



ETHNOMATHEMATICAL EXPLORATION OF TRADITIONAL AGRICULTURAL TOOLS IN HUTAMANIK VILLAGE, SUMBUL REGENCY

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ABSTRACT

This study explores using traditional farming tools in an ethnomathematics context in Hutamanik Village, Sumbul District. The research method used is qualitative, with data collection techniques through observation, interviews, and documentation. The collected data were analyzed with an ethnomathematics approach. Ethnomathematics in traditional agricultural tools can help people maintain local wisdom and strengthen cultural identity. The results showed that conventional farming tools, such as a water drum, coffee mill, sharpener, saw, hoe, and sickle, were used. Cultural, economic, and geographic factors influence the use of these tools. These tools contain mathematical concepts like measurement, comparison, and geometry. An ethnomathematics approach can be applied in learning mathematics to motivate students to learn mathematics because they can see that mathematics is related to everyday life. For this reason, it is suggested that future researchers explore ethnomathematics in different contexts.

EKPLORASI ETNOMATEMATIKA PADA ALAT PERTANIAN TRADISIONAL DI DESA HUTAMANIK, KABUPATEN SUMBUL

ABSTRAK

Kata Kunci:

Etnomatematika
 Eksplorasi
 Alat Pertanian Tradisional

Penelitian ini bertujuan untuk mengeksplorasi penggunaan alat pertanian tradisional dalam konteks etnomatematika di Desa Hutamanik Kabupaten Sumbul. Metode penelitian yang digunakan adalah pendekatan kualitatif dengan teknik pengumpulan data melalui observasi, wawancara, dan dokumentasi. Data yang terkumpul dianalisis dengan pendekatan etnomatematika. Etnomatematika dalam penggunaan alat-alat pertanian tradisional dapat membantu masyarakat untuk mempertahankan kearifan lokal dan memperkuat identitas budaya. Hasil penelitian menunjukkan bahwa terdapat sejumlah alat pertanian tradisional yang digunakan seperti: gendang air, penggilingan kopi, rautan, gergaji, cangkul, sabit. Penggunaan alat-alat ini dipengaruhi oleh faktor budaya, ekonomi, dan geografis. Pada alat-alat tersebut terdapat sejumlah konsep matematika seperti: pengukuran, perbandingan, dan geometri. Pendekatan etnomatematika dapat diterapkan dalam pembelajaran matematika untuk memotivasi siswa untuk belajar matematika karena mereka dapat melihat matematika terkait dengan kehidupan sehari-hari. Untuk itu disarankan untuk peneliti

selanjutnya untuk mengeksplorasi etnomatematika pada konteks yang berbeda.

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1. INTRODUCTION

"Mathematics" comes from the Greek "mathēnein," which means study. The wording is also close to the Sanskrit word "medha" or "widya", which implies intelligence, knowledge, or intelligence. There is currently no agreement among mathematicians regarding the definition of mathematics. Mathematics is a symbolic language [1]. Mathematics is the most crucial subject in schools in modern society. Mathematics can increase students' knowledge in thinking logically, rationally, critically, carefully, effectively, and efficiently. Therefore, mathematics plays an important role that must be taught in schools [2]. Mathematics is a fundamental aspect and necessity for humans who want to be broad-minded in the modern world as it is today. According to the Regulation of the Ministry of Education No. 22 of 2006, the purpose of learning mathematics in schools is to provide students with the skills needed to understand concepts, apply reasoning to problems, find solutions, share ideas, and appreciate the application of mathematics in everyday life.

Many students still do not master mathematics well, even thinking that mathematics is a foreign subject (complex). Mathematics in the classroom is often released from student behavior (culture) which will be the subject of mathematics learning. Therefore, teachers should pay special attention to students' cultural problems when teaching mathematics. Mathematics and culture are two components that are very closely related. On the other hand, culture is a way of life for the whole society [3]. This way of life includes human relationships, values, methods, symbols, and practices of using mathematical concepts and ideas in daily activities. Mathematics is a cultural construct and an essential part of all cultures [4].

Many researchers have conducted mathematical research using ethnomathematics, linking their mathematical research to specific cultures in traditions, traditional buildings, traditional games, traditional clothing, and traditional crafts within a particular area. Mathematical concepts are inseparable from the culture produced by society [5]. This situation leads to the creation of unique and multifaceted results. It can be seen in traditional products, especially in Indonesia, such as kitchen utensils, art, buildings, sculptures, and carvings. In building houses, for example, people also use mathematical concepts. Architects use counting, measuring, and comparing when building a house to produce their work. Builders also used trigonometric concepts and the Pythagorean theorem when building. Therefore, it is necessary to develop information and learning environments using ethnomathematical models [6]

To fulfill the duties of a professional mathematics teacher, teachers must implement learning models that make learning more exciting and meaningful. One such model connects the mathematics taught to the real world. Culture-based learning is one of the innovations in mathematics education to dispel the notion that mathematics is complicated [7].

Ethnomathematics is very important in the process of mathematics learning activities. It makes students know the relationship between mathematics and daily activities. Learning mathematics in schools is essential in developing students' mathematical thinking processes [8]. Ethnomathematics is the study of the way people in a particular culture understand, express, and use concepts and practices that explain mathematical matters. Or simply, ethnomathematics is the study of mathematics in

culture. It can also be seen as an activity involving numbers, geometric patterns, calculations, etc., as the application of mathematical domain knowledge concerning the community's local culture [9].

Agriculture is one of the crucial sectors in the lives of rural communities. In Indonesia, agriculture is still mostly done traditionally using agricultural tools that have existed for a long time [10]. Traditional agriculture is one form of agriculture that has been carried out since ancient times. This activity utilizes simple agricultural tools and is still dependent on natural factors. In the modern era like now, modern agricultural tools have replaced the role of traditional agricultural tools. However, in some rural communities, conventional farming tools are still used. This is due to several factors, among which are cultural, environmental, and economic factors [11]. This research was conducted to reveal the importance of exploring traditional agricultural tools in the context of ethnomathematics in Hutamanik Village, Sumbul District. The etymology of the word "ethnomathematics" is a combination of the word "ethno," which means culture or tradition, and "mathematics," which means the science of numbers, space, and arithmetic. This etymology means that ethnomathematics is a field of study that examines mathematics in the culture or tradition of a particular society. In traditional agriculture, ethnomathematics can help understand mathematical aspects related to traditional agricultural tools, such as measuring distance, area, and volume required in agriculture [12].

Through this exploration, we can understand how traditional farming tools are used in a mathematical context and their use affects the sustainability of traditional agriculture. Amid the shift towards modern agricultural equipment, few rural communities still maintain the use of traditional agricultural equipment. This shift is due to several reasons, among others, because traditional agricultural tools have proven effective and cost-effective in managing agricultural land and because of the desire to preserve cultural heritage and traditions passed on from generation to generation [13].

Ethnomathematics, an interdisciplinary field of study combining mathematics with cultural aspects, has been used to study traditional mathematical knowledge passed down from ancestors. In the context of traditional agriculture, ethnomathematics can be used to understand and study traditional agricultural tools rural communities use. Traditional agriculture is one form of local wisdom that still survives in several regions in Indonesia. One important aspect of traditional agriculture is using traditional farming tools invented and developed by the local community. The use of traditional agricultural tools not only serves to help the agricultural process but also has high cultural values and local wisdom [8].

In ethnomathematics, the use of traditional agricultural tools has its uniqueness. Mathematics is often used to manufacture, use, and repair traditional agricultural tools. Mathematical concepts such as geometry, statistics, and arithmetic are widely involved in using traditional agricultural tools. Therefore, this study aims to explore the use of traditional agricultural tools in the context of ethnomathematics in Hutamanik Village, Sumbul District. Rural Hutamanik, Sumbul District, is one of the areas that still maintains local wisdom in using traditional agricultural equipment. Traditional agricultural tools used by local people have high mathematical value and are useful in maximizing agricultural output [14]. This research can be used as a reference for teachers and media sources in carrying out mathematics learning by exploring agricultural tools.

Agriculture is an activity that humans have carried out since ancient times. In the village of Hutamanik, Sumbul District, many traditional agricultural tools are still used by local farmers. In the context of ethnomathematics, these tools can be studied from a

mathematical point of view, both in terms of form, function, and how to use them. This study explores traditional agricultural tools in the context of ethnomathematics in Hutamanik Village, Sumbul District. This research was conducted through direct observation of traditional agricultural tools used by the community and interviews with farmers about their knowledge and understanding of these tools.

Many studies related to ethnomathematics exploration have been carried out, including ethnomathematics exploration of the Gordang Sambilan musical instrument [2], ethnomathematics studies on farmer activities [3], [4], [6], ethnomathematics of traditional food [8], ethnomathematics on farming tools in Kampar district [10]. However, there has been no research from this study exploring ethnomathematics on traditional farming tools in Hutamanik village. Based on this, the researcher is interested in further researching the ethnomathematics of agricultural tools in the Hutamanik village, which is expected to provide further understanding to the Hutamanik village community regarding the use of agricultural tools following mathematical concepts so that work is more efficient.

This research aims to explore ethnomathematics on traditional agricultural tools in Hutamanik village. The novelty of the research presented is in the form of traditional farming tools in the village of Hutamanik, where the tools being explored are agricultural tools that have been used for generations in the village of Hutamanik. The mathematical working principles of traditional farming tools in Hutamanik village are the study in this study.

2. METHOD

This qualitative research has an ethnographic approach closely related to society or social activities [15]. Qualitative research is an interpretation process based on the science of a method by observing an event or social situation and human problems [16]. The ethnographic approach is empirical and theoretical and aims to find an overview and analysis of events in people's lives [17]. This research focuses on traditional agricultural tools of the Hutamanik rural community. The method of collecting this research data is through observation, interviews, and documentation [18].

The location of this research is at the residence of Mr. Herman, one of the owners of agricultural land in Hutamanik village. The selection of this location was made deliberately (*purposive*) because the consideration of the location is an area where there are many coconut shell charcoal production businesses. This research will be conducted in February-April 2023. This research instrument is *human*, meaning that others cannot represent researchers to collect data. Researchers act as the main instrument in research, supported by observation sheets, interview sheets, stationery, and documentation tools [19]. The data analysis techniques used in this study align with the opinions of Miles and Huberman, namely data reduction, data display, and conclusions. The data validity technique used is a triangulation technique, namely by comparing data based on results obtained from observation, interviews, and documentation [20].

This research begins with a visit to the research site, assembling research instruments, arranging the time of research implementation, and conducting research by collecting existing data with observation, interviews, and documentation. Next, 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 are explored to be able to describe the mathematical concepts contained in it. Furthermore, the last is to conclude by choosing or determining

mathematical concepts in the coconut shell charcoal production process related to learning in schools. The following stages are revealed in this study, as follows.

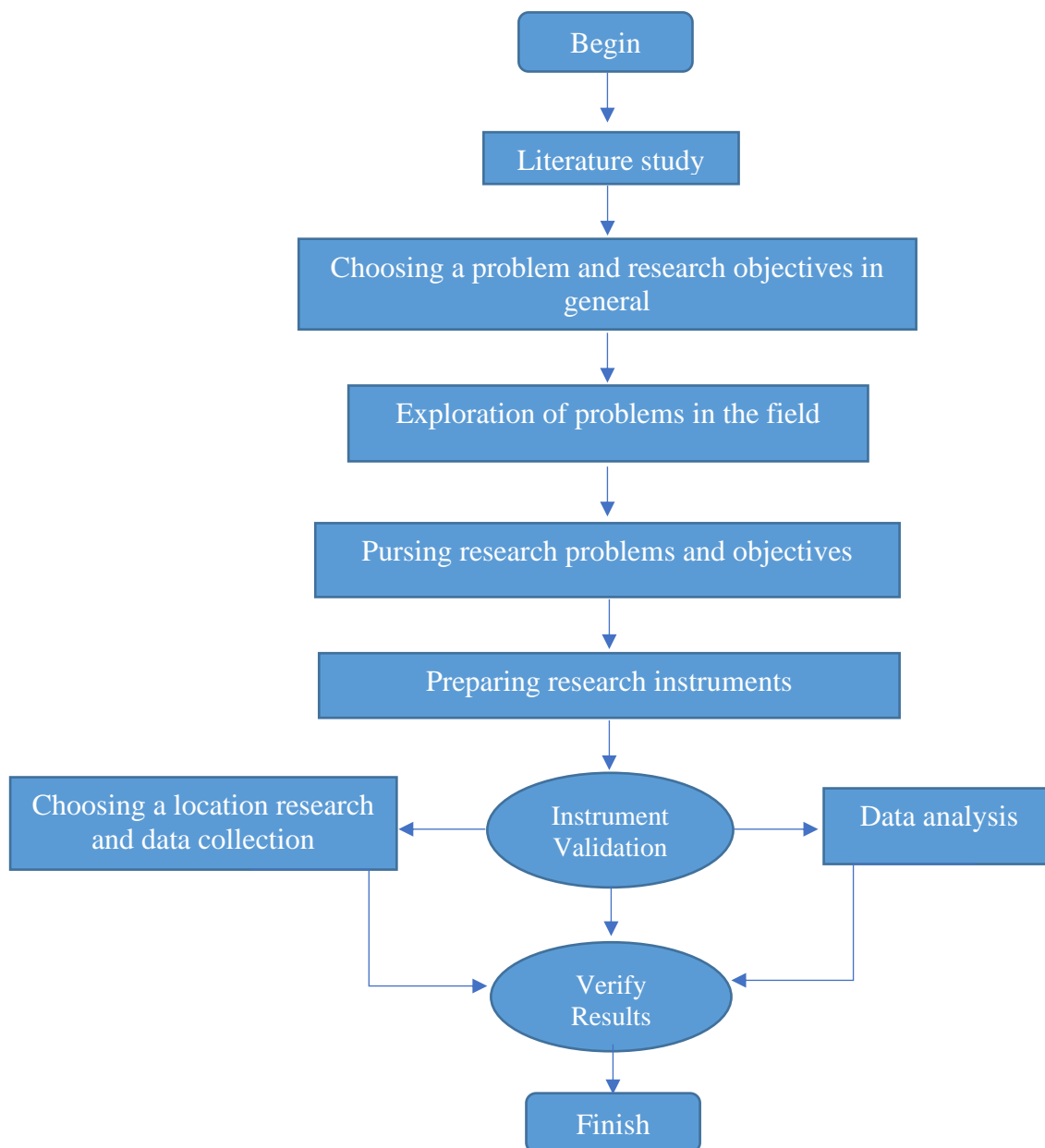


Figure 1. Research Flow [21]

3. RESULTS AND DISCUSSION

The results of this research provide an overview of the use of traditional agricultural tools in an ethnomathematical context in Hutamanik Village, Sumbul District. These findings show that despite the availability of modern technology, farmers in Hutamanik Rural still use traditional farming tools in their agricultural activities. This indicates that the knowledge and skills acquired from previous generations are still essential in agricultural activities in Hutamanik Village. Based on the research, several traditional agricultural tools are still used by farmers in the Hutamanik countryside, namely water drums, coffee mills, whetstones, hoes, saws, and sickles. In addition, the

study also identified several ethnomathematical practices associated with the use of such tools.

3.1 Water Drum

Water drums can be used to teach the concepts of volume and capacity. The water drum forms the plane of the chamber, the tube. In practice, farmers use water drums to store and measure the water needed for farmers' fields. They measured the amount of water required by filling water drums and recorded how many times they had to fill those drums to irrigate or water the entire field. It can be used to teach the concepts of volume and capacity to students [22]. Waterrum is used to store rainwater and provide water supply for agricultural needs. Farmers in Hutamanik Rural use varying sizes of water drums, ranging from small to large, depending on the water requirements for agricultural land.

Farmers in rural Hutamanik use water drums as measuring devices to determine the water needed to water crops. They calculated the amount of water required based on the size of the water drum used. Water drums can also store rainwater during the rainy season, so they can irrigate the land during the dry season. In an ethnomathematical context, a water drum can be seen as a water volume-measuring device farmers use. Farmers in rural Hutamanik use water drums with a capacity of 200 liters. In the researchers' observations, researchers found that farmers use mathematical principles to determine the amount of water that should be pumped into the drum. For example, a farmer will estimate the volume of water needed to water a crop, then calculate the number of times a pump takes to reach that volume of water. In summary, the Ethnomathematical concepts that can be found in this water drum image are [23]:

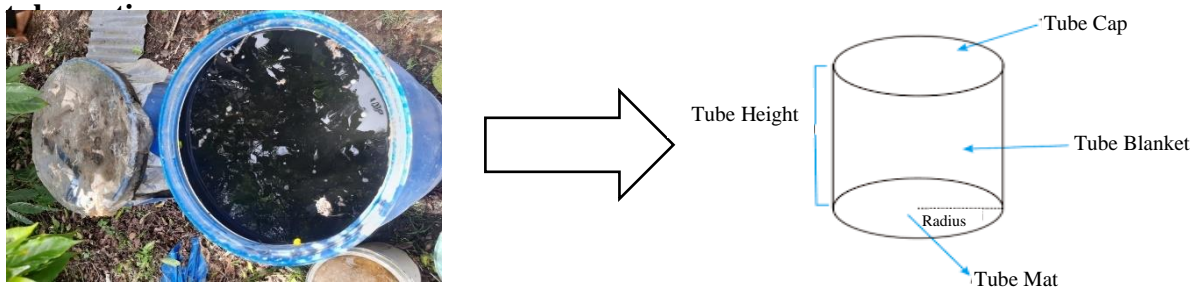


Figure 2. Tube on Water Drum Shape

Table 1. Tube Formula

	Formula
Tube volume	$V = \pi x r^2 x t$
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

Figure 2 shows the size of the water drum illustrated by the researcher through mathematical geometry concepts. In school learning, water drums can be used as a primary object for teachers in providing an overview to students when learning geometry for grade VI following Basic Competence point 3.7, "explaining the shape of a room which is a combination of several shapes, as well as surface area and volume," can also be an object of learning in class VIII, following Basic Competency point 3.9" to distinguish and determine area surface and volume of beams."

3.2 Coffee Grind

The coffee grinder is a vital tool for the people of Hutamanik. Coffee grinders are used to grind coffee beans that have already been harvested. Grinding coffee beans is done manually by rotating the grind by hand. In addition, the Hutamanik people also use specific techniques in choosing coffee beans to be crushed. The selection of coffee beans is made by testing their density and objection. Knowledge and experience in using this coffee grind have been passed down from generation to generation and have become part of the local wisdom of the Hutamanik community.



Figure 3. Coffee Grind

In an ethnomathematical context, coffee grinds can be analyzed from comparison and mathematics. For example, the size and shape of a mill can be measured and calculated to determine grinding efficiency and capacity. In addition, basic mathematical knowledge is also needed in using coffee grinds, such as calculating the number of coffee beans to be crushed and adjusting the grinding time to optimize the quality of the coffee produced. In using the coffee grinder, farmers use knowledge about the ratio of coffee volume and water needed to produce quality coffee [9].

In the following image, the wheel on the circle must be turned to get good coffee beans. The mathematical concept used is Trajectory. The Trajectory formula is as follows [24]:

$$\begin{aligned} \text{Track: } & \text{Circumference} \times \text{Number of Turns} \\ \text{Wheel circumference} & = \pi \times r^2 \\ \text{Trajectory} & = \pi \times r^2 \times N \end{aligned}$$


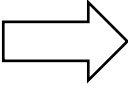

Then in Figure 3 also shows the shape and size of the coffee grind conceptualized on the circle material. However, this object will not be possible as a learning medium in the classroom because this tool can only be found on agricultural equipment. Teachers can provide mathematics learning on circle material by preparing project assignments for students related to circle material. The teacher can ask students to observe or analyze any parts of the coffee grinder that are conceptualized with circle material.

3.3 Whetstone

Whetstone is used to sharpen or sharpen blunt objects such as knives or cleavers and other sharp tools used in agricultural activities. Whetstone can be in the form of a flat, square, or rectangular plane according to the needs of farmers. Farmers in Hutamanik Rural use sharpening tools made of stone or metal. They calculate the amount of material needed based on the size of the base used. In ethnomathematics, the honing process has a high mathematical value [25]. In general, the people of Hutamanik Rural use whetstones as a sharpening tool. They understand how to adjust the angle and pressure so that the sharpened object becomes sharp. The angle should be 20° when sharpening the knife to obtain maximum sharpness. The use of whetstone in Hutamanik Village not only serves as a tool that facilitates work but also as part of their traditions and cultural identity [26].

In summary, the Ethnomathematical concept found in this water drum image is rectangular. This tool has fulfilled the properties of a rectangle, which has four equal-length sides and four equal angles, namely right angles. This tool can include learning mathematics on rectangular material in grade VII junior high school. By looking directly at this tool, students can also calculate why this shahan must be formed rectangular so that students can analyze the area and thickness of the shaping. The bay cake is also a cuboid with six square-shaped sides, all corners on a right cube, and 12 ribs of equal length. The area of the rectangle is as follows:

Table 2. Rectangle Formula

		Formula
		
Rectangular Area Rectangular Circumference		$p \times l$ $2(a + b)$

3.4 Saw

A saw is a traditional agricultural tool used to cut wood or bamboo. In an ethnomathematical context, saws can be analyzed in terms of geometry and mathematics. For example, saw size and blade width can be measured and calculated to determine cutting efficiency and accuracy. In addition, basic mathematical knowledge is also needed in using a saw, such as calculating the angle and size of the material to be cut. Farmers must also pay attention to the length and width of the wood cut to ensure that the wood is suitable for agricultural equipment construction. Farmers in Hutamanik Rural use traditional chainsaws made of iron of varying sizes depending on the size of the wood to be cut. They calculated the amount of wood needed based on the size of the saw used. They must consider angles, sizes, and distances to cut the wood correctly. It can be used to teach geometry concepts and distance calculations to students. In summary, the Ethnomathematical images that can be found in this saw drawing are [27]:

3.4.1 The Concept of Geometry

The geometry concept in the saw is to build a triangle on the saw. Saws can be used as learning media related to various triangles. There is a plane figure concept of a right triangle which is included in the concept of geometry [28]



Figure 4. The Concept of a Right Triangle on a Saw

In Figure 4, we can see that the saw is in the shape of a right triangle. The formula of a right triangle is:

Table 3. Right Triangle Formula

	Formula
Area of a Right Triangle	$\frac{1}{2} x a x t$
Circumference of a Right Triangle	$a + b + c$

3.4.2 The Concept of Pythagoras

On the saw, a right triangle can be converted into Pythagoras' learning media. Students can be invited to look for the concept of Pythagoras on the saw [29]. In the mathematics learning system, the saw is not used to assist teachers in providing teaching materials to students. The saw certainly cannot be used as a learning medium. However, the existence of this saw, which is one of the agricultural tools that is often worn in everyday life, can provide a further and more real introduction to the concept of Pythagoras outside the school environment so that students are more familiar with the basics of what Pythagoras is [30]. In addition, this tool can also provide bright ideas to teachers to liven up the learning atmosphere, namely the environmental study method, which is a natural learning process by introducing natural processes (environment) or introducing all activities in the environment to students related to mathematics. Learning environmental studies can foster a real deep understanding through the direct vision of mathematics in the surrounding environment, with learning through the eye senses will provide good recordings or stimuli in understanding mathematics learning, one of which is the concept of Pythagoras on a sawing tool [31].

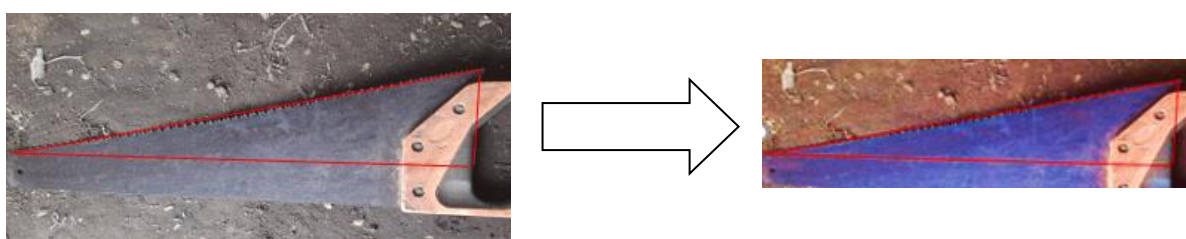


Figure 5. The Concept of Pythagoras

3.4.3 Plane Figure Concept

The concept of a plane figure is found on the handle or handle of this saw. The visible plane figure is a trapezoid. This saw handle can be used as a learning medium for plane figures. Through the saw grip tool, students are more familiar with and know more

about getting up flat. Teachers are more able to break the learning atmosphere through the introduction of this tool. The teacher can ask the students why should the saw grip be in the form of a trapezoid. Why not a circle, triangle, or kite? Through this simple question, the teacher will get several learning strategies by forming a group system to find answers to these questions. The teacher can tell students to do an in-depth analysis by looking for various sources, both books and mobile phones, and the teacher can also provide opportunities for students to discuss with other mathematics teachers to get instructions on the question. Therefore, the trapezoidal concept on the saw grip tool is very important and supports each other in achieving better and more enjoyable learning [32]. The formula of the trapezoid is:

Table 4. Trapezoidal Formula

	Formula
Trapezoidal area	$\frac{1}{2} x (a + b) x t$
Circumference of the trapezoid	$a + b + c + d$

3.5 Hoe

It is used to dig, lift and carry materials such as soil and fertilizer, cut plant roots, and clear weeds from plants. Farmers in Hutamanik Rural use hoes made of iron or steel of varying sizes depending on their agricultural needs. In ethnomathematics, hoes can be viewed as a simple mathematical application. For example, when using a hoe, the farmer must consider the right angle and strength when plowing the land. The use of hoes used by farmers in rural Hutamanik is based on mathematical principles, such as geometry and trigonometry. For example, this map uses an angle of 45° when forming slopes to avoid soil erosion. The farmer must also consider the distance between the rows of crops and the depth of the cultivated soil [3].

Farmers can maximize crop yields and optimize agricultural land use by considering these factors. Hoe can be analyzed in terms of geometry and mathematics. For example, the shape and size of hoes can be measured and calculated to determine their capacity and efficiency of use. In addition, basic mathematical knowledge is also needed in using hoes, such as calculating depth and distance when digging the ground. People in Hutamanik use hoes with certain techniques that require high skill and accuracy. The concept of ethnomathematics contained in the hoe is as follows [23]:

3.5.1 Square Concept

The surface of the base is the main part or element of the hoe because, with this surface, the hoe can be used by the community to carry out farming or gardening activities. Consider the image of the bottom surface of the hoe as follows.



Figure 6. Square Concept

In the picture above, it can be seen that the surface of the base has a square shape with the properties of having four sides of equal length, two pairs of parallel sides, four corners of equal size, both diagonals perpendicular to each other, and both diagonals equal in length. The bottom mat can provide a further and more real introduction to the concept of the square outside the school environment so that students are more familiar with the basics of what a square is. In addition, this tool can also provide bright ideas to teachers to liven up the learning atmosphere, namely the environmental study method, which is a natural learning process by introducing natural processes (environment) or introducing all activities in the environment to students related to mathematics. Learning environmental studies can foster a real deep understanding through the direct vision of mathematics in the surrounding environment, with learning through the eye senses will provide good recordings or stimuli in understanding mathematics learning, one of which is the concept of the square on the base under the hoe [33]. The formula of the square is [14]:

Table 5. Square Formula

	Formula
Square Area	s^2
Square Circumference	$4 \times s$

3.5.2 Angle Concept


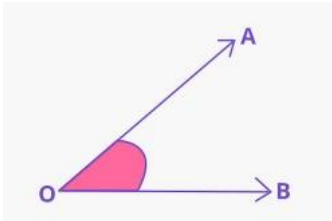
The concept of angle on the hoe can be seen from between the hoe handle and the surface of the hoe base, which forms a pointed triangle. The concept of this angle is very important in the process of making hoes because the size of this angle will provide a very precise measurement in obtaining a balance between the hoe grip and the surface of the base so that anyone who hits it will be safer and not give any danger [34]. Take a look at the image below.



Figure 7. The Concept of Angle on the Hoe

The picture above shows that the hoe handle and the surface of the hoe base form a taper angle with a large angle between $0^\circ < \alpha < 90^\circ$. With this tool, teachers can develop logical thinking in students by observing the surrounding environment, one of which is on a hoe handle. This development can be honed by giving students logical questions to encourage students' thinking stimuli in depth. The teacher can question why the handle of the hoe and the bottom base of the hoe must form an angle. Why do you have to form a tapered corner? Why not an obtuse angle or a right angle? With this logical question, students will begin to think concretely by analyzing and observing the tool to get the right answer [35]. The formula of the taper angle through the image above is [36]:

Table 6. Angle Magnitude Formula

	Formula
 <p>Large angle</p>	 $\sin \theta = \frac{\text{depan}}{\text{miring}}$ $\cos \theta = \frac{\text{samping}}{\text{miring}}$ $\tan \theta = \frac{\text{depan}}{\text{samping}}, 0^\circ < \theta < 90^\circ$

4. CONCLUSION

Based on the study results, it was concluded that traditional agricultural tools used by the Hutamanik rural community have a close relationship with mathematical concepts. Such exploration can provide new insights into rural communities utilizing mathematical knowledge indirectly in their daily lives. In addition, this research can contribute to the development of mathematics learning that is more contextual and connects mathematics with real life.

Ethnomathematical approaches can motivate students to study mathematics because they can see mathematics as related to their daily lives. Traditional agricultural equipment can be an innovative and inspiring mathematics learning model for school students. In rural communities like Hutamanik, fundamental mathematical knowledge is indispensable in using traditional agricultural tools. Therefore, ethnomathematics learning can help improve the community's ability to use traditional agricultural tools effectively and efficiently and maintain existing local wisdom.

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