

Ethnomathematics of Baitu Usyaqil Quran (BUQ) Mosque and Pesantren Darussalam, Banyumas Regency

Kusno*¹, Eka Setyaningsih², Anggun Badu Kusuma³

^{1,2,3}Department of Mathematics Education, Universitas Muhammadiyah Purwokerto, Indonesia *kusnoump@gmail.com

ABSTRACT

The mosque is the oldest Islamic culture which is the center of civilization for Muslims for every group, both adults and children. However, so far the mosque environment is rarely used as an effective learning resource to explore more contextual, meaningful and educational mathematics material. The purpose of this study was to explore mathematics teaching materials and religious values from objects (artifacts) around the mosque. The artifacts explored are mosque objects that have religious values, namely prayer rugs, prayer rugs, mosque reliefs and covers of the Qur'anic manuscripts. The research location is in the *Baitu Usyaqil Quran* (BUQ) Mosque and the *Pesantren* Darussalam Purwokerto Mosque, Banyumas, Central Java. The data collection method uses observation, documents and literature review. The data analysis technique used descriptive qualitative analysis. The results showed that, prayer rugs, prayer rugs, mosque reliefs and covers of the Qur'anic manuscripts concepts such as symmetry, reflection, translation, rotation, and dilation. The results of this study are very important to develop a mathematics curriculum based on student culture.

Keywords: Culture, Ethnomathematics, Mosque, Mathematics, Transformational Geometry

ABSTRAK

Masjid merupakan kebudayaan Islam tertua yang menjadi pusat peradaban bagi umat Islam untuk setiap kalangan baik dewasa maupun anak-anak. Namun, selama ini lingkungan masjid jarang dijadikan sebagai sumber belajar yang efektif untuk menggali materi matematika yang lebih kontekstual, bermakna dan mendidik. Tujuan dari penelitian ini adalah untuk mengeksplorasi bahan ajar matematika dan nilai-nilai religius dari benda-benda (artefak) di sekitar masjid. Adapun artefak yang dieksplorasi adalah benda-benda masjid yang memiliki nilai-nilai religius yaitu karpet sajadah, sajadah, relief masjid dan cover dari mushaf Alquran. Lokasi penelitian di masjid Baitu Usyaqil Quran (BUQ) dan Masjid Pesantren Darussalam Purwokerto, Banyumas, Jawa Tengah. Metode pengumpulan datanya menggunakan observasi, dokumen dan kajian literatur. Teknik analisis datanya menggunakan analisis deskriptif kualitatif. Hasil penelitian menunjukkan bahwa, karpet sajadah, sajadah, relief masjid dan cover dari mushaf Alquran tertur, refleksi, translasi, rotasi, dan dilatasi. Hasil penelitian ini sangat penting untuk mengembangkan kurikulum matematika yang berbasis pada budaya siswa.

Kata kunci: Budaya, Etnomatematika, Masjid, Matematika, Geometri Transformasi

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Introduction

The practice of mathematics in everyday culture has existed and continues from time to time (d'Entremont, 2015). However, because they are not aware of their existence and do not know how to explore them (Maskar, 2018) they are rarely used as interesting teaching materials to teach students mathematics. As a result, not a few mathematics learning practices are far from student culture (Richardo, 2016), and less meaningful (Gazali, 2016). Mathematics learning needs to be built from student culture (Masamah, 2018) in order to have a strong foundation from everyday experience. A cultural foundation based on local wisdom is very important to support students in constructing their experiences into knowledge that is very useful in their lives (Kusno & Makhful, 2022). In every social order there is a culture that reflects the values, traditions, or works of art according to the philosophy of life of the community (Miharja, 2014). Community culture is better known because it is experienced every moment in life. For this

reason, extracting mathematical ideas from a particular culture is very important to support the success of learning mathematics. The practice of mathematics found in each particular culture by D'Ambroso is called Ethnomathematics (Rosa & Orey, 2011) and has been used to teach mathematics to students.

Ethnomathematics is a field of study, so it has an object of study. The object of the study of ethnomathematics is to reveal the organization (concept) which is inseparable from mathematical activity. Ethnomathematics is an effort to understand, explain, explain, study, and deal with community groups in a special way according to their cultural context (Orey & Rosa, 2015). Hardiarti (2017) claims that there are six characteristics of mathematical activity in ethnomathematical studies, namely: counting, finding, measuring, playing, designing, and explaining. These activities are related to human existence, whether practical (for example, designing buildings, navigation, searching for food), social (eg kinship structures) or transcendent practical needs (eg aesthetics, forecasting). Ethnomathematics emerged as a new category in the conceptual discourse of mathematics education, and as an interaction between mathematics and culture (Zhang & Zhang, 2010). Mathematics is realized because of human activities while culture is a unique way for humans to adapt themselves to their environment. As a result of culture, mathematics can have different forms and develop according to the development of the society that uses it. Ethnomathematics uses broad mathematical concepts related to various mathematical activities, including grouping, counting, measuring, designing buildings, determining locations, determining auspicious days, making calendars and making patterns.

The purpose of studying ethnomathematics is to analyze the relationship between mathematics and culture, so that students' and society's perceptions of mathematics become more precise and easier to understand (Risdiyanti & Prahmana, 2018). The importance of the study of ethnomathematics for several reasons, namely: (1) students are accustomed to personally participate in learning mathematics by seeing firsthand their own culture from what they have practiced and what they think about mathematics, (2) culture is the result of the process of social interaction in a society that has educational values, (3) teaching mathematics by respecting culture is one way to appreciate these noble values, (4) research on ethnomathematics as a form of extracting mathematics teaching materials based on local wisdom is still few and far between. will continue to be developed.

According to Saparuddin et al., (2019) an understanding of aspects of ethnomathematical studies can be a perspective used by teachers to adopt culture-based learning. The mathematical understanding of students who study ethnomathematically oriented is higher than students who learn not ethnomathematically oriented (Herawaty et al., 2019). Even the view of mathematics teachers in teaching geometry based on ethnomathematics is better than those who do not (Sunzuma & Maharaj, 2021). For this reason, Rosa et al., (2016) recommend the development of a culture-based mathematics curriculum for students. (Cimen, 2014) stated that Ethnomathematics is a relatively new field of study that is supported by many researchers in the field of mathematics education. Ethnomathematics is present as a new branch of mathematics that recommends student culture-based learning. For this reason, an understanding of ethnomathematics (Supiyati et al., 2019; Utami et al., 2019) is very necessary for elementary and middle school teachers to be able to package learning according to student culture.

The mosque is the oldest Islamic culture in the history of Islamic culture (Siswoyo et al., 2019). The mosque is no stranger to any time and circumstance, because Muslims come to it five times

200 ©2022 by Department of Mathematics Education, Universitas Muhammadiyah Purwokerto, Purwokerto, Indonesia p-ISSN 2477-409X, e-ISSN: 2549-9084 and website: http://jurnal nasional.ump.ac.id/index.php/alphamath/ a day. Therefore, the mosque has been imprinted in the minds of students. This is very relevant to be a foothold in learning because it is already in the mind scheme of every student, especially those who are Muslim. In addition, the mosque contains religious values (Jannah & Jazariyah, 2016) which need to be developed continuously to be loved by Muslims and the development of ethnomathematical-based teaching materials and Islamic nuances is practical to use (Ratriana et al., 2021). For this reason, it is necessary to carry out ethnomathematical exploration as an effort to study mathematical material from mosque culture.

The Baitu Usyaqil Quran Mosque (BUQ) is a mosque has a variety of prayer rugs spread throughout the mosque, prayer rugs for personal use and a variety of Quranic manuscripts. Whereas the Darussalam Islamic boarding school mosque has its own uniqueness because it contains various kinds of reliefs on its walls. Each of these artifacts contains geometric shapes and deep religious values. The geometric shapes on the artifacts in the two mosques are of particular interest to be explored and developed into mathematical material that is contextual and close to student culture. Likewise, the religious values contained in the two mosques are very important to build the religious character of students.

Research Methods

This study uses an ethnographic approach and exploratory methods. Ethnographic approach because it examines the community system in a particular culture (mosque culture), to observe, photograph, reveal facts related to thoughts, statements, behavior, interactions, and cultural meanings from an ethnomathematical point of view. Exploratory method because it deepens certain knowledge in order to find new ideas to formulate problems in more detail. This study aims to explore mathematics teaching materials from mosque culture (especially artifacts in the mosque environment) around Muhammadiyah Elementary and Middle Schools in Banyumas, Central Java. The artifacts explored were prayer rugs, prayer rugs, mosaics on mosque walls, and covers of the Koran. The location of this research is the Tahfidz House Mosque, BUQ Purwokerto, and the Abubakar As-Sidiq Mosque, Pesantren Darussalam, Purwokerto. The data collection method uses observation, documentation and literature study. Observations and documentation are used to find geometric shapes on the artifacts of prayer mats, prayer mats, mosaics on mosque walls, and the cover of the Koran. Furthermore, literature studies are used to analyze the concepts of geometry and geometric transformations that exist in artifacts. The research procedure was carried out as follows: (1) selecting objects (artifacts) around the mosque to be developed into mathematics teaching materials in elementary and secondary schools, (2) fully documenting the objects (artifacts) in the form of photographs, (3) conducting analysis of the spiritual, moral or social values contained in these artifacts, as materials to enrich character education, (4) perform mathematical analysis of the selected artifacts to be explored into relevant mathematical materials.

Result and Discussions

Research Results

In accordance with the research procedure, the first step is to select the artifacts to be explored. The artifacts from the mosque's culture that were chosen to be explored are prayer mats, prayer rugs, mosaics on the walls of the mosque and the cover of the Koran. Furthermore, these artifacts are documented and presented in Figure 1 below:



Discussion

The prayer mat carpet in the mosque is a carpet used for the expanse when a servant prostrates to Allah SWT. Therefore, the prayer mat rug must be holy and located below, to be precise it was held on the floor of the mosque. Philosophically, this teaches a lesson that humans must always purify physically and mentally, be humble and not arrogant because humans come from the land and will return to the land. The prayer mats as shown in Figure 1(a) is documented from the BUQ Karangwangkal mosque in Purwokerto. This prayer rug has a very flexible dotted motif to be explored as a geometry teaching material. The results of the mathematical analysis of the prayer mat can be shown in Figure 2 below:



The artifact of a prayer mat with a dotted pattern can be explored to teach students about geometry, especially about: (a) The position of the angles on a flat shape as shown in Figure 2(a). Learning indicators that are relevant to this artifact include finding the concepts of opposite angles, opposite angles, opposite inner angles, and opposite outer angles, (b) Various types of flat shapes as shown in Figure 2(b). Learning indicators that are relevant to this artifact, for example, find the relationship between the concepts of rectangle, trapezoid, parallelogram, rectangle, rhombus, and square, (c) Transformation as shown in Figure 2(c). Learning indicators that are relevant to this artifact, for example, find differences between the concepts of translation, dilation and reflection, (d) Reflection and rotation as shown in Figure 2(d). Learning indicators that are relevant to this artifact, for example, find the concepts of reflection and rotation on flat shapes.

The prayer rug is a base for prostrating to Allah SWT which is relatively smaller in size because its capacity is only for one person. The narrow-sized prostration mat gives a moral message that in any complicated situation the burdens of life that we experience can definitely be resolved through prayer and prayer. In addition, there is a motif of straight lines that expands on the prayer rug. Straight lines on the prayer rug can give a simple, honest and strong moral message. Simple means that it applies according to its needs and abilities. Honesty means compatibility between words and deeds, and strong means having high resilience. The results of the mathematical exploration of the prayer rug artifact are shown in Figure 1(b), after going through the FGD 3 profiles of teaching materials were produced which are shown in Figures 3(a), 3(b) and 3(c) below:



Figure 3(a) is one of the pieces of the prayer rug artifact belonging to the Tahfidz Baitu Usyaqil Quran House (RT BUQ) Purwokerto. The prayer rug motif is in the form of a rectangular pyramid or pyramid whose upright sides are isosceles triangles. One of the vertical sides is PAA/ with base (AA'), and height (PO). This triangle is an isosceles triangle that can be used to explore transformation materials, especially the concepts of reflection, symmetry, area and perimeter of triangles, dilation, and geometric sequences that are adapted to the school level and the applicable curriculum. Learning indicators that can be achieved through the PAA/ form are: (a) finding the properties of reflection, (b) finding the level of folding symmetry, (c) calculating the area and perimeter of a triangle, (d) finding examples of dilation, and (e) finding an example of a geometric sequence with k>1. The recommended steps to determine the properties of reflection are that students are asked to put forward arguments that (1) (PO) is perpendicular to (AA'), (2) the distance of point A to (PO) is equal to distance (PO) to point A/ and (3) the magnitude of point A is equal to the size of point A'. To find the level of folding symmetry, the recommended ways are: (1) students are asked to make a replication using writing paper according to the picture, (2) find the axis of symmetry in the replication that has been made, (3) through the axis students practice folding it up to the inner area. right and left axes coincide exactly. The number of ways that can be done so that the replication can be folded on its axis so that the regions of the right and left of the axis can coincide exactly is called the degree of folding symmetry.

To find the formula for the area of PAA/ the recommended method is as follows: (1) students are asked to identify the base and height of the triangle, (2) then communicate with the formula for the area of a triangle. Meanwhile, to determine the perimeter of a triangle, the recommended ways are: (1) students are asked to find all the side sizes of a triangle, (2) then the perimeter of a triangle is the sum of the lengths of the three sides. To find examples of dilatation with k>1 recommended methods are: (1) students are asked to observe the following Figure 3(b), (2) If

the first line segment is a, and after dilatation with k>1 the result is b then it can be stated that b = ka. In other words, b is the result of dilatation k>1 of a.

In detail, to find a geometric sequence, students are asked to determine the result of the dilation of the line segment b by k to c so that $c = kb=k^2 a$, the line segment c is enlarged by k to become d so that $d=kc=k^2 b=k^3 a$ and so on so that a,b,c,d...until n terms $= u_1, u_2, u_3...un = a$, ka, $k^2 a$, $k^3 a...k^{n-1} a$ forms a geometric sequence with the ratio k.

Figure 3(c) is obtained from Figure 1(b) cut crosswise. Figure 3(c) is a profile of teaching materials that can be used to teach students about geometry, especially the concept of translation. Learning indicators that can be achieved through this figure are for example formulating the rules for the translation of a shape when point A is translated into A/ and point B is translated into B/. The recommended steps to formulate the translation rules are: (1) students are asked to write down the coordinates of points A(x₁, y₁) and A' (x₂, y₂), then calculate the value of x₂-x₁ and y₂-y₁ so that the translation matrix is $T\begin{pmatrix} x2 - x1 \\ y2 - y1 \end{pmatrix}$. Details of Figure 3(c) can be seen below.

Mosque relief is a tree-dimensional sculpture or carving made in one part of the mosque and serves for beauty and contains moral messages. Figure 1(c) is a relief from one of the walls in the Abubakar As-Siddiq Mosque, Pesantren Darussalam Purwokerto which depicts geometric patterns, especially transformations. On the relief there are four-star, eight-star, and square patterns. The eight star is the logo of the glory star of Islam which has the meaning (1) balance, harmony and cosmic harmony, (2) the unity inherent in creation and the laws of nature that flow, (3) the direction of the wind that gives a message in order to know the path taken in the world. human life journey. The results of mathematical exploration of mosque reliefs produce three profiles of teaching materials as shown in Figures 4(a), 4(b) and 4(c). Figures 4(a) and 4(b) are the reliefs of a mosque cut in such a way that they form 4 and 8 stars. These shapes are symmetrical so they can be used to explore the concepts of symmetry, reflection, and rotation. Learning indicators that can be explored from this picture for example identify the concepts of rotational symmetry, reflection and rotation. To identify the concept of rotational symmetry and the level of symmetry, the recommended methods are as follows: (1) Students are asked to observe Figure 4(a) of a 4-star that is lowered from the relief of the mosque, (2) Students are asked to rotate 900 counterclockwise, (3) Students are asked to conclude what happened from the results of the round, (4) Students are asked to continue the rotation at angles of 1800, 2700 and 3600 and then asked to conclude the number of possible ways of turning in order to occupy the frame correctly. The same way is repeated for Star 8, only at Star 8 the rotation starts from the initial position to 45° , 90° , 135° , 180° , 225° , 270° , 315° , 360° . Figure 4(c) is a relief that is cut in such a way that it only contains square parts. Figure 4(c) in addition to being used to construct the concepts of symmetry, reflection, and rotation can also be used to explain the concept of translation, for example, square A in Quadrant I can be translated to Quadrant II into B. In detail, the results of the exploration of the reliefs contained in the walls of the mosque are stated in Figure 4 below.



The cover of the Quran in Figure 4(d) has a combined motif of squares and circles that are intertwined with each other. In graphic design, square has the meaning of honesty and stability. In addition, square is also a logo that is trusted, safe and comfortable so that it is more familiar. Square can give the impression of conformity, peace, solidarity, security and equality. This logo expresses an arrangement of squares arranged so that the next square lies within the previous one. Likewise, each corner of the next square is in the middle of the side of the previous square. While the circle shows the meaning of dynamic, moving, having speed, uninterrupted, always repeating, eternal, having no beginning and end and perfection. The combination of the arrangement of squares and circles occurs regularly with the pattern that each square is followed by its respective inner circle so that the next circle is within the previous circle and forms an artistic arrangement. This logo expresses the geometric relationship between the areas of the square, and the areas of the circle that make up the geometric sequence. The results of mathematical exploration of the logo from the cover of the Quran in Figure 4(d), the profile of teaching materials as shown in Figures 5(a), 5(b) and 5(c) below:



What is quite interesting about the square logo is the geometric sequence pattern because there is a relationship between the first square (outermost), second square (middle) and third square (innermost) in Figure 5(c). According to the Pythagorean Law, if the length of the side of the first square is U1 = s, then the length of the side of the second square is $U_2 = \sqrt{(\frac{s}{2})^2 + (\frac{s}{2})^2} = \sqrt{2.(\frac{s}{2})^2} = \frac{s}{2}\sqrt{2}$ and the side length of the third square is $U_3 = \sqrt{(\frac{s}{4}\sqrt{2})^2 + (\frac{s}{4}\sqrt{2})^2} = \sqrt{2.(\frac{s}{4}\sqrt{2})^2} = \frac{1}{2}s$ then the magnitude of the ratio r is $U_2 : U_1 = \frac{s}{2}\sqrt{2} : s = \frac{1}{2}\sqrt{2}$ atau $U_3 : U_2 : \frac{1}{2}s: \frac{s}{2}\sqrt{2} = \frac{1}{2}\sqrt{2}$. Thus, it can be concluded if the length of the side of the first square is the first square is the first term (U1=s), the side length of the second square is the second term ($U_2 = \frac{s}{2}\sqrt{2}$), the length of the side square is the first term (U1=s), the side length of the second square is the second term ($U_2 = \frac{s}{2}\sqrt{2}$), the length of the side of

with the ratio $r = \frac{1}{2}\sqrt{2}$ that: U₁, U₂, U₃... U_{n-1}, U_n = s, $\frac{s}{2}\sqrt{2}$, $\frac{1}{2}s$... $(\frac{1}{2}\sqrt{2}/)^{n-2}$.s, $(\frac{1}{2}\sqrt{2})^{n-1}$.s. In addition to the relationship between squares in this logo, there is also a relationship between the inner circles (Figure 5b) on each square, namely inner circle 1 on square 1, inner circle 2 on square 2, and inner circle 3 on square 3. Inner circle 1 on a square of radius 1, $r_1 = \frac{1}{2}s$, inner circle 2 on square 2 with radius $r_2 = \frac{s}{4}\sqrt{2}$ and the inner circle 3 on the square 3 of radius $r_3 = \frac{1}{4}s$. Thus the ratio $\frac{r_2}{r_1} = \frac{r_3}{r_2} = \frac{1}{2}\sqrt{2}$, thus forming a geometric sequence with the first term $r_1 = \frac{1}{2}s$ second tribe $r_2 = \frac{s}{4}\sqrt{2}$ third tribe $r_3 = \frac{1}{4}s$ and so on until the nth term $= \frac{1}{2}s.(\frac{1}{2}\sqrt{2})^{n-1}$ as follows: $U_1 = r_1$ $r_1 = \frac{1}{2}s = \frac{1}{2}s(1) = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^0 = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^{1-1}$ $U_2 = r_2$ $r_2 = \frac{s}{4}\sqrt{2} = \frac{1}{2}s(\frac{1}{2}\sqrt{2}) = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^{1-1}$ $U_3 = r_3$ $r_3 = \frac{1}{4}s = \frac{1}{2}s(\frac{1}{2}\sqrt{2})(\frac{1}{2}\sqrt{2}) = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^2 = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^{3-1}$... U_n $R_n = \frac{1}{2}s(\frac{1}{2}\sqrt{2})^{n-1}$

There is still a lot of material that can be extracted from this logo, for example how to determine the area of the entire square, the area of the entire circle, the length of the sides of the entire square, and the length of the circumference of all possible circles and so on. To determine the area of the entire square or the area of the entire circle, the concept of a geometric series can be used by first finding the values of Un. Furthermore, students are asked to find the relationship that occurs between the size of the nth term or Un with the total area of the first n or Sn. Furthermore, the evaluation instrument can be explored by giving the task to design a logo with the given provisions so that it can train students' creativity to be able to bring forth creative ideas using appropriate concepts.

Conclusion

The mosque is the oldest Islamic culture which is the center of civilization and education for Muslims. From an early age, Muslim children are introduced to the mosque so that the culture of the mosque is familiar to them. It's just that, the use of mosque culture as a tool for learning mathematics is still rarely used. In fact, many mosque cultures are related to mathematics so that it is appropriate to be used as a context in the development of mathematics teaching materials. The geometric shapes on the prayer rugs and prayer mats in the BUQ mosque are rich in material for plane shapes, angular positions and geometric transformations, while the covers of the Mushaf of the Qur'an contain material for geometric sequences and series. Apart from being rich in geometric material, the artifacts in the two mosques also contain deep religious values. Prayer mats contain inner and outer values, are humble and not arrogant because humans come from the land and will return to the land, on the relief there is an eight-star image which contains the values of the glory of Islam and on the cover of the Qur'anic mushaf there are values of conformity, peace, solidarity, security and equality.

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