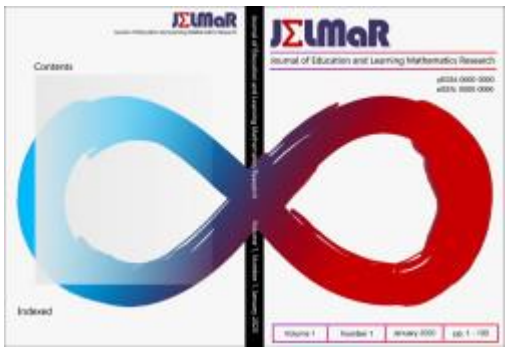

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Exploration of Jepara Carving Ethnomatics and Its Implementation in Geometry Learning Junior High School

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***Abstract**: This study aims to explore the ethnomathematics of Jepara carving and its implementation in learning geometry, especially at the junior high school level. This type of research is qualitative research with an ethnographic approach. Subjects/resource persons in this study were Jepara carving craftsmen in the city of Rau Jepara. The research instrument is the researcher as the main instrument, observation, interviews, and documentation. Based on the results of research on the ethnomathematics of Jepara carving shows that there are basic mathematical activities in the mindset that is applied to the process of making Jepara bones related to measurement, calculation, and design, as well as geometric concepts such as angles, squares, rectangles, rhombuses, triangles, and circles. The implementation of ethnomathematical learning based on Jepara carving, especially geometry learning that can be applied in schools is learning material in the form of a collection of contextual questions related to the local culture of Jepara carving on angles and flat shapes studied in Junior High School Education.*

Keyword: Jepara Carving, Ethnomathematics, Geometry Learning

INTRODUCTION

Mathematics and culture are things that cannot be avoided and are important in everyday life. Mathematics is a source of knowledge and the main needs of everyone, generally people know mathematics as a science related to numbers and arithmetic operations such as addition, subtraction, division, and division, but mathematics is a science that includes many things and can be defined in a general way (Maryono, 2020). Mathematics has a very important role for students, one of which is so that students can gain knowledge, form good attitudes and intelligent mindsets so that later they can live better (Rantau et al., 2022). Meanwhile, culture is a unity and guideline for community behavior that plays an important role in the growth of the ancestral virtues of a community group or nation.

Mathematics is part of the culture, because mathematics and learning mathematics makes mathematics belong to everyone, therefore mathematics is universal. Therefore, cultural mathematics education can be used as a medium for students to transform everything that exists in nature and values related to nature, namely the design of learning experiences and strategies to create a learning environment that incorporates culture as part of the learning process.

Education and culture cannot be separated from everyday life, because culture is an integral and comprehensive part that affects a society, and education is a very important need for everyone (Putri, 2017). Nisa (2020) said that if there is a combination of culture, mathematics and education, it will produce ethnomathematics, ethnomathematics or in Indonesian it is called ethnomathematics. D'Ambrosio was the first to propose ethnomathematics, saying that ethnomathematics is a mathematical practice that can be recognized by a culture and can be seen as the study of mathematical concepts in any culture (Rosa & Orey, 2011). Ethnomathematics has a broader definition than ethno

(ethnic), ethnomathematics is defined as the anthropology of mathematics and cultural education (Arwanto, 2017). In simple terms, ethnomathematics is the study of mathematical concepts in local culture.

One of the local cultural heritages in Indonesia is the art of Jepara carving. Carving is an art form made by scratching, cutting or carving on wood, shell and other materials. (Depdiknas, 2008:1773). The results of this carving are easy to find in Jepara. Jepara is one of the cities in Central Java Province which is also known as the City of Carving (Prastiyan, 2017:5). The process of making Jepara carvings cannot be separated from the manual skills, work processes and thought processes of the craftsmen. The process of Jepara carving is integrated into various activities that have become a tradition in Jepara society, one of which is the activity of measuring, counting, and making patterns that are closely related to mathematics. The activities carried out by craftsmen in the process of making Jepara carvings are basic mathematical activities, not only in the manufacturing process, the motifs of Jepara carvings also often contain various mathematical concepts, especially geometric concepts such as angles and flat shapes. This shows that mathematical concepts, especially geometry without realizing it, are widely used and have been embedded in the culture of the Jepara people.

The purpose of this study is to find out ethnomathematics in Jepara carvings and implement them in geometry learning at junior high school (SMP), besides that, researchers will also observe mathematical activities in the process of making Jepara carvings in terms of basic mathematical activities, namely measuring, calculating, and designing.

METHOD

This type of research is qualitative research with an ethnographic approach, this is because the problems that will be studied by researchers are problems related to social and cultural. (Subadi, 2006) said that qualitative research methods are methods used in research in the field of science, especially social science, culture, psychology, and education. Ethnography is a qualitative research method that seeks to discover the culture of a group/society. This is in line with the theory(Brewer, 2000) which emphasizes that ethnography is one of the principles of social science research which is included in the qualitative research model. Ethnographic methods are used to describe, describe, and analyze culture.

The research procedure to be carried out in this study includes 6 stages, namely: (1) the preliminary activity stage, (2) the stage of making research instruments, (3) the implementation stage, (4) the data verification stage, (5) the data analysis stage and (6) conclusion drawing stage. The technique used in taking the subject in this study used a purposive sampling technique. (Etikan et al., 2016) Purposive sampling is a technique of taking subjects by considering the quality of the subject itself. The subjects in this study were selected based on the criteria set by the researchers, namely several business actors/craftsmen who were involved in the field of carving or carving craftsmen who had experience in the world of Jepara carving for more than 10 years, had knowledge, and understanding of Jepara carving techniques, and has expertise in making various forms of carving motifs.

Data regarding mathematical activities in the manufacturing process and the shape of the Jepara carvings were obtained through observations, interviews and documentation conducted by researchers. In collecting data, the researcher acts as the main instrument which is equipped with observation guidelines, interview guidelines and documentation guidelines. The data analysis techniques used in this study are: (1) data reduction is done by classifying data, summarizing data and removing irrelevant data, (2) data presentation is done by exposing reduced data in order to obtain a complete

and complete picture, (3) drawing conclusions based on the data that has been collected to determine the ethnomathematics of Jepara carving and its implementation in learning geometry.

RESULT AND DISCUSSION

Observation and interviews of Jepara carving craftsmen began to be carried out on April 1-8 2022. On April 1-4, observations and interviews were carried out at the carving production site Subject S1 (Mr. Rojikan) and on April 5-8, observations and interviews were carried out at the carving production site Subject S2 (Mrs. Lika). In the observation activity, the researcher observed the process of making Jepara carvings from the process of selecting the wood that would be used to make Jepara carvings until the carvings were finished, and taking pictures of the finished carvings as documentation. After the observations were completed, the researchers then conducted an interview session with Jepara carving craftsmen, namely Subject S1 and Subject S2.

After the observation and interview data have been collected, then the results of observations and interview answers from each Jepara carving craftsman will be analyzed based on basic mathematical activities seen from the indicators of measuring, calculating, designing activities in the process of making Jepara carvings and geometric concepts in the form of Jepara carving motifs. Based on the results of the analysis of observations and the results of data interviews that have been carried out, the following results are obtained.

1. Ethnomathematics of Jepara Carving Based on Basic Mathematics Activities
   a. Basic Mathematics Activities on Measure Indicators Activities

P : *"How do you determine the type of wood to be used? Is there a specific reference in determining the type of wood to be used? How do you determine the thickness / thinness of the wood to be used for carving Jepara? Is there a certain reference in estimating the thickness/thinness of the wood to make carvings?"*

S1 : *"I use teak wood because the quality is good. Yes, as a reference I use teak that is old around the age of 20 years, because the older the teak wood, the texture is also perfect, the pores of the wood are solid and not perforated. The thickness of the wood used for carving 1-2 cm according to the shape of the carving to be made, the reference for determining the thickness/thinness of the wood is determined by the customer's request or the shape of the carving motif to be made, but the benchmark is 1-2 cm, because if the wood is thinner the risk of breaking or cracking is also high, the thicker the wood, the longer the drying process."*

The results of the interview with Subject S1, it was explained that the type of wood used was teak with a reference to teak wood that was 20 years old, because the older the teak wood, the texture is also perfect, the pores of the wood are solid and not perforated. The thickness/thinness of the wood to be used is 1-2 cm according to the shape of the carving to be made, the reference in determining the thickness/thinness of the wood is 1-2 cm, depending on the carving to be made or according to consumer demand, because the thinner the wood will be. When used, the risk of cracking or breaking in the wood is higher, and the thicker the wood used, the longer the time required for the drying process. Selection of teak according to Subject S1 can be modeled mathematically as follows:

$$f(x) = x - 20 \text{ where } x = \text{age of wood (years)}$$

The value of $f(x) > 0$ indicates the age of the wood, which is recommended for Jepara carving, whereas the value of $f(x) < 0$ indicates the age of the wood which is not recommended for Jepara carving.

P : *"How do you determine the type of wood to be used? Is there a specific reference in determining the type of wood to be used? How do you determine the thickness / thinness of the wood to be used for carving Jepara? Is there a certain reference in estimating the thickness/thinness of the wood to make carvings?"*

S2 : *"I use teak wood, as a reference I use A2 teak, 1-1.9 meters long, 22-28cm in diameter, visible/embossed wood grain, dense wood pores. The thickness of the wood that I usually use for carving is 1-2 cm, the average thickness here is 1-2 cm, or according to customer orders, for thick/thin wood references usually follow the customer's request or the shape of the carving you want to make, but the benchmark is 1- 2 cm, because the thinner the wood is, the easier it is to break or crack"*

The results of the interview with Subject S2, it was explained that the type of wood used was teak with the reference of the chosen wood being A2 teak, 1-1.9 meters long, 22-28cm in diameter, embossed/visible wood fibers, dense wood pores. The thickness/thinness of the wood to be used is 1-2 cm according to the shape of the carving to be made or according to consumer demand, the reference in determining the thickness/thinness of the wood is 1-2 cm according to the shape of the carving to be made or according to consumer demand, because The thinner the wood to be used, the higher the risk of cracking or breaking the wood.Selection of teak according to Subject S1 can be modeled mathematically as follows:

$$f(y) = y - 100 \text{ where } y = \text{length of wood (cm)}$$
$$f(z) = z - 20 \text{ where } z = \text{ diameter of wood (cm)}$$

The values of $f(y) > 0$ and $f(z) > 0$ indicate the recommended length and diameter of the wood for Jepara carving, whereas the values of $f(y) < 0$ and $f(z) < 0$ indicate the length and diameter of the wood which is not recommended for carving. made into Jepara carvings. From the results of the explanation above, it can be concluded that there is a measuring activity carried out by the subject in the process of selecting the type of wood used to make Jepara carvings.

b. Basic Mathematics Activities on Counting Indicators Activities

P : "*How to determine the time in the wood drying process?*"

S1 : "*Drying time is usually 3-5 days depending on the weather, wood that is ready for production is usually not too dry, the dryness rate is around 60-70%*"

Based on the results of the interview with Subject S1, it is known that the drying time is 3-5 days depending on the weather, the wood that is ready for production is usually not too dry, the dryness level is around 60-70%.

P : "*How to determine the time in the wood drying process?*"

S2 : "*The wood drying time is usually 3-5 days depending on the weather, it is hot or cloudy, the wood produced is usually not too dry and not too wet, if it is 50% dry it can be carved*"

Based on the results of the S2 Subject interview, it is known that the wood drying time is 3-5 days depending on the weather, the wood that is ready for production is usually not too dry and not too wet, the dry rate is above 50%.

In determining the drying time of wood for this Jepara carving, it can be modeled mathematically as follows:

$$f(w) = \frac{w}{6} \times 100\% \text{ where } w = \text{drying time (days)}$$

The value of $f(w) > 50\%$ indicates the level of wood drying is recommended for Jepara carvings.

Based on the above discussion, the calculation activity in the Jepara carving process is to calculate the length of time for wood drying, the length of time required for wood drying is 3-5 days, adjusted to the level of dryness of the wood required, the average level of wood of drying must be above 50% or at least 3 days. drying time. The higher the level of dryness of the wood required, the longer the drying time of the wood.

c. Basic Mathematics Activities on Design Indicators Activities

P : *"How to determine the carving pattern to be made? What are the steps in making a pattern?"*

S1 : *"To determine the pattern to be made, I usually adjust it to the consumer's wishes, later the consumer sends a picture of the desired pattern to me, then it is processed for pattern making or it can also use the carving pattern that I usually produce, the pattern making stage is done by preparing cardboard to be drawn halfway. motif, then pasted on the wood and in the picture, after that the pattern is reversed to get a symmetrical or the same result.*

The results of the interview with Subject S1, it was explained that to determine the pattern to be made, it was usually adjusted to the wishes of the consumer or it could also use an engraving pattern that had been made for production. The steps in making the pattern are to prepare the cardboard to draw half the motif, then stick it on the wood and draw it, after that the pattern is reversed to get a symmetrical and the same result.

P : *"How to determine the carving pattern to be made? What are the steps in making a pattern?"*

S2 : *To determine the pattern to be made, consumers usually send a picture of the pattern to me, then me read it for pattern making or it can also use a pattern that is usually produced, for the pattern making stage, first prepare the cardboard to draw half the motif, then stick it on the wood and draw it, Ms. the pattern is reversed so that the resulting pattern is the same"*

The results of the interview with the subject of S2, explained that determining the pattern to be made is usually adjusted to the wishes of the consumer or can also use an engraving pattern that has been made for production. The steps in making the pattern are to prepare the cardboard to draw half the motif, then stick it on the wood and draw it, after that the pattern is reversed to get the same result.

In the process of making patterns to produce reflection or reflection properties, reflection properties are part of a geometric transformation that moves the main point of the geometric shape by using objects and shadows.

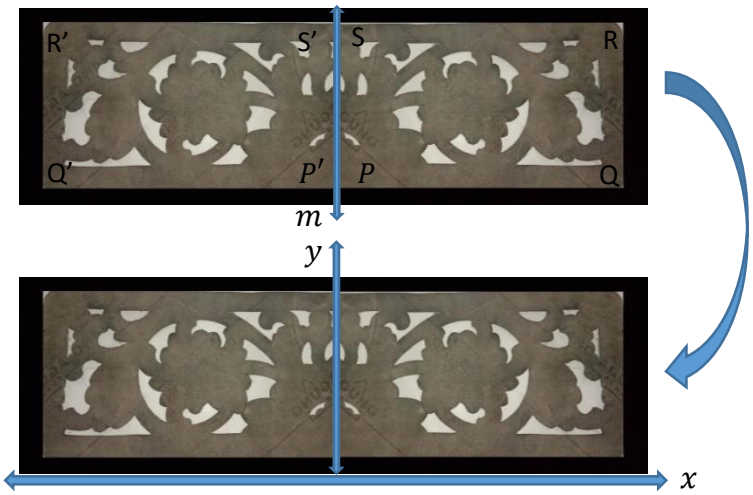


Figure 1. The Nature of Reflection in Making Jepara Carving Patterns

The picture above shows that the shape PQRS in the Jepara carving pattern reflects m line is called the reflection line, so the reflection image is $P'Q'R'S'$, this is because points P and S lie on the reflection line, therefore, the origin and the image are at the same point. So that the distance between point P to line m is the same as the distance from point P' to line m, as well as the distance from point S to line m is equal to the distance from point S' to line m, this also applies to other points, namely the distance $Qm=mQ'$ and $Rm=mR'$. By using the nature of reflection, craftsmen can draw or produce symmetrical carvi ng patterns. From the results of the analysis above, there are ethnomathematics in the process of making Jepara carving patterns.

Based on the results and discussion above, it can be seen that there are basic mathematical activities in the process of making Jepara carvings including measuring, calculating and designing activities. Measuring activities include measuring the type of wood to be used as raw material for making Jepara carvings and measuring the thickness of the wood according to the shape of the carving motif to be made. Counting activities include the activities of Jepara carving craftsmen in determining the length of time the wood drying is adjusted to the dryness level of the wood needed in making Jepara carvings and design activities include the process of drawing patterns or forms of carving motifs on wood, determining the size of the motifs to be made. .The same thing was found in the research conducted by Jainuddin et al (2020) showing that Jepara carving craftsmen perform basic mathematical activities such as counting, measuring, locating and designing in the manufacture of Toraja carvings. Research conducted by Nurhikmah et al (2019) shows that there are mathematical activities contained in a variety of typical Malay carving patterns, such mathematical activities such as measuring, calculating and designing activities, these activities are used from the initial measurement process, designing patterns to the engraving process.

2. Geometry Concepts in Jepara Carving and Its Implementation in Middle School Geometry Learning

Based on the results of observations of the form of Jepara carving motifs, it can be concluded that there is ethnomathematics in Jepara carvings based on

geometric concepts in the form of motifs, namely angles and two-dimentional figure. two-dimentional figure in Jepara carvings include rectangles, squares, rhombuses, triangles and circles.

a. Angles

There is one type of angle in this corner flower carving motif wich can be obtained from the shape of the carving motif that forms an angle, learning about angles is taught at the junior high school level (SMP) where students can recognize the concept of angles by relating them to something around them. For example, in the form of Jepara carvings that form right angles, so that direct can help students' understanding in capturing learning about angles.

Figure 2. Carving Kembang Sudut

Figure 3. Carving Kembang Sudut Analysis

After being analyzed by the researcher, the shape of the engraved flower motif used for the top of the chair legs and angle/L has the concept of an angle, which is a right angle and can be used as a source of materials and learning media wich designed to assist students in understanding learning about corner. The angle material on the shape of the carving motif in this study can be used as a source and teaching material in geometry learning for junior high school (SMP) class VII semester 2 of the 2013 curriculum which is presented in the following form.

Let's Observe!

Have you ever seen an engraving like this? This is a kembang sudut motif carving, this carving is a typical Jepara carving. Did you know that in the engraved image above there is one type of angle! can you determine what type of angle is in the form of the carving above? and what are the angles?

b. Rectangle

A rectangle is a two-dimensional flat shape formed from two pairs of sides that are the same length and parallel to their partners and have four angles, all of which are right angles.

Figure 4. Carving Kembang Mawar

Figure 5. Carving Minimalis Ferrari

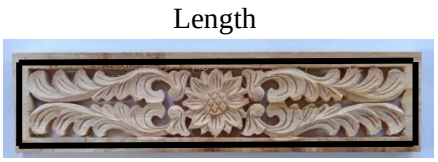


Figure 6. Carving Kembang Mawar Analysis

Figure 7. Carving Minimalis Ferrari Analysis

Based on the analysis that has been done, the shape of the carved kembang mawar motif and minimalist ferrari carving is a rectangular shape, because it has two pairs of sides that are the same length and parallel to their partners and have four corners, all of which are right angles.

Flat rectangular shapes in the form of carving motifs in this study can be used as a source or teaching material in geometry learning at the seventh grade junior high school (SMP) level in the 2013 curriculum which is presented in the following sample questions.

Let's Solve Problems!

An engraving craftsman makes a rectangular rose flower motif like the picture side, the carving has a length and width of 20 cm and 12 cm. Calculate the area of the rectangular engraving!

c. Square

A square is a two-dimensional flat shape formed from four edges of the same length and has four angles, all of which are right angles.

Figure 8. Carving Kembang Bulan

Figure 9. Carving Kembang Tirai

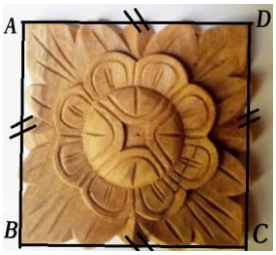


Figure 10 Carving Kembang Bulan Analysis

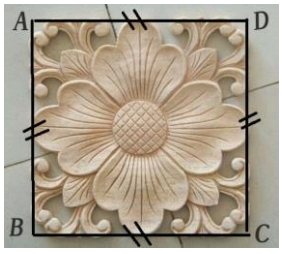


Figure 11. Carving Kembang Tirai Analysis

Based on the analysis that has been carried out, the shape of the kembang bulan and kembang teratai motif carving is a square, because it has four ribs of the same length and has four corners, all of which are right angles.

Square shapes in the shape of the motif in this study can be used as a source or teaching material in the class VII junior high school (SMP) geometry learning in the 2013 curriculum which is presented in the following sample questions.

Let's Solve Problems!

Mother bought a carving to be used as a home decoration, the carving is square like the picture on the side, the carving has a circumference of 40 cm. then calculate the side length of the square engraving!

d. Triangle

A triangle is a flat shape that has only 3 sides and 3 vertices. There are two kinds of triangles in the form of carving motifs in this study, namely right triangles and equilateral triangles. A right triangle is a triangle in which one of the angles is 90°, while an equilateral triangle is a triangle that has three equal sides and three angles.

Figure 12. Carving Kembang Mawar

equilateral triangles triangles

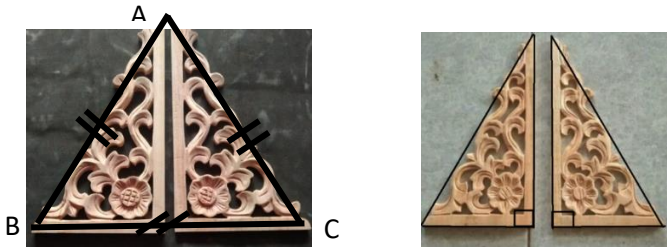
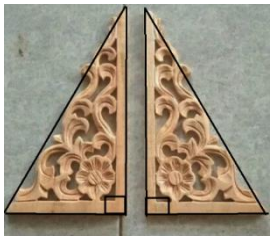


Figure 13. Carving Kembang Sudut Analysis

Based on the analysis that has been done, the shape of the kembang sudut motif carving is a triangular shape, there are two types of triangles in the kembang sudut motif carving, namely equilateral triangles and right triangles. It is said to be an equilateral triangle because it has side lengths and three angles that are the same size, while it is said to be a right triangle because there is one angle 90°.

The triangular flat shape that is in the form of this carving motif can be used as a source or teaching material in learning geometry at the seventh grade junior high school (SMP) in the 2013 curriculum, which is presented in the following sample questions.

Let's Solve Problems!



Look at the picture beside, the picture beside is an engraving made by carving craftsmen in the city of Jepara, if the carving is an equilateral triangle which has a slanted side of 26 cm, height 10 cm, calculate the area of the right triangle above!

e. Circle

A circle is a flat shape that has circle elements including: 1) has a center point (p), the center point is the point that becomes the center of the circle which is located right in the middle of the circle, 2) has a radius (r), the radius is the distance between the center of the circle and a point on the circle, 3) has a diameter (d), the diameter is a line connecting two points on the circle through the center point.

Figure 14. Carving Minimalis Bagong

Figure 15. . Carving Ukiran Kembang Bulan

Figure 16. . Carving Minimalis Bagong Analysis

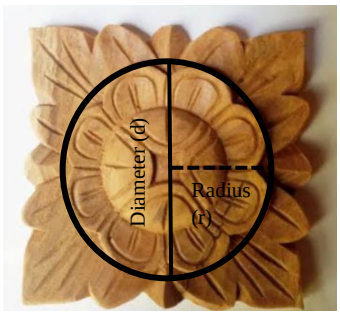


Figure 17. . Carving Kembang Bulan Analysis

Based on the analysis that has been done, the shape of the minimalist bagong motif carving and kembang bulan motif carving is a circular shape, because it has a center point, radius and diameter. One of the circular flat shapes in the form of a Jepara carving motif can be used as a source or teaching material in geometry learning for class VIII in the 2013 curriculum which is presented in the following sample questions.

Let's Practice!

Look at the picture beside, there is a circle on the carving, if it is known that a circle's radius is 14 cm, then calculate the circumference of the circle!!

Based on the above discussion, it can be concluded that the ethnomathematics found in Jepara carvings has several mathematical elements in it, including basic mathematical activities and geometric concepts. Research conducted by Ariyanto, et al (2022) states that there are geometric concepts in the form of flat shapes such as squares, rectangles, rhombuses and circles in the gebyok carvings in the village of Gemiring Kidul Jepara. The results of the same study were also found in research conducted by Anisa Amalia dkk (2021) showing that there are basic mathematical activities in the process of making batik Krakatoa Cilegon including counting, measuring, determining locations, designing, playing and explaining.

The ethnomathematics found in Jepara carvings can be used by educators as a source or material for learning mathematics, especially geometry learning at the junior high school (SMP) level. This is in line with the research by Muchamad Subali Noto, dkk (2018) on ethnomathematics in archaeological wells in Kaliwadas Village, Cirebon and its relation to mathematics learning in schools which resulted in ethnomathematical studies and teaching materials that can be applied by educators to increase the level of understanding of students in understanding learning materials. delivered by utilizing the existing local culture.

CONCLUSION

Based Based on the results and discussion above, it can be concluded that there are basic mathematical activities in the process of making Jepara carvings carried out by craftsmen, namely measuring, calculating and designing activities and there are also geometric concepts in the shape of the Jepara carving motifs, namely angles, reflection and flat shapes such as squares, rectangles, rhombuses, triangles and circles.

The implementation of Jepara carving ethnomathematics in mathematics, especially Geometry learning that can be applied in schools is learning material in the form of a collection of contextual questions related to the local culture of Jepara carving on angles and flat shapes that are studied at the Junior High School (SMP) level. With the existence of mathematics learning based on the local culture of Jepara, it is hoped that it can foster student interest in learning and support the values of local cultural wisdom in the surrounding environment.

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