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Ethnomathematics in Understanding the Exchange Rate of Banten Coins through Linear Equation Analysis

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Abstract: This study examines the application of Ethnomathematics in analyzing the exchange rate of Banten Coins through the Linear Equation approach. This study aims to explore the mathematical concepts contained in the Banten Coin exchange rate system as a cultural heritage and identify its relationship with the principle of Linear Equations. The method used is a qualitative analysis of historical and cultural data related to the Banten Coin, complemented by mathematical modeling based on Linear Equations to understand the exchange pattern. The results of this study show that the Banten Coin exchange rate system contains mathematical principles such as proportions, ratios and linear relationships, which can be explained through simple equations. Thus, these findings strengthen the role of Ethnomathematics in uncovering the practical and philosophical value of local cultures while facilitating contextual mathematics learning. The implications of this research encourage the integration of local culture into mathematics education to increase students' relevance and interest in learning.

Keywords: Ethnomathematics, Banten Coins, Linear Equations

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A. INTRODUCTION

Education is one way to shape and improve the quality of human resources in facing challenges in the era of globalization (Achilla, 2024). According to Jean Piaget, training can be analogized to a bridge connecting two different poles. One pole contains individuals constantly undergoing growth and development, while the other reflects a group that holds fast to social, intellectual, and moral values.

According to James, mathematics is a science that studies logic related to shapes, structures, sizes, and various concepts that are interconnected in large numbers. This field is generally divided into three main branches: algebra, analysis, and geometry (Oktavia & Suparni, 2021). History proves that mathematics is an important part of human life and cannot be separated from it. Like the two sides of a coin, on the one hand mathematics is based on logic and rationality, while on the other hand, mathematics develops from various human activities in daily life. Mathematics is a discipline structured in studying patterns of relationships, thought patterns, art, and language, all of which are logically analyzed and deductive. This science plays a role in helping humans understand and solve various problems in the social, economic,

and natural fields. Based on this, mathematics connects with the concept of human life and culture (Mauleto, 2025).

So the relationship between mathematics and culture is called Ethnomathematics. The term Ethnomathematics was coined by D'Ambrosio (1989) to describe the practice of mathematics in cultural groups that can be identified and considered as the study of mathematical ideas found in each culture. Ethnomathematics is a typical approach a specific cultural community or society uses to carry out mathematics activities (Lestari et al., 2020). This math activity involves abstracting everyday experience into mathematical concepts, or vice versa. These activities include grouping, calculating, measuring, designing buildings or tools, creating patterns, counting, determining positions, playing, explaining, etc.(Sarwoedi et al., 2018)

In terms of ethnomathematics itself, it has its origin in English which includes three words, namely "Ethno", "Mathema", and "Tics". The term of the 3 words is, "Ethno" which means something oriented to the socio-cultural context such as community culture, customs, customs, myths, symbols in society and others. "Mathema" means to explain, find out, carry out activities, measure and draw conclusions. As for "Tics" which has the origin of the word "Techne" which has the meaning of technique (Sri et al., n.d.).

Ethnomathematics can be understood as a program that aims to teach students how to understand, express, manage, and apply mathematical ideas, concepts, and practices. Establishing the connection between culture and mathematics is crucial to understanding the diverse mindsets that birth to various forms of mathematical concepts (Setiana et al., 2021). Thus, students can use this knowledge to solve problems related to daily activities. Ethnomathematical objects refer to cultural objects in society with mathematical concepts. These objects include traditional games, typical crafts, artifacts, and various cultural activities (Oktavia & Suparni, 2021). One of the cultural relics of Banten that we can raise is the relics of currency in the era of the Sultanate of Prince Maulana Muhammad or often also called "Prince Ratu Ing Banten", namely the Banten Coin.

There are several types of currencies in the sultanate of Banten. The three currencies most widely used during the sultanate were the local currency (real), the Chinese currency (cash or picis), and the VOC currency (doit). Money functions as a measuring tool, namely to declare the value of a good or service and calculate total wealth and the amount of loans (Lasmiyati, 2012). The currency used in the Sultanate of Banten is the Kasha money, which is the currency of China. This money is shaped like a small round with a hexagonal hole. In addition to Kasha money, Khasa currency is circulating in the Sultanate of Banten. This currency is made of copper and has Old Javanese and Arabic letters. The Banten coin, which is inscribed on the face with Arabic letters and Malay reads "prince quatu ing Banten”. Banten coins function as a medium of exchange and contain deep cultural and historical values. The value system of these

coins, which is often complex and unique, can be analyzed using mathematical concepts, especially those in Linear Equations.

The linear equation system is one of the bare branches of mathematics. A linear equation is a set of equations with the same unknown variable. Variables or coefficients in linear equations are not only real numbers, but can also be numbers in the form of intervals, fuzzy numbers, or complex numbers (Ihsan et al., 2024). A linear equation system is a collection of two or more interconnected linear equations. This concept has a significant role in the study of linear algebra. The general form of the linear equation system can be written as Ax = y (Marzuki & Herawati, 2015). The Linear Equation allows us to model the relationship between various variables in the Banten Coin exchange rate system. Through this Linear Equation analysis, we can investigate how ratios and proportions are applied in transactions using the coin. As well as understanding how the people of Banten in the past used mathematical concepts in their daily lives.

This study aims to explore the mathematical concepts contained in the Banten Coin exchange rate system as a cultural heritage and identify its relationship with the principle of Linear Equations. Thus, this research highlights the mathematical aspects of the Banten coin exchange system and reinforces the importance of ethnomathematics as a tool to understand and appreciate the rich cultural heritage.

B. METHOD

This research uses a qualitative method with an ethnographic approach. Data collection and processing is carried out inductively, emphasizing understanding the deep meaning of the phenomenon being studied, by the social and cultural context that is the focus of the study (Irsyad et al., 2020).

The subject of this study is the Banten Coin Exchange Rate in the Banten Museum. Observation, documentation, and interviews carry out the data collection technique. The analysis of the results of observations and interviews was used to find out more about the use of ethnomathematical concepts in the exchange rate of Banten coins through linear equations. Meanwhile, the documentation itself is used to support the data that has been obtained, both observation and interview data. By the type of research approach, the main instrument underlying this research is the researcher himself (human agency), which is supported by several other tools, namely field notes, interviews, and documentation (University & Nation, 2023). This research was carried out on March 25, 2025 at the Old Banten Archaeological Site Museum.

C. RESULTS AND DISCUSSION

The Sultanate of Banten flourished in the 16th to 18th centuries and was an important trading center in the western region of the archipelago. In economic and trade activities, the people of Banten use the metal coin system as a medium of

exchange. These coins are minted from materials such as copper and silver, with official royal stamps as collateral of exchange rates.

In the traditional society of Banten, the value of coins is not only based on the material, but also on the size and symbol of the kingdom listed. This indicates the existence of a value system that is logically and systematically arranged, although it has not been packaged in formal mathematical language.

The currency that applies to the sultanate of Banten internationally is Chinese money which we often know as Chinese or Cash. Chinese money circulating during the Banten sultanate based on findings starting from the era of the tang dynasty. One example is a coin with the inscription "Kai Yuan Tong Bao" (開元通寶) which was first minted in 621 AD. The coin is round with a square hole in the center and Chinese characters around it.

Figure 1. Chinese Money

The next currency circulating in the Banten sultanate was the VOC currency. The denomination of the VOC currency is called "Doit" where the word doit became a word for money during its development.

Figure 2. VOC Coin

Furthermore, the currency circulating during the Banten sultanate was the Banten currency itself. There are 2 Banten currencies, the first is a currency inscribed with Javanese letters that reads "Prince Ratu Ing Bantan" with a hole in the middle in the shape of a triangle and the 2nd currency with a Javanese inscription, namely 4040 with a hole in the middle in the shape of a triangle.

Figure 3. Javanese Coin

Banten's currency is called "Picis" where the people of Banten call the money as picis until now. The making of the Banten currency with a hole in the middle imitates Chinese coins, a hole is made in the middle of its function to assemble the money. The nominal or exchange rate of these coins during the trading period during the Banten sultanate used to be exchanged or nominalized for the number of pieces. Such as 1 pack of 200 pieces, 1 pack of 1,000 pieces, 1 pack of 10,000 pieces, and 1 keti of 100,000 pieces.

Figure 4. Banten sultanate Coin

From this explanation, the researcher found that the existence of mathematical concepts in the traditional coin exchange rate system is a form of application of mathematics in people's lives in the era of the Banten Sultanate, namely about linear equations as follows:

1. Concept of Linear Relationships

A linear relationship is a relationship between two or more variables in which a change in one of the variables will result in a constant (constant) change in the other variable. It is known that the people during the Banten Sultanate used the following units:

1 pack = 200 pieces
1 snail = 1,000 pieces
1 pack = 10,000 pieces
1 keti = 100,000 pieces

This system is a form of number and measurement concepts that develop locally, and can be studied using a mathematical approach, namely linear equations. Suppose:

a = number of strokes
p = number of pegs
b = number of packs
k = number of keti
x = number of pieces

From this reasoning, a mathematical model can be made, namely:

$$x = 200a + 1{,}000p + 10{,}000b + 100{,}000k$$

This model shows the linear relationship between traditional units and the total number of pieces.

2. The Concept of Ratio and Proportion

During the Banten Sultanate, the Chinese bought pepper in the interior of Sijo for 1 keti. At that price the Chinese get 8 sacks of pepper, then the Chinese sell the peppers to the port of Karangantu with 4 sacks of pepper for 1 keti so that the Chinese get a 200% profit from the results of 8 sacks of pepper whose selling price becomes keti. Then the coins are arranged and ronce in strands, because they are valued based on the pieces.

From this discussion, the researcher found the mathematical concepts in linear equations, namely ratios and proportions as follows: If the Chinese buy 8 sacks of pepper for 1 keti of Banten coins, then when the Chinese buy 16 sacks of pepper, the total number of Banten coins is obtained into 2 keti of Banten coins. From this example, it can be concluded that the concept of value comparison (ratio) if it is included in the ratio formula, namely:

$$\frac{A_1}{B_1} = \frac{A_2}{B_2}$$

If the Chinese buy 8 sacks of pepper for 1 keti. How many kettles do Chinese people get when they buy 16 sacks of pepper?

Known:
A_1 = 8 karung lada
B_1 = 1 keti
A_2 = 16 karung lada

B_2 = ?

Settlement

$$\frac{A_1}{B_1} = \frac{A_2}{B_2}$$

$$\frac{8}{1} = \frac{16}{B_2}$$

$$8 \text{ x} = 16 \text{ x } 1B_2$$
$$B_2 = \frac{16}{8}$$
$$B_2 = 2$$

It can be concluded from the example above that the concept of value comparison occurs if the value of one quantity increases, then the value of another quantity also increases. So in the sultanate era, there was a mathematical concept on linear equations regarding ratios.

The proportion is the equality between two ratios for example, the ratio of 8:1 is equivalent to 16:2 so the proportion is written

$$\frac{8}{1} = \frac{16}{2}$$

Through this example, we see that traditional societies, such as those in Banten, have intuitively applied the concept of ratios and proportions in their exchange rate systems. While they may not call it "proportion" formally, understanding equivalence of values and comparisons still suggests that mathematical principles have lived on in their cultural practices.

D. CONCLUSIONS AND SUGGESTIONS

This research shows that the coin exchange rate system in the era of the Sultanate of Banten not only has historical and cultural value, but also contains relevant mathematical concepts, especially ratios, proportions, and linear relationships. The people of Banten in the past, intuitively applied mathematical principles in trade practices through units such as atak, peku, wrapkus, and keti.

The mathematical model used in the research is a linear equation in the form of:
x = 200a+1000p+10000b+100000k

It shows that modern mathematical approaches can analyze the coin exchange rate calculation system logically and systematically. These findings strengthen ethnomathematics's position as a bridge between cultural heritage and contextual mathematics learning. Ethnomathematics not only uncovers how mathematics lives in local cultures, but also becomes a practical approach to foster students' interest in learning through cultural values close to everyday life.

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