaments

In figure 10, we see a form of triapesium obtained from geometric islamic ornaments on the walls of the mosque.

Figure 11. Mbah Nur Kalam's Heritage Well

Shown in the figure the 11 building of the well has a shape like the curved space which is the tube. The well is 80 cm (26 in) high and 180 cm (6 in) in diameter.

Figure 12. Drum (Bedug) and Kentongan

The drum's surface has a circle of about 100 cm in diameter. The drum frame has a rectangular shape measuring 148 cm (20 in) in length. The circular element on the drum surface may be related to eighth grade secondary school/MTs class II sylabus math subject 2013 Curriculum KD 3.7, 3.8, 4.7 and 4.8.

Table 1. Mathematical Concepts in the Architecture of the Great Mosque of Nurul Kalam Pemalang

No.	Mosque Architecture	Mathematical Concepts	Information
1.	Mosque Roof	Rectangular Limas	Figure 3
2.	Mosque Core Building	Cube	Figure 4
3.	Mosque Pole	Canister or Prism	Figure 5
4.	Lafadz's "*Muhammad Rasulullah*" design	Square	Figure 6
5.	Door of the Mosque	Rectangular	Figure 7
6.	Rooftop of the Mosque from the Far Side	Triangle	Figure 8
7.	Islamic Geometric Ornaments	Triapesium and Square	Figure 9 & 10
8.	Mosque Well	Tube or Cylinder Circle	Figure 11
9.	Bedug and Kentongan		Figure 12

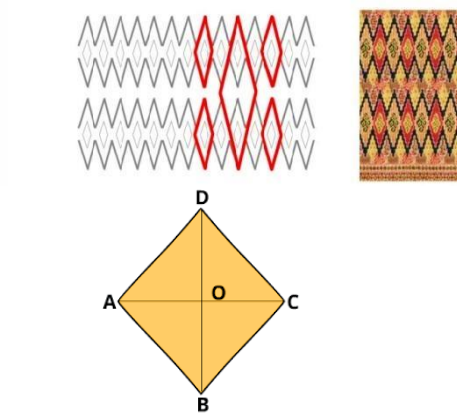
As the results of ethnomath in the architecture of the Great Mosque Nurul Kalam's Pemalang can be a source of learning mathematics through the application of examples of problems consistent with the math concept found. The production of an example in this matter refers to dictating Republic of Indonesia No. 37 in the 2018 sylabus class of the 2013 curriculum.

Matter : Rectangular and Triangular

Class : VII Junior High School

Semester : II (Even)

1. Consider the design of an eccentric batik ornamentation that forms the building of a microphone



If AD=(5a+2), BC=(a+6), BCD=60º, find:

a. Grade a
b. Length of side AD
c. The big $\angle BAD$ and $\angle ABC$

Alternate Completion:

Unknown: $AD = (5a + 2)$,

$BC = (a + 6)$,

$\angle BCD = 60^o$

Question: value; length of side AD; big $\angle BAD$ and $\angle ABC$ ...?

Answer:

a. Grade a

$AD = BC = DC = AB$

$AD = BC$

$5a + 2 = a + 6$

$5a - a = 6 - 2$

$4a = 4$

$a = 1$

So, a is 1 cm.

b. Length of side AD

$AD = 5a + 2$ → substitution $a = 1$ to equality $AD = 5a + 2$

$5(1) + 2$

$5 + 2$

7

So the sides of the AD are 7 cm.

c. The big $\angle BAD$ and $\angle ABC$

$\angle BCD = \angle BAD =$ 60º, obtained $\angle BAD =$ 60º

$\angle ABC = \angle ADC,$ suppose the big angle is m, then:

$\angle BCD + \angle BAD +$ $\angle ABC + \angle ADC =$ 360º

$60^o + 60^o + m + m =$ 360º

$120^o + 2m = 360^o$

$2m = 360^o - 120^o$

$2m = 240^o$

$m = 120^o$

So, $\angle BAD = 60^o$ and

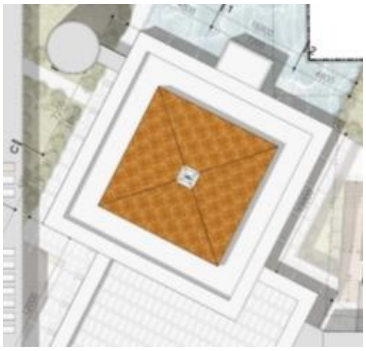
$\angle ABC = 120^o$

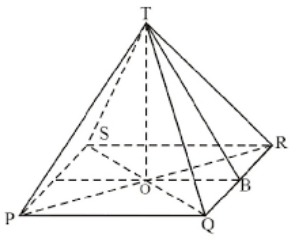
Matter : Build a Flat Side Space

Class : VIII Junior High School

Semester : II ((Even)

2. The roof of the Great Mosque Nurul Kalam's grass-shaped limas.





If the lymph height is 4 m and the rib high is 5 m, specify:

a. Square circumference
b. Pyramid surface area
c. Pyramid volume

Alternate Completion:

Unknown: pyramid height $(TO) = 4$ m; tall upright ribs $(TB) = 5$ m

Question: Square circumference;
Pyramid surface area;
Pyramid volume...?

Answer:

a. Square circumference

Half square side length by the Phytagoras Theorem

$OB = \sqrt{TB^2 - TO^2}$

$OB = \sqrt{5^2 - 4^2}$

$OB = \sqrt{25 - 16}$

$OB = \sqrt{9}$

$OB = 3$ m

Square side length $= 3 \times 2 = 6$ m

Square circumference $= 4.s$

Square circumference $= 4.6$

Square circumference $= 24$ m

So the square circumference is 24 m.

b. Pyramid surface area

$LP = (La) + (4.$ vertical width)

$LP = (s.s) + (4. \frac{1}{2}.s.t)$

$LP = (6.6) + (4. \frac{1}{2}.6.5)$

$LP = (36) + (60)$

$LP = 96$ m^2

So the surface area of pyramid is 96 m^2

c. Pyramid volume

$V = \frac{1}{3}.(s \times s).t$

$V = \frac{1}{3}.(6 \times 6).4$

$V = \frac{1}{3}.(36).4$

$V = 48$ m^2

So the pyramid volume is 48 m^2.

CONCLUSION

Ethnomath is the study of the relationship between mathematics and culture. One of the cultural objects that can be the source for learning mathematics is the architecture of the Great Nurul Kalam's construction mosque. Where within the architecture of the mosque was obtained a mathematical concepts of a geometry concepts of flat up and space. The level waking elements referred to are triangles, rectangles, squares, triezosos, and circles. While the building blocks of space were found... pyramids, cubes, and tubes.

The mathematical study resources in the architecture of the Great Mosque Nurul Kalam in accordance with the 2013 curriculum are included in the VII Junior High School class II on the sefour and triangular materials, eighth middle school semester II on the circle and build level space, and Junior High School IX semester I on the curved side space materials.

REFERENCES

Abi, Alfonsa M. 2016. *Integrasi Etnomatematika dalam Kurikulum Matematika Sekolah*, (Program Studi Pendidikan

Matematika STKIP SOE NTT: Jurnal Pendidikan Matematika Indonesia. Vol. I No. 1.

Faida, Z.A. 2019. Eksplorasi Etnomatematika dalam Pembelajaran Matematika Kurikulum 2013 Melalui Candi Sanggrahan Tulungagung. *Skripsi*,dipublikasikan. IAIN Tulungagung.

Isrok'atun & Amelia Rosmala. 2018. *Model-model Pembelajaran Matematika*. Jakarta: Bumi Aksara.

Kurniaman, O. & Noviana, E. 2017. *Penerapan Kurikulum 2013 dalam Meningkatkan Keterampilan, Sikap, dan Pengetahuan*. Riau: Jurnal Primary Program Studi Pendidikan Guru Sekolah Dasar Fakultas Keguruan dan Ilmu Pendidikan Universitas Riau. Vol. 06. No. 02.

Pujangga, Agung Cahya. 2020. Eksplorasi pada Masjid Muhammad Cheng Hoo Jember sebagai Bahan Pembelajaran Matematika. *Skripsi*, dipublikasikan. Universitas Jember.

Putra, Nusa. 2012. *Metode Penelitian Kualitatif Pendidikan*. Jakarta: Rajawali Pers.

Rahman, Arief Aulia. 2018. *Strategi Belajar Mengajar Matematika*. Banda Aceh: Syiah Kuala University Press.

Riyah, Sur'atur. 2021. Eksplorasi Etnomatematika pada Arsitektur Masjid Agung Demak sebagai Sumber Belajar Matematika Berbasis Budaya Islam. *Skripsi*, dipublikasikan. IAIN Salatiga.

Sidiq, Umar & Choiri, Moh. Miftachul. 2019. *Metode Penelitian Kualitatif di Bidang Pendidikan*. Ponorogo: CV. Nata Karya.

Syifa N. & Salafudin. 2021. Implementasi Tradisi Syawalan pada Pembelajaran Matematika Berbasis Etnomatematika. Pekalongan: *Jurnal Pendidikan Matematika*.Vol. 01. No. 01.