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MATH OBJECT IDENTIFICATION ON MATERIAL CULTURE ON THE ISLAND OF AMBON

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Abstract

Mathematics learning will be more interesting if aspects of the cultural context around students are involved. In this regard, the identification of cultural aspects of both material and non-material culture needs to be continuously carried out and integrated into learning. This research is an exploratory study to identify the material culture in villages in the Central Maluku district on Ambon Island. There are 3 (three) sub-districts in the administrative area of Central Maluku Regency located on Ambon Island. In each sub-district, one village was selected as a sample village, considering that (1) the village is a traditional village and (2) cultural objects are still well preserved. In the Leihitu sub-district, Negeri/Village Hila was selected; in the West Leihitu sub-district, Negeri/Village Allang was selected; and in the Salahutu sub-district, Negeri/Village Tulehu was selected. Data collection was done through observation and interviews. Data were analyzed using descriptive qualitative. The identification process found that the material culture, in the form of traditional houses, bailey, forts, old churches, old mosques, fishing facilities, weaving, and food, is related to mathematical objects. Material culture can be a cultural context that is integrated into learning the concept of flat and spatial shapes.

Keywords: math objects, material culture

1. Introduction

Mathematics is a subject that is expected to provide various benefits to students. Learning mathematics is not only intended to encourage students to understand mathematical concepts and principles but also to improve reasoning and problem-solving skills. Mathematics is intended to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together. These competencies are needed so that students can have the ability to obtain, manage, and utilize information to survive in an ever-changing, uncertain, and competitive situation.

The main problem that arises is that many students dislike math, and math learning outcomes are relatively low. In the Trends in International Mathematics and Science Study (TIMMS) 2015 for grade IV, Indonesian students obtained a math score of 397 and ranked 45 out of 49 countries. This score is much different from the score of Singapore students who scored 618 and ranked first (Mullis et.al, 2015).

Relatively low mathematics learning outcomes are also found in schools in Maluku province. Research results on students in Maluku Province, including in Ambon City, show that mastery of concepts, principles, mathematical operations, problem-solving, and reasoning is relatively low (Ratumanan et al., 2016; Ratumanan & Laurens, 2016), students' higher-order thinking skills are relatively low (Ratumanan & Ayal, 2018); students' numeracy literacy skills are relatively low (Ratumanan & Salamor, 2021).

Low math learning outcomes are an interesting aspect that needs to be continuously studied and found a solution. There are many contributing factors, among which is the weak learning of mathematics in schools. Over the years, the structuralist approach has dominated mathematics learning in Indonesia. Mathematics learning emphasizes theorems, formulas, and applications of these theorems and formulas. This emphasis often ignores the context aspect so that mathematics appears as a set of abstract theorems and formulas. Then, the structuralist approach was replaced with a mechanistic approach to the application of arithmetic. In this approach, the emphasis is more on operations or procedures. Similar to the structuralist approach, the context aspect is also often ignored. These approaches are not appropriate for learning mathematics. In solving problems, students often do not pay attention to the context and only focus on

numbers. Ratumanan and Rosmiati (2019) provided problems that were incomplete, illogical, and had no answers for freshmen to solve. Interestingly, some people continued to work on the problem because their attention was only focused on the numbers.

Presenting local cultural contexts in mathematics learning will have a positive impact on learning processes and outcomes. Learning will take place more interestingly because the starting point is from concepts that already exist in student cognition (Piaget uses the term *scheme*). This kind of learning, according to Ausubel, will be more *meaningful*. Measurement learning, for example, if it starts with local measurement systems such as inches, cubits, fathoms, steps, and feet, will be interesting for students. Geometric shapes learning, for example, if it starts by displaying traditional houses or traditional houses of Saparua Island, Banda Island, Haruku Island, various villages on Seram Island, or other Islands in Maluku, will be interesting for students and will focus students' attention in learning. Similarly, in learning similarities in geometry, if it starts by displaying Tanimbar woven fabrics or Kisar woven fabrics that are rich with a variety of beautiful motives, it will make learning mathematics more interesting and meaningful.

Several previous studies, namely Supriadi (2016), Pathuddin (2021), Naja et al (2021), and Bito and Wawan (2021), have successfully identified mathematical concepts in regional culture. This research will focus on identifying mathematical objects in the culture of objects in the Central Maluku Regency area on Ambon Island. Begle (1979) divides mathematical objects into facts, concepts, operations, and principles. The identification of mathematical objects in cultural aspects will provide important implications for the improvement of mathematics learning. This study is also important for the next stage of developing mathematics learning based on island culture

2. Method

This research can be categorized as an exploratory study with a qualitative approach. In this study, the process of inventorying the material culture on Ambon Island has a relationship with mathematical objects and can be integrated into learning.

This research is limited to the Central Maluku Regency area on Ambon Island. There are 3 (three) sub-districts on Ambon Island included in the Central Maluku administrative area, namely (1) Salahutu, Leihitu, and West Leihutu. In each sub-district, one Negeri/village was selected as a sample village, with the consideration that (1) the Negeri/village is a traditional Negeri, (2) the cultural objects in the Negeri are still well preserved. In the Leihitu sub-district, Negeri/Village Hila was selected; in the West Leihitu sub-district, Negeri/Village Allang was selected; and in the Salahutu sub-district, Negeri/Village Tulehu was selected.

Data collection was done by observation and interview. Respondents who became data sources in this study were community leaders in each village who understood well the cultural objects studied. The respondent from Negeri Allang has the initials JP, Head of one of the Soa in Negeri Allang. The respondent from Negeri Hila had the initials YI, the manager of the Wapauhe Mosque, and HT, a respondent from Negeri Tulehu, one of the community leaders. Data were analyzed using descriptive qualitative.

3. Result and Discussion

3.1 Result

1. Material Culture in Negeri/Village Hila, Leihitu Sub-district

In the land/village of Hila, various objects of material culture contain or are related to mathematical objects.

a. Hila Old Church

Immanuel Old Church was originally built by the Portuguese two years after the spice warehouse was built, precisely in 1514, in the form of a *chapel* (small Catholic church) with the name of St. Jacobus and is a Catholic church. After being taken over by the Dutch in 1605, this wooden church was then enlarged, but the name was not changed. Then, the Dutch Governor General for Maluku in 1780-1781, Bernardus Van Plueren, changed its name to Immanuel and switched its function to a Protestant church. The old church in Hila Kaitetu village also has various parts related to mathematical objects and can be integrated into mathematics learning.

b. Wapauwe Mosque

The mosque was founded in 1414 and was originally called the Wawane Mosque because it is located on the slopes of Mount

Wawane. In 1664, the Dutch took control of the Leihitu region. The people who inhabited the Wawane mountains were moved to an area near the coast. Similarly, the Wawane Mosque was moved. The mosque was $10 \times 10\ m^2$. It was built in a location where forest mangoes grow, which in the Kaitetu language is called Wapa. Hence, the mosque is called the Wapauwe Mosque. Many mathematical objects can be identified in the Wapauwe Mosque. Wapauwe mosque was built in 1414

c. Lating Nustapy Old House

In Hila, several old houses also function as traditional houses, including the Listing traditional house, Tatisina traditional house, Hatala traditional house, and Selang traditional house. In the Lating Nustapy old house, various parts of the house have a connection with the objects of flat geometry and spatial geometry. The slope of the roof of the house can also be used as an introduction to learning gradient (slope) line material.

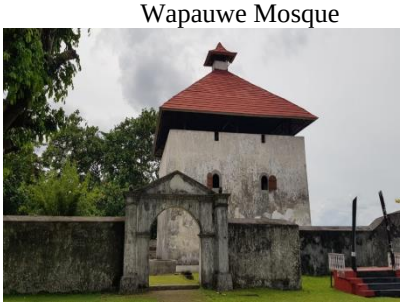
d. Fort Amsterdam

Fort Amsterdam is one of the Dutch heritage cultural heritage. Fort Amsterdam was built by Gerard Demmi R in 1642, then expanded and enlarged by Arnold de Vlaming van Ouds Hoorn in 1649-1656, then restored by the Ministry of Education and Culture 1991-1994. In this fort, there are also various parts related to mathematical objects.

Imanuel Hila Church

Wapauwe Mosque

Lating Nustapy House



Fort Amsterdam

Figure 1. Material Culture in Hila Village, Leihitu Sub-district

2. Material Culture in Negeri/Village Allang, West Leihitu Sub-district

In Negeri Allang, West Leihitu sub-district, several cultural objects have a relationship with mathematical objects and can be accommodated in mathematics learning. The cultural objects are Baileo and the king's house.

a. Baileo Negeri Allang

Baileo Negeri Allang symbolizes the traditional culture, which is the center of activity for the people of the Negeri. Baileo Negeri Allang was built around the 15th century AD. Baileo has two floors of the stage, upper and lower floors. The upper floor is reserved for the king and the head of the soa, while the lower floor is for the citizens. Two stairs connect the two floors; the first staircase to go up the lower floor has 6 (six) steps, and the second staircase connecting the lower floor and the upper floor has 3 (three) steps. The total number of stairs is 9 (nine), which symbolizes Patasiwa. The people of Negeri Allang belong to the Patasiwa group. Baileo supporting poles totaling 32 pieces, there are 4 (four) rows, each totaling 8 (eight) poles, which symbolizes 8 (eight) ancestors or founding kapitang of Negeri Allang.

Baileo Negeri Allang has several functions that are still practiced today, including:

1) State meeting place
2) The place where the king was inaugurated
3) Place of inauguration of the head of the soa

4) A place of interaction between residents of Negeri Allang

b. The King's House

The King's House is a house built for the king's residence. The construction of the king's house is more modern when compared to Baileo. The roof of Baileo uses a sago roof, while the roof of the king's house uses Zinc. Nevertheless, the authenticity of the king's house is still maintained, with only the replacement of the sago roof with the Zinc roof.

Allang Village Baileo

The King's House

Figure 2. Material Culture in Negeri Allang, West Leihitu Sub-District

3. Material Culture in Negeri/Village Tulehu, Salahutu Sub-district

In Negeri Tulehu, in the Salahutu Sub-District, material culture other than buildings was identified. This is intended to identify material cultural objects that are more varied. Material cultural objects identified include:

a. Fishing facilities

Fishing facilities that have a relationship or can be connected with mathematical objects that can be identified in the form of semang boats, bubu, and kite fishing rods. Fishing facilities are related to a variety of geometric shapes, both flat and space so that they can be used in learning geometry.

Semang Boat

Fishing Kite

Bubu

Figure 3. Fishing Facilities

b. Weaving

Several types of weaving are identified as having a connection or can be connected to mathematical objects, namely kamboti and tagalaya. These weavings have shapes associated with various geometry objects so that they can be used in geometry learning

Kamboti

Tagalaya

Figure 4. Types of weaving

c. Food

Several types of snacks can be accommodated in math learning, such as sago, walnut bread, and talam cake. These foods have shapes related to various geometric shapes so that they can be accommodated in learning. These foods have shapes related to various geometric shapes so that they can be accommodated in learning. The typical food is presented in the following picture.

Sago

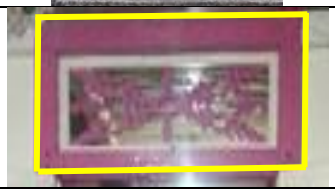
Sago Sugar

Walnut Bread

Figure 5. Typical food of Central Maluku

The mathematical objects that can be identified from the various objects of material culture in the Negeri in Central Maluku District on Ambon Island are presented in Table 1 and Table 2 below.

Table 1. Parts of Material Culture Objects Related to Geometric Plane Objects

No.	Name and Part of Objects	Images	Math Objects
1.	Hila Church Window		Square 1. Square Perimeter 2. Square Area.
2.	Amsterdam bull roof mattress		
3.	Walnut Bread		
4.	Amsterdam Castle Entrance		Rectangle 1. Rectangle Perimeter 2. Rectangle Area
5.	Old House Ventilation Lating Nustapy		

No.	Name and Part of Objects	Images	Math Objects
6.	Stairs to the stage floor of Baileo Negeri Allang		
7.	Ornaments on the staircase of the Fortress of Amsterdam		Rhombus 1. Rhombus Perimeter 2. Rhombus Area
8.	Ventilation at the Wapauwe Mosque		
9.	Kamboti webbing		Parallelogram 1. Parallelogram Perimeter 2. Parallelogram Area 3. Parallelogram Height 4. Parallelogram Diagonal Length
10.	Church Roof		Trapezoid 1. Trapezoid Type 2. Trapezoid Perimeter 3. Trapezoid Area
11.	The ridge of the Old House of Lating Nustapy		
12.	Fishing kite		Kites 1. Kite Perimeter 2. Kite Area

No.	Name and Part of Objects	Images	Math Objects
13.	Side Roof of Hila Old Church		Triangle 1. Triangle Type 2. Triangle Perimeter 3. Triangle Area
14.	The roof of Fort Amsterdam		
15.	Well Floor of Amsterdam Fortress		Pentagon 1. Pentagon Corner 2. Pentagon Perimeter 3. Pentagon Area
16.	The House Top of the Negeri Alang King		
17.	Table		Circle 1. Circle Elements 2. Circle Circumference 3. Circle Area

Table 2. Parts of Material Culture Objects Related to Geometric Plane Objects

No.	Name and Part of Objects	Images	Math Objects
1.	The crossbeam on the Baileo Negeri Allang		Beams: 1. Block Volume 2. Block Surface Area 3. Net of a Block
2.	Sago sugar, a specialty in Central Maluku, including in Negeri Tulehu		

No.	Name and Part of Objects	Images	Math Objects
3.	The roof of Fort Amsterdam		Pyramid 1. Pyramid Volume 2. Pyramid Surface Area 3. Pyramid Nets
4.	Top of the Roof of the Wapauwe Mosque		
5.	The House Roof of the King of Allang		Prism 1. Prism Volume 2. Prism Surface Area 3. Prism Nets
6.	Talam Cake		
7.	Well, at Fort Amsterdam		Tube 1. Tube Nets 2. Tube Volume 3. Tube Surface Area
8.	Tifa at Baileo Negeri Allang		

3.2 Discussion

From the identification of object culture in a sample of villages in Leihitu, West Leihitu and Salahutu sub-districts, it was found that various objects of material culture have a relationship with mathematical objects. Begle (1979) divides mathematical objects into facts, concepts, operations, and principles. Meanwhile, Bell

(1981) distinguishes mathematical objects into two types, namely direct objects and indirect objects. Direct objects are the objects of mathematics itself. In contrast, indirect objects are things that will accompany the acquisition of learning direct objects such as transfer of learning, ability to discover, ability to solve problems, self-discipline, and appreciation of mathematical structures. The direct objects of mathematics are divided into four categories, namely facts, skills, concepts, and principles (Ratumanan, 2015).

Mathematical objects in the form of mathematical concepts that can be identified as related to material culture objects in this study can be developed for use at several levels of educational units. The concept of flat and spatial shapes has been introduced since grade IV of elementary school up to grade IX of junior high school.

From this study, the mathematical objects that can be identified are limited to the concept of geometry. The geometry objects consist of (1) flat geometry, including square, rectangle, trapezoid, parallelogram, rhombus, triangle, and circle, and (2) spatial geometry, including block, prism, pyramid, and tube.

However, various other objects can be explored further that are related to other mathematical concepts. For example, in the Negeri of Hila, the tradition of Lawa Pipi is identified, which is the tradition of carrying goats around the negeri and the mosque. This tradition is also found in Tulehu and is called "Abda'u." In the Abda'u tradition, three goats are carried and paraded around the Negeri before being sacrificed. This tradition can be related to the concept of distance and speed. In Negeri Tulehu there are several types of sago plants, namely tuni, ihur, makanuru, rattan thorn, and molat. Sago flour is made into various types of food, including papeda, bagea, and sago tumbu. The process of making papeda is done by putting boiling water into the sago flour while stirring. The context of making papeda can be used in learning comparison materials. Bagea is generally filled in small plastics; each plastic contains 10-20 pieces of bagel. This context can be used in learning number operations. Sago tumbu is made from a mixture of dried sago flour, palm sugar and walnuts that are pounded until the dough is evenly mixed. The dough is then wrapped using oil paper or small plastic. This context can be used in learning number operations, comparison, and linear programs.

4. Conclusion

In this research, various material cultural objects in Leihitu, West Leihitu, and Salahutu sub-districts that are related to mathematical objects were identified. These cultural objects are the Hila Old Church, Wapaue Old Mosque, Lating Nustapy Old House, Amsterdam Fort, Baileo Negeri Allang, Allang King's House, various fishing equipment, various weavings, and various typical foods of Salahutu Sub-district. Mathematical objects related to cultural objects that can be identified consist of (1) flat geometry, including squares, rectangles, trapezoids, parallelograms, rhombuses, triangles, and circles; and (2) spatial geometry, including blocks, prisms, pyramids, and tubes.

This study is expected to be beneficial for mathematics learning. Presenting cultural context in mathematics learning, both as part of the perception and as part of the problem-solving process, will have a positive impact on the quality of learning. Therefore, educators are expected to pay attention to and involve cultural context in mathematics learning. This is important because it will not only have an impact on the effectiveness of learning but will also have an impact on efforts to develop students' appreciation and love for their local culture and foster a commitment to take part in preserving the culture of the Negeri (region).

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