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ETHNOMATHEMATICS: COCONUT SHELL CHARCOAL PRODUCTION PROCESS IN POND VILLAGE AND ITS IMPLEMENTATION IN MATHEMATICS LEARNING

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Abstract:
The purpose of this study is to reveal and implement mathematics learning with community activities. This research focuses on the production process of charcoal handicrafts derived from coconut shells by communities in Kampung Kolam, Deli Serdang, North Sumatra. This research uses qualitative research methods with an ethnographic approach. The method of data collection in this study is by observation, interviews, and documentation. This research instrument is the researcher himself who is supported by observation sheets, interview sheets, stationery, and documentation tools. Data analysis techniques used in this study are data reduction, data presentation, and conclusions. While the data validity technique in this study uses triangulation techniques, namely by comparing data based on observations, interviews, and documentation. The results of the study show that there is a mathematical concept in the coconut shell charcoal production process, namely build a curved side space contained in a hollow hemispherical coconut shell and a tubular kiln used, build a flat side space contained in the block-shaped kiln used, a comparison of the value and reverse value contained in time and the number of coconut shells used.

Keywords: Ethnomathematics, Coconut Shell Charcoal, Pond Village

ETNOMATEMATIKA: PROSES PRODUKSI ARANG BATOK KELAPA DI KAMPUNG KOLAM DAN IMPLEMENTASINYA DALAM PEMBELAJARAN MATEMATIKA

Abstrak:
Tujuan penelitian ini adalah untuk mengungkap dan mengimplementasikan pembelajaran matematika dengan aktivitas masyarakat. Penelitian ini berfokus pada proses produksi kerajinan arang yang berasal dari batok kelapa oleh masyarakat di Kampung Kolam, Deli Serdang, Sumatera Utara. Penelitian ini menggunakan metode penelitian kualitatif dengan pendekatan etnografi. Metode pengumpulan data dalam penelitian ini adalah dengan observasi, wawancara, dan dokumentasi. Instrumen penelitian ini adalah peneliti sendiri yang didukung oleh lembar observasi, lembar wawancara, alat tulis dan dokumentasi. Teknik analisis data yang digunakan dalam penelitian ini adalah reduksi data, penyajian data, dan kesimpulan. Teknik validitas

data dalam penelitian ini menggunakan teknik triangulasi, yaitu dengan membandingkan data berdasarkan observasi, wawancara, dan dokumentasi. Hasil penelitian menunjukkan bahwa terdapat konsep matematika dalam proses produksi arang batok kelapa yaitu membangun ruang sisi melengkung yang terdapat pada tempurung kelapa hemisferis berongga dan tungku tubular yang digunakan, membangun ruang sisi datar yang terdapat pada tungku berbentuk blok yang digunakan, perbandingan nilai dan nilai balik yang terdapat dalam waktu dan jumlah batok kelapa yang digunakan.

Kata Kunci: Etnomatematika, Arang Batok Kelapa, Kampung Kolam

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INTRODUCTION

Mathematics is a subject that is considered difficult, boring, and complicated by most circles, be it among the community, especially among students (Pratiwi & Pujiastuti, 2020). Some students think that maths is not so important to learn because it has no effect on their future or in their lives. Mathematics is a science that has an important role in everyday life (Wahyudi & Putra, 2022). Without realizing it, mathematics in the scope of education is very influential in life and our daily lives. Moreover, what we must know is that mathematics is one of the keys in the business world in the current era of globalization so every aspect of trade and business in society becomes helpless without mathematics (Siregar, 2021).

Mathematics is part of society, so mathematics belongs to all circles, and mathematics is born based on the journey of human life, therefore mathematics and community culture have a close relationship (Dhiki & Bantas, 2021). In community activities without realizing it or not, it cannot be separated from the application of mathematical concepts that show the relationship between mathematics and community culture known as ethnomathematics. More broadly, ethnomathematics is mathematics in culture, namely the habits of human activities with their environment, such as the activities of rural or urban communities, work groups, age groups, professional classes, indigenous people, and certain groups or groups so on (Sarwoedi, Marinka, Febriani, & Wirne, 2018). According to Barton (1996), there are two ways to be able to research ethnomathematics, namely the first

by analyzing mathematical activities in the cultural group of the community, and the second by revealing mathematical concepts that are in the activities of the community (Atika, Dawati, & Iswandi, 2019).

Indonesia as a tropical country has very abundant natural resources, one of which is coconut trees. The coconut tree is a plant dubbed as the tree of a thousand benefits. Nicknamed so because starting from the roots to the leaves of coconut trees can be used its use is still very open to being studied and further developed so that it can be utilized optimally. One example is the use of coconut shells. Some people consider coconut shells to be just factory waste in coconut processing whose availability is quite abundant so it is seen as a problem in the environment and of low value (Pambayun, Yulianto, Rachimoellah, & Putri, 2013). Though coconut shells can be processed as products with high selling value, namely charcoal which is useful as natural fuel for cooking.

Coconut shell charcoal is the result of coconut shell production obtained through an incomplete combustion process (Tumbel, Makalalag, & Manurung, 2019). The use of coconut shell charcoal in fuel has long been known by rural communities and modern communities in developing countries so that they can participate in the continuity of energy supply for the community (Budi, 2017).

In the process of producing coconut shells into charcoal, there are mathematical concepts that are useful as an educational medium about how important mathematics is in producing something. This study is useful for various groups, especially students who aspire to become entrepreneurs. So that they know the real application of mathematics in the business world, which aims to motivate them to be more enthusiastic and interested in learning mathematics and make them realize that mathematics is a science that cannot be ignored.

Mathematics is very important to be understood by all groups, especially those who are interested in the business field or students who aspire to become an entrepreneur so that later they will be able to run and manage a business properly based on the application of concepts or appropriate mathematical calculations. Being an entrepreneur who runs a business with careful mathematical calculations, of course, can increase one's income so that it can provide benefits for oneself as an entrepreneur or other communities involved (Darmayanthi, Putri, & Sumandya, 2022).

Entrepreneurship is the ability to create added value with creative and innovative resource management. Many benefits can be obtained as an entrepreneur such as having the freedom to achieve one's goals and dreams by showing their full expertise so that one can provide maximum benefits, and have the freedom to be able to make changes and create job opportunities for people in need (Vernia, 2019). By increasing the spirit of entrepreneurship among students, it is expected to be able to reduce the unemployment rate in Indonesia, because students are expected to be able to become educated young entrepreneurs who can run businesses independently due to the business era in the present and the future prioritizing knowledge and skills (Turmuzi, Sudiarta, & Sutajaya, 2022).

In previous research, ethnomathematical studies are certainly familiar to be studied, such as studies or research conducted by Pertiwi and Budiarto (2020) on "Ethnomathematical Exploration in Milaten Pottery", research conducted by Lusiana, Afriani, Ardy, and Widada (2019) on "Ethnomathematical Exploration in the Jamik Mosque of Bengkulu City", research that has been conducted by Mulyo, Sunardi, Monalisa, Setiawan, and Murtikusuma (2018) regarding "Ethnomathematics in Orange Farmer Activities in Pesanggaran Banyuwangi District as Student Teaching Material", research conducted by Diniyati, Ekadiarsi, Bila, Herdianti, Amelia, and Wahidin (2022) on "Ethnomathematics: Mathematical Concepts in Eid Cake" and so on. However, no one has researched ethnomathematics in the coconut shell charcoal production process. So that researchers are interested in conducting ethnomathematical studies entitled "Ethnomathematics: The Production Process of Coconut Shell Charcoal in Kampung Kolam and Its Implementation in Mathematics Learning" which is expected to be an innovation in ethnomathematical studies which is certainly useful for readers.

METHODS

This research is skin research with an ethnographic approach that is closely related to society or asocial activity (Abroriy, 2020). Qualitative research is an interpretation process based on the science of a method by observing an event or social situation and human problems (Lusiana, Afriani, Ardy, & Widada, 2019). The ethnographic approach is an empirical and theoretical approach that aims to find an overview and analysis of events in people's lives (Diniyati, Ekadiarsi, Bila, Herdianti, Amelia, & Wahidin, 2022). This research focuses on the production process of charcoal handicrafts

derived from coconut shells by people in Kampung Kolam. The method of collecting this research data is through observation, interviews, and documentation (Mulyo, Sunardi, Monalisa, Setiawan, & Murtikusuma, 2018).

The location of this research is at the residence of Mr. Subandi the owner of a coconut shell charcoal business located in Kampung Kolam, Percut Sei Tuan District, Deli Serdang Regency-North Sumatra. The choice of this location was done deliberately (purposive) due to the consideration that the location is an area where there are many coconut shell charcoal production businesses. This research will be conducted in January-March 2023. This research instrument is a human instrument, which means that researchers cannot be represented to others to collect data because researchers act as the main instrument in research supported by observation sheets, interview sheets, stationery, and documentation tools (Fitriyah & Syafi'i, 2022). The data analysis techniques used in this study are in line with Miles and Huberman's opinions, namely data reduction, data display, and conclusion (Khairunnisa & Siti Salamah Br Ginting, 2022). Meanwhile, the data validity technique used is the triangulation technique, namely by comparing data based on results obtained from observation, interviews, and documentation (Aslamiyah & Fibri Rakhmawati, 2022).

This research began with carrying out visits to research sites, assembling research instruments, setting the time for conducting research and conducting research by collecting existing data with observation, interviews, and documentation. Furthermore, researchers convert data in the form of images into writing and sort out data that is considered unneeded. Then the results of observations, interviews, and documentation that have been obtained in the coconut shell charcoal production process are explored to be able to describe the mathematical concepts contained in it. Furthermore, the last is to conclude by selecting or determining mathematical concepts contained in the coconut shell charcoal production process related to learning at school.

RESULTS AND DISCUSSION

Based on the results of research that has been done, in the process of producing coconut shells into charcoal, there are mathematical concepts that can be used as learning materials within the scope of education. The mathematical concepts contained in the coconut shell charcoal production process are building curved side space, building flat side space, value

comparison and value reversal, and social arithmetic. The following is a presentation of mathematical concepts contained in ethnomathematical studies in the coconut shell charcoal production process.

1. The Concept of Building a Curved Side Space

As the name implies, the main ingredient in making coconut shell charcoal, of course, is coconut shell. Based on observations, interviews, and documentation, it is known that the coconut shell charcoal production process begins with the selection of a good coconut shell, which is still in the shape of a half ball and is not destroyed so that it will produce good charcoal.

Figure 1. Coconut shell

In figure 1, we can see that the coconut shell used is in the form of a hollow half-ball. The formula of the hollow half ball is:

Table 1. The Formula of The Hollow Half Ball

Hollow half-spherical surface area	$\boldsymbol{2\ x\ \pi\ x\ r^2}$
Hollow half-spherical volume	$\frac{2}{3}\ x\ \pi\ x\ r^3$

Where; π (phi) = 22/7 or 3.14 and r = radius

We can apply the hollow half-ball shaped coconut shell in the material to build a curved side space related to a hollow half-ball in class IX odd semester which we can implement into learning as follows:

Table 2. Implementation of Hollow Hemispherical Coconut Shell

Basic Competency (KD)	**Competency Achievement Indicators (GPA)**	**Sample Questions**
Solve contextual problems related to surface area and volume of the side space lengkung (Half Ball).	Apply the formula surface area and volume of a curved side space (Half Sphere) to solve problems related to a curved side space (Half Ball) construct.	It is known that a hollow hemispherical coconut shell has a radius of 7 cm. What is the surface area and volume of the coconut shell?

The half-ball-shaped coconut shell is then put into the furnace/burning container to be burned. The coconut shell is arranged in a furnace until it is full and then burned with a little supporting material, namely kerosene so that the fire burns quickly. After the shell becomes half charcoal and shrinks, then the other shell continues to be inserted into the kiln until the shell runs out and is at the perfect maturity stage with a time of approximately 5-6 hours. The kiln used by Mr. Subandi is in the form of blocks and tubes. Figure 2 is a tubular kiln used by Mr. Subandi in producing coconut shell charcoal.

Figure 2. T-Shaped Kiln

The mathematical formula contained in the tube-shaped combustion furnace is:

Table 3. The Mathematical Formula in The Tube-Shaped Combustion Furnace

Tube volume	$\boldsymbol{V = \pi\, x\, r^2\, x\, t}$
Tube surface area	$L = 2\ x\ \pi\ x\ r\ (r + t)$
The surface area of the capless tube	$L = \pi\ x\ r\ (r + 2\ x\ t)$

Where; π (phi) = 22/7 or 3.14, r = radius, and t = height

We can also apply the tubular coconut shell charcoal burning furnace in the form of material to build a curved side room related to tubes in class IX odd semester which we can implement into learning as follows:

Table 4. Implementation of The Tube-Shaped Combustion Furnace

Basic Competencies (KD)	**Competency Achievement Indicators (GPA)**	**Sample Questions**
Solve contextual problems related to surface area and volume of the side space (Tube)).	Apply the formula of surface area and volume of the curved side space build (Tube) to solve problems related to the curved side space build (Tube)).	A tubular charcoal kiln without a lid has a diameter of 70 cm and a height of 180 cm. What is the surface area and volume of the charcoal kiln?

2. Build a Flat Side Space

Figure 3. Alok B-Shaped Kiln

In figure 3 we can see that Mr. Subandi also uses a block-shaped kiln in the coconut shell charcoal production process. The mathematical formula contained in the block-shaped combustion furnace is:

Table 5. The Mathematical Formula in The Block-Shaped Combustion Furnace

Beam surface area	$\boldsymbol{L = 2\ x\ (pl + pt + lt)}$
Beam volume	$V = p\ x\ l\ x\ t$

Where; p = length, l = width, and t = height

We can apply the block-shaped coconut shell charcoal burning furnace in the form of blocks in building flat side space materials in class VIII odd semesters that we can implement into learning as follows:

Table 6. Implementation of The Block-Shaped Combustion Furnace

Basic Competency (KD)	**Competency Achievement Indicators (GPA)**	**Sample Questions**
Solve contextual problems related to surface area and volume build flat side space (Beams).	Apply the formula of surface area and volume of flat side space build (Beam) to solve problems related to flat side space build (Beam).	Mr. Subandi wants to make a coconut shell charcoal kiln with a size of 180cm x 80cm x 100cm. If the cost of making the furnace is Rp.250,000/m^2, what are the surface area and cost needed by Mr. Subandi to make the furnace? Also, determine the volume of the combustion furnace!

3. Comparison of Worth and Reverse Value

Figure 4. Coconut shells that have become charcoal

In figure 4, a shell of 2 tons that has been burned into the kiln for approximately 5-6 hours has become charcoal. Previously, the charcoal was sifted first to separate it from the ashes. After sifting, then the charcoal is packed into sacks and weighed to be marketed to the central factory.

Based on this, we can apply it in comparative materials worth and turn around grades in class VII even semesters that we can implement into learning as follows:

Table 7. Implementation of Coconut Shell Charcoal Into Learning

Basic Competencies (KD)	**Competency Achievement Indicators (GPA)**	**Sample Questions**
Resolving contextual problems related to value comparisons and value reversals.	Able to solve problems related to value comparisons and value reversals.	-Pak Subandi was able to burn 2 tons of coconut shells within 6 hours. How long does it take for Mr. Subandi to burn 5 tons of coconut shells? -With 1 kiln, Pak Subandi took 30 hours to burn 10 tons of coconut shells. How many furnaces does Mr. Subandi need to complete shell burning within 6 hours?

4. Social Arithmetic

In one production, the coconut shell used by Mr. Subandi as much as 2 tons with a capital of approximately Rp. 2,000,000 can produce 600kg of coconut shell charcoal at a selling price to the factory of Rp. 5,000 / kg. Pak Subandi can produce coconut shell charcoal 3-4 times a week. He has 2 workers with wages of Rp100,000 to Rp150,000/day each.

Based on this statement, in the coconut shell charcoal production process, there are also mathematical concepts related to social arithmetic material in class VII even semester that we can implement into learning as follows:

Table 8. Implementation of Coconut Shell Charcoal Into Learning

Basic Competencies (KD)	**Competency Achievement Indicators (GPA)**	**Sample Questions**
Solving contextual problems related to social arithmetic (Profit, Loss, Profit Percentage, and Loss Percentage)	Able to solve problems related to social arithmetic (Profit, Loss, Profit Percentage, and Loss Percentage)	-In the past week, rains have often disrupted Mr. Subandi's charcoal production activities, so they were only able to sell 300kg of charcoal for 5,000/kg with a capital of Rp2,000,000. What is the loss suffered by Mr. Subandi and the percentage? -In each production, Mr. Subandi can produce 600kg of coconut shell charcoal with a capital of Rp2000,000. He has 2 workers with a salary of Rp150,000 each in each production. What is the profit obtained by Mr. Subandi from selling charcoal if the selling price is IDR5,000 / kg and what percentage of the profit?

CONCLUSION

Based on the results and discussion, we can know that there is a mathematical concept in the coconut shell charcoal production process, namely build a curved side space contained in a hollow hemispherical coconut shell and a tubular kiln used, build a flat side space contained in the block-shaped kiln used, a comparison of the value and reverse value contained in time and the number of coconut shells used. used, as well as social arithmetic contained in the capital and income obtained.

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