The role of ethnomathematics in West Java
(a preliminary analysis of case study in Cipatujah)

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Abstract. Indonesia is a multicultural country of which people usually do anything influenced by their culture. The culture contain of many aspects, one of them is ethnomathematics. It is a study about the connection between culture and mathematics concepts. It also reveals mathematical practices of day life. These mathematical practices could be seen at Cipatujah, West Java, Indonesia. It has several ethnics which implemented of ethnomathematics in their life, for example they implement traditional mathematical concept in the way they determine the time to head seaward for fishing, and the way they construct their houses. The exploration will describe about how deep is the role of ethnomathematics in Cipatujah and state any problem found according to the exploration result. The objectives of this study is to show that ethnomathematics holds an important role in our day life, with the case study of primary school students and for the people of Cipatujah. The method which implemented in this study is exploratory. The result is the people of Cipatujah have been implemented ethnomathematics in their life for many years and believe that ethnomathematics is part of their life, but the teachers of primary school there have not implemented ethnomathematics approach yet in learning process of mathematics. Conclusion of this study is ethnomathematics as the root of culture life in West Java.

1. Introduction

Indonesia is rich of ethnic which influences the lives of its inhabitants. They implement the culture into everyday life. West Java is one of the areas in Indonesia that contain a variety of ethnic characteristic and ethnomathematics is part of the ethnics. Ethnomathematics is the relation between culture and mathematics [3].

Most people (including students) thought that mathematics is simply a set of concepts or formulas that are not related to their daily lives, and this affects the interest of students to learn mathematics more deeply. Actually, their opinion is wrong. The reality is mathematical concepts unwittingly have relevance to everyday life for many years. That means, culture and mathematics have a strong bond. This paper will discuss how the ethnomathematics role in the lives of people from West Java, with the case of the elementary school students and inhabitants in Cipatujah.
1.1. Ethnomathematics

As it grows, there is some definitions of ethnomathematics proposed by the observer of mathematics education in the world, D’Ambrosio [3] suggested that ethnomathematics is mathematics applied in cultural groups. The opinion was supported by Lee [2] that ethnomathematics is a concept to increase knowledge about the development of mathematics in different cultures around the world. Other statement revealed that ethnomathematics is the way in which people of diverse cultures when using mathematics in everyday life [3] and there is another opinion that states that ethnomathematics is a study that relates between mathematics (and math education) with a cultural background, covers the mathematical concepts generated, transferred, and how mathematics to blend into different culture system [15].

From some of those opinions, it can be concluded that ethnomathematics is a concept, knowledge, study, or approaches that associate mathematics with culture. The correlation can be viewed from various aspects, including:

(i) How a society / particular culture use mathematics in everyday life.
(ii) Mathematical concepts contained in a culture.
(iii) How to teach mathematics adapted to the local culture and the unique character of their students.
(iv) How deep mathematics blended to the local culture.
(v) Mathematical activities which have done by locals.

D’Ambrosio [3] suggested that ethnomathematics bring harmony in human behavior, and between humans and nature. It is based on the ethics of diversity:

(i) Respect
(ii) Solidarity
(iii) Cooperation

According to Francois [5], expanded of the use of ethnomathematics corresponding to the cultural diversity of students and with mathematics in their daily practice of bringing mathematics closer to students environment because ethnomathematics implicitly is a program or activity that delivers the values in mathematics and mathematics education.

Adopting ethnomathematics into mathematics learning activities is something that is feasible [4]. In fact it can also be used as an alternative ethnomathematics learning of mathematics [13]. Those opinions could be an inspiration for practitioners in mathematics education to apply ethnomathematics in learning activity.

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1.2. Culture in Cipatujah

Cipatujah is sub area of Tasikmalaya, West Java, with a population of 54766 inhabitants. Situated on a plateau and has some beautiful beaches. The name ”Cipatujah” comes from the name of the river Cipatujah which means "hit each other". This illustrates that the river flows into the south coast sea. Most residents of Cipatujah are farmers and fishermen. After working all day, they would gather at night in a place called saung. The building is made of bamboo and palm trees. In textitsaung, they do discussion between inhabitants and indigenous leaders, and children play traditional instruments from bamboo called textitcalung renteng. There are cultural arts performances and a parade in Cipatujah which held on every December 31th.
1.3. Ethnomathematics in Cipatujah

Inhabitants of Cipatujah still adhere to their ethnic and believing it. The ethnic influence whatever they do in everyday life. With regard to ethnomathematics, they use unique tools that are typical for the dating system called tunduk (kolenjer). Based on their beliefs, they can be used to specify the month, day, and to predict the fate of life. Tunduk made of wood sized 6x25 cm and marked by several lines and dots on its surface. There are three types of tunduk by function, namely:

(i) **Tunduk indit-inditan** is used to determine the good days and directions to guide someone who will do traveling.

(ii) **Tunduk durujana** is used to find the thief or someone who has done bad things to inhabitants of Cipatujah.

(iii) **Tunduk bajo** is used to attack strangers who interfere to inhabitants of Cipatujah.

Tunduk is an important tool for inhabitants of Cipatujah, because the system is calculated based on their culture. In addition to these tools, they use some particular terms in the calculation systems (as unit of measure), as follows: Jengkal, Jenjeuh, Sasiku, Sadepa, Satuur, Satangtung, Sadampal.

Those terms are used to calculate the length and inhabitants of Cipatujah never use centimeters, meters, and other units of measure in their daily lives. For measuring the weight, they used to utilize traditional tools made of stone and rope, called dapon or kasungka.

1.4. Ethnomathematics in Mathematics Learning

Ethnomathematics is an important part of mathematics education, where a math teacher demanded to be more creative and innovative to see or "capture" mathematical ideas contained in a local culture, and apply learning approach in accordance with the unique character of the students based on the particular culture. Ethnomathematics is good to be developed as it has some usefulness as follows:

(i) Sharpen the sensitivity of students.

(ii) Instill a sense of awareness of students.

(iii) Digging math concepts that inherent in a culture.

(iv) Associate mathematical concepts with the culture, therefor it will make the students more appreciate the culture of their nation.

In addition to the aspect of the local language, community activities and objects used in everyday life, ethnomathematics may contain of philosophies believed by certain communities, which can be implemented in mathematical story problems.

Learning ethnomathematics divided into three parts [14], namely:

(i) Learn about the culture, placing culture as a science. The process of learning about the culture has been studied directly by the students through the subjects of arts and crafts, art and literature, painting and drawing. Cultural subjects studied in a particular culture to culture. Product prevailing culture in a society can be used as a method of solving mathematical problems.

(ii) Learn by the culture. Learning by the culture for students include the benefit of various forms of cultural manifestation that becomes learning media or context in learning process in the classroom.

(iii) Learning through the culture. Learning through the culture for students is provided an opportunity to demonstrate achievement of understanding or meaning is created in a subject through a variety of cultural manifestation.
Learning mathematics by using ethnomathematics has some benefits [14], includes:

(i) Their misconceptions in mathematics and is still ongoing, therefore there is a belief that mathematics will be taught effectively and meaningful by relate it with the culture [4].
(ii) To affect how students think about math, not how or what they will learn [2].
(iii) Respect other students who have different cultures with them [6].
(iv) Teaching basic education would be more effective and meaningful if it starts from the socio-cultural context for students, in order to students could recognized it easier [9].
(v) Constructing on students knowledge by bringing culture and their history in order to promote the values and culture [7].
(vi) The development of positive attitudes towards mathematics [12].
(vii) Reduced the abstract nature of mathematics learning [1].
(viii) Bring up the emotion in learning, motivation, spiritual awareness and cultural identity [10].

2. Methodology

The method used in this study is exploratory. The goal is to gather information, to describe circumstances / facts and the specific character of the population. The subjects were 25 students of the 5th grade, 5 teachers at Primary School in Cipatujah, and inhabitants of Cipatujah. The procedures of this study are as follows:

(i) Planning Phase
   (a) Preliminary Study: formulating problems and objectives, it is ethnomathematics in Cipatujah.
   (b) Literature: finalize the concept; they are ethnomathematics and culture of Cipatujah.
   (c) Framing of research instruments: to make the questionnaire for inhabitants of Cipatujah (for information on the application of ethnomathematics in everyday life in Cipatujah) and the questionnaire for the 5th grade students and teachers of primary school in Cipatujah (for information on implementation of ethnomathematics approach in learning process of mathematics).

(ii) Data Collection Phase
   (a) Observing the daily activities that carried out by inhabitants of Cipatujah, which apply ethnomathematics.
   (b) Conducting interview to several inhabitants of Cipatujah, regarding to the implementation of ethnomathematics in their daily lives.
   (c) Conducting interview to the 5th grade students and teachers of primary school in Cipatujah.

(iii) Phase Analysis
   (a) Processing data of observations results and interviews.
   (b) Make a conclusion.

3. Main Result

Cipatujah is one area in West Java that has a unique culture. Inhabitants of Cipatujah do many things in everyday life by adhering to the culture they believe. Unwittingly, they use the basic concepts of mathematics in various activities such as in trading, farming, fishing and building a house. There are some basic concepts of mathematical calculations are usually carried out by inhabitants of Cipatujah for many years, that will be discussed.
3.1. Time Calculation Rules of Farming in Cipatujah (Pranata Mangsa)

Because most inhabitants of Cipatujah are farmers, then they do account when the right time very carefully to start planting and harvesting. Cipatujah society have known the term prananta mangsa, means the time calculation rules. According to indigenous leaders, inhabitants of Cipatujah divide it into two types of mangsa. The first mangsa, divided into 8 mangsa, which is used to ngahuma (term in farming, which means it is growing rice in a field or on dry lands). The second mangsa, consisting of 12 mangsa, which is used to nyawah (term in farming, which means it is growing rice in the fields or in wet lands). Each time of mangsa is divided into two periods, namely:

(i) mangsa panas bumi (It's not time to grow rice), starting from mangsa 1 to mangsa 3.
(ii) mangsa tiis bumi (it's time to plant), starting from mangsa 4 to mangsa 8 or mangsa 12.

mangsa 4 is transition mangsa from mangsa panas bumi to mangsa tiis bumi.

Here are the divisions of the first kind of mangsa:

(i) Mangsa hiji : state of the earth/ soil is getting hottest.
(ii) Mangsa dua and mangsa tilu : state of the earth is still hot. In these circumstances, any crop planted will die, although it has been raining.
(iii) Mangsa opat : state of the earth is getting cold, is characterized by appearance of buds of leaves on each plant.
(iv) Mangsa lima : state of the Earth is cold, is characterized by already verdant foliage.
(v) Mangsa genep : state of the Earth is still cold.
(vi) Mangsa tujuh : this mangsa is in extreme cold, and usually characterized by appearance of the grass in the fields.
(vii) Mangsa dalapan : on this mangsa, the rain rarely falls.

Pranata mangsa 12 times in a year are presented in the following table 1

3.2. Calculation of Repok

In everyday life, especially on marriage, inhabitants of Cipatujah usually do calculation of repok that aims to avoid their life from the altercation which begins from disputes in marriage.

Here is the standard of calculation of repok:

(i) Alphabet: H = 1, D = 6, P = 11, M = 16, N = 2, T = 7, D = 12, G = 17, C = 3, S = 8, A = 13, B = 18, R = 4, W = 9, Y = 14, T = 19, K = 5, L = 10, NY =15, NG = 20
(ii) Day of birth: Monday = 4, Tuesday = 3, Wednesday = 7, Thursday = 8, Friday = 6, Saturday = 9, Sunday = 5
(iii) Conclusion of the results of calculation (based on the rest of numbers after deducting 7 / based on modulo 7)

(a) Pisang punggel = less good
(b) Lumbung gumuling = less good
(c) Tunggak kasemi = less good
(d) Satria lalaku = good
(e) Sangga waringin = good.
(f) Padaringan kebek = good
(g) Ratu sabdaning pandita = good

Most of the calculation on these findings has similarity to Mustapa [11]. For example:
A man named Rosadi (born on Sunday) and a woman named Sarinah (born on Wednesday), they come from the village Sindangkerta, Cipatujah, and then the calculation is as follows:
### Tabel 1 Pranata Mangsa 12 times in a Year

| NO. | MONTH OF HIJRIYAH | MONTH OF MASEHI | NAME OF MANGSA | SUM OF DAYS | CHARACTER |
|-----|------------------|-----------------|----------------|-------------|-----------|
| 1.  | Sawal            | 22nd Jun - 2nd Aug | I              | 41          | starts to plant palawija |
| 2.  | Hapit            | 2nd Aug - 25th Aug | II             | 24          | to plant second palawija |
| 3.  | Haji             | 25th Aug - 18th Sep | III            | 24          | time for harvest palawija |
| 4.  | Muharam          | 18th Sep - 13th Oct | IV             | 24          | time to plant bananas |
| 5.  | Sapor            | 13th Oct - 9th Nov | V              | 27          | rainy season |
| 6.  | Mulud            | 9th Nov - 22nd Dec | VI             | 44          | working in the fields |
| 7.  | Silih Mulud      | 22nd Dec - 3rd Feb | VII            | 42          | windy season |
| 8.  | Jumadil Awal    | 3rd Feb - 1st Mar | VIII           | 26          | bulging rice |
| 9.  | Jumadil Ahir    | 1st Mar - 26th Mar | IX             | 25          | blooming rice |
| 10. | Rajab            | 26th Mar - 19th Apr | X              | 23          | to plant palawija on the land |
| 11. | Rewah            | 19th Apr - 12th May | XI             | 24          | there are a lot of birds |
| 12. | Puasa            | 12th May - 22nd Jun | XI             | 41          | very cold morning |

Hijriyah is tentative, and masehi is permanent.

- Ro-sa-di = 4 + 8 + 6 = 18; Sa-ri-nah = 8 + 4 + 2 = 14; So 18 + 14 = 32
- Because based on modulo 7, the rest of 32 is 4, so its included in satria lalaku (at good category)
- Next, added by sum of both peoples days of birth, are 12.
- So 12 + 32 = 44; then 44 - 32 = 12; then 12 - 7 = 5; so its include in sangga waringin (at good category).
- Because Sin-dang-ker-ta = 8 + 6 + 5 + 7 = 26; and based on modulo 7 the rest is 5, so its included sangga waringin.
- The conclusion based on the calculation is Rosadi and Sarinah will avoid the altercation in their marriage.

According to previous discussion, it showed that inhabitants of Cipatujah involve the basic concepts of mathematics in any activities in their daily life. In other words, ethnomathematics hold an important role in cultural life in Cipatujah.

#### 3.3. Primary School Mathematics Learning in Cipatujah

Based on interview result of 25 students of 5th grade and 5 teachers of public primary school in Cipatujah, obtained the following information:

(i) According to the students:
• Mathematics is a difficult subject to understand.
• Learning mathematics in the classroom is less attractive for them.
• Mathematics is not related to their daily lives.
• Mathematics is not related to their culture.
• Mathematics is not useful in real life.

(ii) According to the teachers:
• It is difficult to make students understand mathematics.
• It is difficult to make students interested in mathematics learning.
• Mathematics learning in the classroom usually uses direct learning/expository method.
• Lack of props (i.e. real objects) that can allow students to understand math concepts easier.
• They have never implemented ethnomathematics approach in mathematics learning.

Based on these descriptions can be said that need to do some efforts to make the students can be more interested in mathematics learning, and in order to the students also assume that mathematics is related to their culture and can be applied in everyday life. If ethnomathematics approach implemented in mathematics learning, then the culture will indirectly be maintained.

4. Conclusion
In daily life, inhabitants of Cipatujah still hold on their culture and involving ethnomathematics in performing some rituals based cultures such as the calculation in the use of *tunduk*, prananta mangsa, and calculation of *repok*. Most of Cipatujah cultures have in common with sudanese basic culture on other areas in West Java, but Cipatujah has differences in *prananta mangsa* which dividing of each *mangsa* into 2 parts, *mangsa panas bum* and *mangsa tiis bum*.

The 5th grade students of primary school in Cipatujah feel that the mathematical concepts taught in the classroom is not related to everyday life and it made them think that mathematics is not interesting (although any of them get good score on math). However, according to the observation, the teachers of primary school in Cipatujah have not yet formally implemented ethnomathematics approach in learning process of mathematics (means, it has not been included in the current curriculum).

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