Ethnomathematics: The Exploration of Learning Geometry at Fort Rotterdam of Makassar

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Abstract: The needs of math in various aspects of life prove that through math, human can understand and solve the problems. Basically, learning math has never been separated from daily lives, especially the culture, but most of students assume that math and culture have no any much correlation. This may occur because almost all teaching media used by the teachers have not given any real examples yet on the relation between math and culture that we have. One of the ethnomathematical objects that can be used as learning media are the historical objects at Fort Roterdam. The study aims to deeply explore and dig the concept of learning geometry bases on any kinds of ethnomathematics that can be used as the sources or learning math on Junior High School level. This field study shows that based on the exploration, observation, and documentation results as well as the literature study, it was found the geometry concept on the historical objects at Fort Roterdam. Learning math based on ethnomathematics can be implemented in order to introduce the cultures to the students as well as to give more interesting learning.

1 INTRODUCTION

Indonesia is an archipelago consisting of various ethnic groups, languages, arts and cultures, and various kinds of natural wealth. With those Indonesia's ethnicity and culture diversities, it is not such an easy job to keep and preserve it on the rapidly increasing globalization. Nowadays, the presence of a combination between education and culture gives positive impact on the cultural development in Indonesia. It is expected that our nation's successors will continue maintaining their cultural preservation even on the rapidly increasing globalization someday. One of math learning alternatives that are currently viral in math education matter is by linking math learning with daily life based on the local culture. Math and culture are two interrelated things. A student can start learning math from the concrete things that he has known such as exploring the information on what he has gained in his daily life relating to the math that he is learning.

Learning math related to the local culture is a good model to be continually developed so that the math learning become more fun, interesting, and familiar for the students because every activity done by the students always prioritizes their cultural background. It is in line with (Turmudi, 2018), (Marsigit, Setiana, & Hardiarti, 2016), (Zayyadi, 2017), (Ekowati, Kusumaningtyas, & Sulistyani, 2017). In general, said that the obe way to conclude mathematics learning is related to local culture. Other thatD'Ambrosio's point of view in Marsigit et al. (2018) that "the term requires a dynamic interpretation because it describes concepts that are themselves neither rigid nor singular-namely, ethno and mathematics" (D'Ambrosio, 2011). The term 'etno' describes everything that creates culture of a group, namely, language, code, values, jargon, beliefs, food and clothing, habits, and physical traits. Meanwhile, according to Gerdes (1994) in Wahyuni, he states that Ethno-mathematics is the math implemented by a certain cultural group, group of workers / farmers, the children from certain class community, professional classes, and so forth (Wahyuni, 2016).

As a matter of fact, on the contrary, almost all students especially in Makassar still think that math cannot be related to daily life so that the students fail in understanding the basic concept of math. Another reason of it is because most of the devices used by the teachers have no link between the students' learning and their daily lives, whereas math learning should be associated with the concrete things that

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the students have known. The concrete things known by the students are the knowledge bridges to understand the math abstractness. The knowledge bridge that is meant is by implementing the media of ethno-mathematics.

It is in line with D'Ambrosio's point of view (1985) in Hardiarti that on the other hand, there is a reasonable amount of literature on this by anthropologists (Hardiarti, 2017). Making a bridge between anthropologists and historians of culture and mathematicians is an important step towards recognizing that different modes of thoughts may lead to different forms of mathematics; this is the field which we may call ethnomathematics. It means that creating a bridge between culture and math is necessary step to recognize various thinking ways that can create mathematical forms; it is what is called as ethno-mathematics. It can be interpreted that various concept of math can be explored and found in the culture so that it clarifies that the math and the culture are interrelated; math can be created from the culture, and math can be explored in the culture so that it can be used as one of concrete learning sources existed around the students. It is in line with (Wahyuni, 2016), (Fajriyah, 2018), (Putri, 2017), (Hardiarti, 2017) and (Maryati & Prahmana, 2018) in general said that mathematics should be associated with daily life based on local culture.

One of the historical objects that can be used as learning media is the relic of historical object in Fort Ujung Pandang or more known as Fort Rotterdam located in the center of Makassar city. Fort Rotterdam is one of the legacies of Gowa kingdom and has a lot of relics of historical objects. Some of buildings and historical objects at Fort Rotterdam seem have similarity with the math concepts especially geometry material. The learning sources derived from those historical objects can be used to introduce forms of shapes and surface area. Marsigit et al. (2018) state that ethno-mathematics serves to express the relation between the culture and the math. Therefore, ethno-mathematics is a science used to understand how the math is adapted from a culture.

Through math learning resources derived from the socio-cultural environment, it is expected to facilitate students in understanding the basic concepts of math because the learning process that is carried out starts from informal math knowledge as well as to develop the students' insight on the culture diversity that they have especially the local culture. The math learning based ethno-mathematics is one of alternatives that can make learning more meaningful, contextual, interesting, and fun. it is in line with Putri's explanation (2017) in her research that the exploration on the cultural studies related to the math is able to give new information about local culture diversity and it is easier to understand the math learning because it is not perceived as an 'odd' thing by the students anymore.

Based on the above descriptions, it can be concluded that this study aims to explore and describe the geometrical concepts found in the historical objects at Fort Rotterdam and how to utilize the math concepts in math learning on those historical objects at Fort Rotterdam.

2 METHOD

The study used qualitative research with ethnographic approach. Ethnographic research is also often referred to as field research. According to Lawrence Neuman, ethnography is the extension of field research. Meanwhile, according to Roice Singleton, ethnography provides answers to the question on what the culture of an individual group is. The qualitative research is used by the researcher in order to be directly involved in getting what information needs to be known.

The research instrument in the qualitative research with ethnography approach is the researcher himself/herself (human instrument) which means that the researcher acts as the main instrument that cannot be replaced by others. The role as the main instrument is setting the research focus, selecting the informants as data sources, collecting library data, interviewing, observing, and documenting.

Data analysis techniques were carried out by changing the data obtained from both the informants and those obtained by the researcher in the form of recordings or images into writing or report by selecting which data needed in the study.

3 FINDINGS AND DISCUSSION

3.1 The Area of Fort Rotterdam

Figure 1: The Area of Fort Rotterdam (makassar.tribunnews.com)

Fort Ujung Pandang which is now called as Fort Rotterdam was firstly established by the 9th King of Gowa, Daeng Matanre Karaeng Manguntungi Tumapparisi Kalonna, in 1545 (Natsir, 2017). The purpose of this establishment was to strengthen the base defense of Gowa Kingdom along the coast of Makassar in order to face the expansion of VOC power (the Dutch eastern company) that continues to expand its influence in the field of politics and economy in the eastern Indonesia.

When the Dutch conquered Gowa kingdom in 1667, Bungayya Treaty was made in which one of its contents was yielding Fort Ujung Pandang to the Dutch then it was further changed into Fort Rotterdam.

The total area of the building in Fort Ujung Pandang is 12.999,57 m^2. There are 15 buildings that were entirely built by the Dutch, and 1 building was built during the Japanese occupation.

Table 1: The Buildings at Fort Rotterdam

Building A-H	Building I-P
Building A It was a place to receive guests from Bone.	Building I It was built by the Japanese as the office of language and farming research. 
Building B The top part of it was used as a place of trade representatives and the bottom part of it was used as prison.	Building J It was functioned as the office for the bookkeeper. 
Building C It was functioned as the guest house for the guests from Buton. 	Building K It was functioned as city hall office. 
Building D The back was functioned as the hospital for the Dutch then changed as public building for the army. 	Building L It was functioned as prison. 
Building E It was the residence place for the leaders of trade and priest. 	Building M It was functioned as warehouse and trade office of the Dutch. 
Building F It was the residence place for the Dutch.	Building N It was functioned as the place for the guests from Bacan. 
Building G It was the place for carpentry.	Building O It was used as the governor office of South Sulawesi and its surrounding area.

	
Building H It was the place for the guests from Ternate. 	Building P It was a church. 

Nowadays, the buildings at Fort Rotterdam are partly functioned as the offices of Cultural Heritage Conservation Center of South Sulawesi and museum. One of them is building D and M which are functioned as the La Galigo Museum building. La Galigo museum has collections as many as about 4999 historical relics consisting of prehistoric collection, numismatic, foreign ceramics, history, manuscript, and ethnography. The ethnography collections consist of various kinds of technology results, arts, living equipment, and other objects created and used by four ethnics in South Sulawesi, namely, Buginese, Makassarese, Mandarese, and Torajaist. The museum also has the objects coming from the local kingdoms and the weapons that were once used during the independence revolution.

Table 2: Some Collections in La Galigo Museum

The Collection	Figure
Archipelago Collection: In the form of replica of some sites or cultural heritage in Indonesia and also the custom objects of the Archipelagic kingdom.	
Ceramic Collections: Consist of various kinds of ancient ceramics coming from different countries.	
Traditional Tools of Agriculture, Fisheries, and Marine: In the form of harvesting tools	
Bike	
Equipment of traditional weaving and fabric	
The Royal Seals of Bone Kingdom	

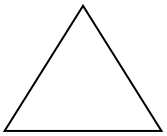
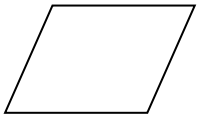
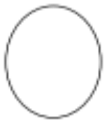
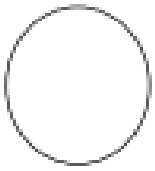
3.2 Geometry Learning Concept of Junior High School in the Historical Objects at Fort Rotterdam

The ethno-mathematics is one of the bridges that help the students in understanding the math lesson related to each local culture. The roles of ethno-mathematics also give positive impact on the development of math learning in Indonesia especially related to the learning media. The teacher can develop many ideas on utilizing learning media related to the students' daily lives, the more the students' experiences in understanding their cultures, the easier they understand the math concepts in their learning. Zayyadi (2017) states that to create a concept: it needs a number of experiences with the similarities. Those similarities are trusted as the initial concepts that can bridge the students' knowledge on the math concepts. One of the cultural inheritances that have the concept similarities with

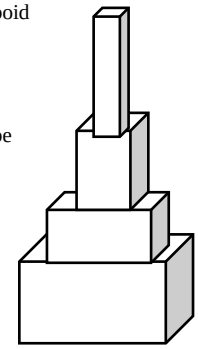
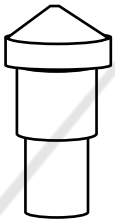
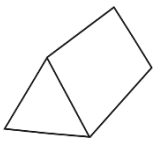
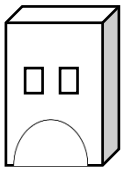
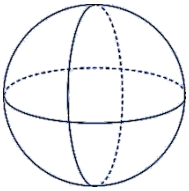
the math learning in Makassar, South Sulawesi are the buildings and the cultural objects in Fort Rotterdam. The similarities of buildings and the cultural objects can be used as the media in learning math especially related to the geometrical materials. The buildings and the cultural objects make the students easier in shaping the concrete initial concepts and make the students easier in constructing their understanding.

Based on the field observation result conducted at Fort Rotterdam on April 17th, it was found some building images and historical objects in La Galigo Museum and related to ethno-mathematics. It was found that there are a lot of historical objects that can be used as ethno-mathematics media. Some of them are inscription stone from Sri Sultan Hamengkubuwono, *Salokoa* (the Crown of Gowa Kingdom), bridal bracelets, *batik*, and harvesting tools. Those objects were then analyzed to get the representation of what kind of geometry concepts consisted in those historical objects. After being analyzed and taxonomy, it was found that the historical objects related to geometry concept are as follows:

3.2.1 Two-Dimensional Figure

No.	Object Images	Longitudinal section
1.	 Building O have similarities with several plane figure, namely rectangle, square and equilateral triangle.	Rectangle  Square  Equilateral triangle 
2.	 Epigraphy has similarities with one of plane figures such as parallelogram.	Parallelogram 
3.	 South Sulawesi's Batik has similarities with several plane figures, namely isosceles triangle and circle.	Isosceles triangle  Circle 
4.	 Phinisi miniature has similarities with several plane figure, namely Equilateral triangle and trapezoid.	Equilateral triangle  Trapezoid 
5.	 Ceramic as similarities with one of the plane figure such as a circle.	Circle 

3.2.2 Space Form

No.	Object Image	Longitudinal section
1.	Monument has  similarities with several geometry figure, namely cuboid and cube.	Cuboid Cube 
2.	 A similarities with several geometry figure, namely cone and cylinder.	Cone Cylinder 
	 The crown has similarities with several geometry figure, namelycone and cylinder.	Cone Cylinder 
4.	 Building P has similarities with several geometry and plane figure, namely prism, cuboid, rectangle and semi-circle.	Prism  Cuboid Rectangle Semi-circle 
5.	The Royal Seals has similarities with one of geometry figuressuch as sphere.	Sphere 

3.3 The Alternatives of the Historical Objects Use in Geometry Learning

Let's observe!


Figure 2. Building P


Figure 3. Monument


Figure 4. King Crown


Figure 6. Archipelagic


Figure 7. Fisheries

Pay attention to the images above!
Let's give question!
Based on some images that you have observed, make questions about space form!
Let's try it out!
Based on the questions that you have made, find a space form that is similar to the image! On your own opinion, what kind of the space form image it is?
Let's associate!
Based on the space form that you have mentioned, draw the longitudinal section of the image!
Let's communicate!
Make conclusion about the activity that you have done.
Let's think about!

The image above is one of the jewelries used by Buginese – Makassarese when conducting wedding ceremony. The bracelet is used hereditary by Buginese.
If it is assumed that the bracelet is similar to a space form, what kind of the space form if it? Please draw

the longitudinal section of it! Furthermore, if it is known that the bracelet height is 20 cm with diameter of 2 cm, determine the surface area of the bracelet.

Some of the above explanation shows that there is ethno-mathematics concept in the historical objects at Fort Rotterdam. The ethno-mathematics concept existing in those historical objects is seen on the shapes that resemble to the shapes of two-dimensional form and space form.

4 CONCLUSIONS

Based on the above several analysis and discussion, it can be concluded that there are ethno-mathematics concepts found on the historical objects at Fort Rotterdam such as: 1) two-dimensional form: parallelogram, triangle, isosceles triangle, circle, rectangle, and trapezoid, 2) space form: cube, beam, tube, cone, pyramid, and ball, 3) the historical objects that resemble the two dimensional forms and the space forms can be used as knowledge bridge in learning math. By using learning based local culture, the learning activity in the classroom will be more meaningful and interesting because the learning comes from the local knowledge so that the students are easier in understanding the abstract math to be more concrete.

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