ETHNOMATHEMATIC EXPLORATION IN THE GRIND PARTY TRADITION IN SRAGI SUGAR FACTORY

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ABSTRAK

Pekalongan merupakan sebuah kota yang berada di jalur Pantai Utara, Provinsi Jawa Tengah. Kota ini terkenal dengan berbagai tradisi dan budayanya yang beragam. Salah satu tradisi tahunan warga Pekalongan adalah pesta giling tebu yang biasanya dilaksanakan oleh warga Kecamatan Sragi Kabupaten Pekalongan. Tradisi ini bertujuan untuk mengungkapkan rasa syukur kepada Allah SWT serta sebagai doa agar diberikan keselamatan dan kelancaran pada saat memproduksi gula. Acara pokok yang dilakukan pertama kali adalah pemetikan tebu temanten dan dilanjutkan dengan acara arak — arakan penganten glepung yang diikuti masyarakat sekitar, hal ini menandakan bahwa Pabrik Gula Sragi siap melaksanakan giling tebu. Tujuan dari penelitian ini adalah untuk mengetahui berbagai macam konsep matematika yang ada di dalam tradisi pesta giling tebu. Jenis penelitian yang digunakan adalah kualitatif dengan pendekatan etnomatematika. Proses pengambilan data dilakukan dengan studi lapangan, observasi, wawancara, dan dokumentasi. Subjek dalam penelitian ini adalah masyarakat Desa Sragi Kecamatan Sragi Kabupaten Pekalongan. Hasil dari penelitian ini adalah terdapat konsep matematika dalam tradisi pesta giling tebu diantaranya bangun ruang dan persamaan linear. Sehingga diharapkan penelitian ini dapat memberikan manfaat dalam pembelajaran kontekstual dan sebagai contoh penggunaan konsep matematika di sekitar kita.

Kata kunci *:* Etnomatematika, Tradisi, Pesta Giling, Pabrik Gula Sragi, Konsep Matematika

ABSTRACT

Pekalongan is a city on the path North Coast , Province of Central Java. This city is famous with various tradition and diverse culture. One annual tradition inhabitant of Pekalongan is Giling Tebu Party that usual implemented by inhabitant of Sragi Subdistrict, Pekalongan

Regency. This tradition aim is for express of gratitude to Allah SWT and as prayer to be given safety and smoothness while produce sugar. The first time of main program thing to do is picking sugarcane bride and next with procession bride glepung parade that followed public around, this thing is signify that Sugar Factory of Sragi is ready to Giling Tebu Party. The objective from this study is know various type of math concepts inside of Giling Tebu tradition party. Research type used is qualitative with approach ethnomathematics. The data collection process is carried out with studies field, observation, interview, and documentation. The subject in this study is the public of Sragi Village Sragi Subdistrict Pekalongan Regency. The results from this study is there is concepts of mathematics in Giling Tebu tradition party of them there are solid shape and line equation. So it is expected that this study could give benefit in contextual learning and as example of using math concepts around us .

Keywords : Ethnomathematics, tradition, Giling Tebu Party, Sragi Sugar Factory , Mathematics concepts.

INTRODUCTION

Mathematics is a science with the basics that must be mastered to be able to understand other sciences. In math learning, we needed an approach that could provide effectiveness in implementation. One approach that can be used in learning mathematics is ethnomathematics

Ethnomathematics is a form of integration between mathematics and culture, as wrong mathematics and culture are in one effort to introduce mathematics and culture together. Difficulty in students, real lives is the main importance of the integration of culture-based learning in learning.

In Indonesia alone, there are various traditions and cultures. one of them is the party tradition brewed at the Sragi Sugar Factory. The tradition of the milling party is one of the annual traditions held at Public Sragi, Regency Pekalongan, in order to enter sugarcane season. Party traditions This mill begins with Kirab sugarcane bride and bride flour paraded and accompanied by a variety of arts and math, about one kilometer to the factory to then grind. In this tradition, there is an element or concept.

Mathematics that can be studied and researched. The mathematical concept can later be used as a mathematical learning media culture based. This research is very interesting, because it is rare for researchers who explore elements or mathematical concepts in party tradition to grind like this.

The purpose of the research is to know about the history and relevance of party traditions milled at the Sragi Factory with the concept of mathematics. Then, explore Education ethnomathematics found in procession of milled parties starting from bride doll, musical instrument traditional, food offerings, and barongan.

The application of cultural values can be conducted in the environment through family, education, and in society, of course.

Culture describes a special feature of a nation or state. Indonesia is a rich country with culture. Ethnomathematics in Indonesia is actually not a new science but has been known since the introduction of mathematics itself. However, this

science was realized after several scientists introduced the name ethnomathematics to be part of mathematics. After that, ethnomathematics began to be developed through studies of various relevant sciences. Therefore, now there have been many developments in ethnomathematics, especially in learning applications in schools. The applied culture allows the embedded mathematical concepts to flourish, and it is proven that everyone develops a special way of doing mathematical activities called ethnomathematics.

Ethnomathematics includes mathematical ideas, thoughts, and practices developed by all cultures.

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Ethnomathematics is a branch of learning that has cultural elements that are linked to mathematics. Students who are given knowledge about culture related to mathematics and everyday life are expected to increase their ability to learn mathematics more optimally. Wahyuni (2015) defines ethnomathematics as special methods used by a certain cultural group or society in mathematical activities. Whereas mathematical activities are activities in which there is an application process from real experiences in everyday life into mathematics or vice versa, including grouping, counting, measuring, designing buildings or tools, making

patterns, counting, determining locations, games, explaining, and so on. Ethnomathematics experts argue that the development of mathematics is inseparable from the culture and values that already exist in society.

Ethnomathematics can also be considered as a program that aims to study how students can understand, articulate, process, and ultimately use mathematical ideas, concepts, and practices that can solve problems related to their daily activities. The aim of ethnomathematics is to recognize that there are different ways of doing mathematics, taking into account the knowledge of academic mathematics developed by different sectors of society as well as taking into account the different modes in which different cultures negotiate their mathematical practice (how to classify, count, measure, design buildings, etc.). Ethnomathematics raises cultural wisdom so that it can motivate students to learn mathematics. Ethnomathematics can also be considered as a program that aims to study how students can understand, articulate, process, and ultimately use mathematical ideas, concepts, and practices that can solve problems related to their daily activities. The aim of ethnomathematics is to recognize that there are different ways of doing mathematics, taking into account the knowledge of academic mathematics developed by different sectors of society as well as taking into account the different modes in which different cultures negotiate their mathematical practice (how to classify, count, measure, design buildings, etc.). Ethnomathematics raises cultural wisdom so that it can motivate students to learn mathematics.

Ethnomathematics is related to problems in everyday life. This is in line with the views of Freudental and Gravemeijer that mathematics is a human activity (Athar, 2012). According to Freudenthal (Heuvel & Panhuizen, 1996), mathematics must be connected with reality, remain close to children and relevant to people's lives. This point of view involves not only mathematics as a subject but also as a human activity, which is closely related to local culture. Ethnomathematics is a cultural element that contains mathematical concepts. The

ethnomathematical elements can be in the form of traditional crafts, artifacts, traditional games, and other cultural activities.

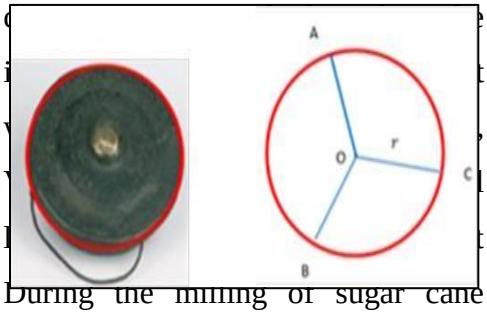
The tradition of milling parties held in Sragi District has existed since ancient times, it's just that over time there has been the addition of several procession icons whose purpose is as a public entertainment item. In the procession icon, the milling party tradition contains several ethnomathematical activities, for example, calculating the ratio of materials used to make glepung brides, traditional music in the form of flat shapes, and so on. The role of ethnomathematics is very important in learning mathematics, because involving culture in understanding mathematical concepts can make it easier for students and provide broader knowledge to students related to learning mathematics. Learning mathematics is not only done in class; learning mathematics is actually done by studying and observing what only those in our environment do, such as the milling party culture in Sragi District.

Based on the background of the existing problems and considering the very important role of ethnomathematics in learning mathematics, it is necessary to study more deeply regional culture, such as the Giling Party tradition in Sragi District. This is done to identify mathematical concepts through ethnomathematical exploration. village, Pekalongan district. Data collection techniques were carried out by interviews, observation, and documentation methods. The interview method was carried out with the Sragi village community, village officials, and local traditional leaders. Observations were made at the time of the sugar cane milling ceremony. The documentation method is needed to see artifacts and cultural activities of the sugarcane milling party that contain mathematical concepts. The data analysis technique was carried out qualitatively by describing historical cultural objects or artifacts and their relationships to mathematical elements.

RESEARCH METHODS

This type of research is a qualitative investigation using a qualitative descriptive method. Qualitative

Research is research that describes or describes a situation, event, condition, activity and so on.(Arikunto, 2014). The object of this Research is the cultural activity of the Sragi sugarcane milling celebration in Sragi village, Pekalongan district. Data collection techniques were carried out. through interviews, observation, and



During the milling of sugar cane ceremony. The documentation a method is needed to see artifacts and Sugarcane-related cultural activities a milling party that includes mathematical concepts. The data an analysis technique was carried out qualitatively by recounting historical events Cultural objects or artifacts and their relation to mathematical elements.

DISCUSSION

Musical Instruments in the Procession of the Grind Party Tradition

In the procession, there are many traditions that occur, including the manten being accompanied by strains of music consisting of gamelan music and additional music from the drum band of kindergarten children in the Sragi area. This musical instrument contains many mathematical concepts, including:

- **Pangora**

Figure 1. Pangora Musical Instrument

The Pangora musical instrument is similar to the Javanese gong because it has the same shape. However, the Pangora is different from the gong in terms of the sound it produces. How to use Pangora by being hit with a stick.

The mathematical concept of Pangora is the flat shape of a circle. As shown above, the geometric modeling of Pangora Based on the results of the analysis on the shape of the pangora, there is a geometric concept, namely a circle. A circle is a curved line whose two ends meet, and all points on the curved line have

the same distance from the center point. From the picture above, it can be concluded that a circle has the following properties:

– A circle has no angles. A circle has only one side, has folding symmetry, and an infinite number of rotational symmetry. The distance between the points of the curved line and the center point is always the same. The point O is called the center point, while the points A, B, and C, which have the same distance to the point O, are called the radius (r).

– Circle Formula

Diameter = $d = 2r$

Circumference = $2\pi r$

Area = πr^2

Note:

$r =$ radius

$\pi = \frac{22}{7}$

- **Garatung**

Figure 2. Garantung Musical Instrument

The Garatung is a Toba Batak musical instrument made of wood with five tone blades. Garatung is the carrier of the melody and the carrier of variable rhythms in certain songs in Batak music. Garatung is played by hitting 5 chords called Mamalu. Garatung consists of 7 wilahan shaped like blocks that are hung on top of a box. This instrument is played using a stick and then beaten. The stick in the left hand is the carrier of rhythm and melody, while the stick in the right hand hits the garating stalk in playing a song.

There are two mathematical concepts in Girantung musical instruments, including:

– Rectangular

Figure 3. rectangular concept on garantung musical instrument

The picture above is a geometric model of Garatung. Based on the results of the shape of Garatung, there is a geometric

diagonals are the same length (OA = OB = OC = OD), the four angles are right angles (OA = OB = OC = OD =

90°), and the rectangle has 2 folding symmetry and 2 rotating symmetry.

Rectangle formula :

Perimeter of rectangle

$K = 2 \times (p + l)$ Area of rectangle

$K = p \times l$

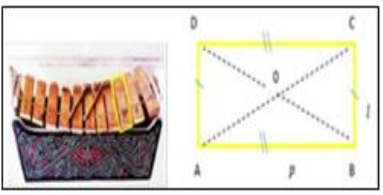
Note :

p = length

l = width

– Trapezoid

Figure 4. Trapezoid Concept in Garatung



Musical Instrument

The picture above is a geometric modeling of flat shapes from Garatung.

Based on the results of the analysis of the shape of the garatung, there is a geometric concept, namely a trapezoid. From the picture above, it can be concluded that Garatung has the following properties: a trapezoid with a pair of parallel sides, the number of adjacent angles between parallel sides is 180°; and it has 2 diagonals of equal length.

Trapezoid formula Perimeter of a trapezium = $A + B + C + D$ while the area of the trapezoid is : = $\frac{1}{2}(a + b)$

It turns out that traditional Batak musical instruments can not only be modeled into flat shapes but can also be in the form of spatial shapes, namely a trapezoidal prism where the base is a trapezoid.

Drumband

Figure 5. Drumband

The picture above is a geometric model of the Drumband. Based on the results of the analysis of the shape of the drumband, there is a geometric concept, namely the tube. In the picture above, it can be concluded that the tube has the following characteristics: the tube has 3 sides, namely 2 sides of the base (the side of the base is circular with a center P1 and the top is centered on P2) and 1 side of the

blanket (curved side), the base side and the top side. The cylinder has a diameter AB and a top diameter CD, the radius of the base (r) of circles P1A and P1B and the top radius of P2A and P2B, and the height of cylinders P2P1, DA, and CB.

Tube Formula

Area of Base = $\frac{22}{7}\pi r^2$

Tube Volume = $\pi r^2 t$

Perimeter of the base/close circle = $2\pi r$

Blanket Area = $2\pi rt$

Tube Surface Area = $2\pi r(r+t)$

Glepung Bride Tradition

The tradition of the glepung bride is a tradition that has been carried out by the people of Pekalongan, especially at the Sragi Sugar Factory every year. The tradition of glepung brides has existed since ancient times as a substitute for humans, who at that time were used as offerings. This tradition is carried out in hopes and offerings for the smooth and successful operation of the sugar production process later. In this tradition, the glepung bride is treated like a normal bride. The bride and groom are married, have a walimahan ceremony, and then are finally taken to the milling machine.

Figure 6. bride doll

In making the pair of glepung brides shown in Figure 6, the ingredients needed are 30 kg of rice, which is a mixture of Rojolele rice and glutinous rice in a ratio of 20: 10. Then the rice is finely ground until it becomes flour and stirred until evenly mixed. After the rice flour and glutinous rice flour are mixed, add enough water to make a dough and then steam until cooked. Steaming the dough only takes 1 hour. After it is cooked, the dough is divided into 2 with a ratio of 10 : 5 or 2 :1 for each part. In this section, there is a mathematical concept of equivalent comparison. As for the measurement of the size and height of the bride, the residents of Sragi only equate it with the size of a small child.

As for the process of making the limbs of the bride and groom,

namely by kneading the dough that has been cooled until it is fluffier. In addition, four papayas are needed to make the head frame and shape the bride's belly. The papaya fruit is strung together with bamboo, then wrapped with the fluffier glepung until it is flat and forms a complete human body with a head, ears, nose, mouth, eyes, neck, hands, chest, and legs in a sitting position. Inside the papaya fruit, which is used as a stomach shaper, is filled with kinco (liquid Javanese sugar) as a symbol of blood. About 1 kg of brown sugar is used. The glepung bride-to-be is then put on bridal clothes and made up like a wedding couple who will go up the aisle.

Determination of Dates in the Implementation of the Milling Festival Tradition

The day before the milling ceremony, the bride and groom of the flour and friends of the cane are arranged or married like a normal human bride. At the event, a walimahan was also held, as is the tradition of weddings in Indonesia in general. In determining the date or day of the wedding, not just any day can be used. Determination of the wedding date of the bride and groom of flour and cane cane friend uses a calculation of good and bad days, which is often referred to as weton.

Weton is a traditional calculation pattern system that is believed to be the direction in carrying out life activities. In Javanese culture, weton is very influential in everyday life. There are several uses of weton, including as a count in finding a good day when you are going to get married, to build a house, move house, or to determine the time of circumcision. The number of weton can be known from the day of birth and the market.

In determining the date of marriage, Javanese people usually base it on 7 days (Monday-Sunday) and 5 markets. Every day and market has its own number pattern which states the value of the day and market. The values for the day and the market are as follows which are listed in table 1.

Day	Neptu	Pasaran	Neptu
Monday	4	Legi	5
Tuesday	3	Pahing	9
Wednesday	7	Pon	7
Thursday	8	Wage	4
Friday	6	Kliwon	8
Saturday	9		
Sunday	5		

To determine the wedding day used is the day and market of the bride. For example, the bride's birthday is Kliwon Friday. In determining the wedding day, we can use two choices, namely to use the day or the market.

Using Day

Calculation of auspicious days using days is based on the following steps:

- Make a series of days from Wednesday to Tuesday to determine the best days. The table row of days is shown in table 2 below.

Table 2. Day Row

Day	**Friday**	**Saturday**	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**
Row	1	2	3	4	5	6	7

Take the day of his birth or the day that has an even order (Friday, Saturday, Monday, Wednesday) for example; take Monday because the serial number is 4.

- Match the selected day with the market. The rule in determining the market, namely looking for a market which if the market neptu is added to the neptu day and divided by 4, the remainder is 1 or 2. Because the remaining 1 is a symbol of the teacher (the person who becomes a role model) and 2 is the symbol of Vishnu (a puppet character who sent down the gods). While the remaining 3 are symbols of Bromo (hot fire) and 4 are symbols of senile (forgetful or people who do not have calculations).

  Example: Monday has the number neptu 4, so it can be paired with neptu 5 (legi), or neptu 9 (pahing). So the good day of the wedding is Monday Legi or Monday Pahing.

Using Pasaran

The second way to determine a good day is to use the market; here are the steps:

- Make a sequence of market rows from Kliwon to determine the market listed in table 3 below.

Table 3. Pasaran Row

Pasaran	**Kliwon**	**Legi**	**Pahing**	**Pon**	**Wage**
Row	1	2	3	4	5

Take the market of birth or the market that has an even order (Kliwon, Legi, and Pon) for

example, take the Legi market because the serial number is 2.

- Looking for a day partner

The rule in determining the day, which is to find a day that has a neptu from that day when added to the market neptu and divided by 4, has a remainder of 1 and 2.

For example, Legi has a neptu of 5, so it can be paired with 4 (Monday), 8 (Thursday), 9 (Saturday), and 5 (Sunday). So if you want to get married on the Legi market, then the right days are Legi Monday, Legi Thursday, Legi Saturday and Legi Sunday.

In calculating good days in Javanese society, it can be associated with number patterns or mathematical formulas. From the explanation above, it can be concluded that in determining the date or day of the milling party there is a mathematical concept of a number pattern with the following formula:

$x = \frac{h+p}{4}$, reminder 1 or 2

Where:

x = quotient

h = $neptu$'s day

p = $neptu$'s $pasaran$

The Tradition of Offerings or Offerings in the Milling Festival Tradition

An offering is a gift (offerings) as a sign of respect or gratitude for everything that happens in society, according to supernatural whispers that come from psychics or elders. Offerings have a very sacred value in the views of people who still believe in them. The purpose of giving offerings is to seek blessings. The giving of these offerings is usually done in places that are considered sacred and have high magical value, such as hundreds of year old trees, temples, the southern sea of Java, mountains that are considered sacred, and so on.

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southern sea of Java, mountains that are considered sacred, and so on.

These offerings have the meaning that in order to increase one's degree and authority at work and to always be enthusiastic and always be given protection by God Almighty, In the Giling Manten procession at the Sragi Sugar Factory, there are several kinds of offerings, namely offerings at the tomb, offerings in the first mill, second mill, third mill, and fourth mill. The offerings in some of these places contain almost the same food, only a few different foods. These offerings have the meaning that in order to increase one's degree and authority at work and to always be enthusiastic and always be given protection by God Almighty, In the Giling Manten procession at the Sragi Sugar Factory, there are several kinds of offerings, namely offerings at the tomb, offerings in the first mill, second mill, third mill, and fourth mill. The offerings in some of these places contain almost the same food, only a few different foods.

Based on the results of the researchers' observations during the sugarcane milling party in Sragi, some of the foods used for offerings were, among others, grilled chicken, meat, tumpeng, rice, young coconut (degan), ketupat, areca nut, waluh, cigarettes, herbal uwat-uwat. Some of the foods used as menu offerings have interesting historical meanings and contain mathematical elements. The groups presented in the offerings are 12. This is because 12 is the number of months in a year. A dish containing rice, salted fish, and various vegetables is served in a shape resembling the conical shape shown in Figure 7 below. There is the radius r, the painter's line s, the diameter d, the area of the cone, and the volume of the cone.

Figure 7. Smooth Rice Cone

Young coconut is also an offering on the menu. The people of Sargi call it with gusto. All parts of a coconut, including the water, flesh, shell, and fibers, can be used (isine

klapa jangkep ana Gunane). How to consume it: the coconut is broken first, which means that the mind is open (think broken). So it is hoped that later his mind will be open so that it is easy to carry out the tasks that are carried out while working at the Sragi Sugar Factory.

The next menu that contains elements of mathematics is ketupat. As we know, the diamond has an element of flat geometry, namely a rhombus. Ketupat has the meaning that, as a human being, of course, we make mistakes and forgive each other. so that the sugar cane milling process runs smoothly because people forgive each other and form an attitude of mutual cooperation and help. Kupat, or diamond, in this offering has the concept of a flat shape. rhombus features:

- It has four equal sides, where the opposite sides are parallel.
- A diagonal line bisects a rhombus at a right angle.
- The sum of two adjacent angles is 180º
- has 2 axes of symmetry.
- The rhombus formula

  Around = 4 x side

  Area of rhombus = $\frac{1}{2} \times d_1 \times d_2$

  with d_1 = diagonals 1 and

  d_2 = diagonals 2

Gambar 9. Ketupat

CONCLUSION

Based on the research that we conducted on the tradition of the sugar cane milling party in Sragi District, there is a link between mathematical concepts and several components, including:

First, during the procession of the sugarcane milling party, there are pangora musical instruments and a drumband in the form of a circle, as well as a garatung with a square base. This musical instrument is associated with mathematical concepts, specifically in the flat material.

Second, in the procession of the milling party, there is also a glepung bride made of rojolele rice and glutinous rice that has been made into flour. In the manufacture of this bridal doll, the flour used to divide

the bride and groom to have the same size has a ratio of 20:10. This, of course, has something to do with mathematical concepts, precisely in the matter of worth comparison.

Third, another ethnomathematical component that we explored was the determination of the date of the implementation of the milling party tradition, or what is commonly known as weton. In the calculation of good days in Javanese society, it can be associated with number patterns or mathematical formulas.

Fourth, the ethonamathematical component of the milled party is found in food offerings. In the tradition of offerings, commonly referred to as offerings, the concept of the geometrical geometry of cones is used on rice tumpeng.Suggestions for further research to explore ethnomathematics in each element of the milling party procession This study only contains four elements, namely musical instruments, glepung brides, offerings, and calendars/wetons. so that it can provide more knowledge for readers.

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