The ethnomathematics in making woven bamboo handicrafts of osing community in Banyuwangi, Gintangan village as geometry teaching material

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Abstract. Ethnomathematics refers to the application of mathematics in cultural life. This research was intended to describe the ethnomathematics in making woven bamboo handicrafts in Gintangan village, Banyuwangi. The things obtained in this research were the changes in of geometric teaching material, covering Test Problem Package with Ethnomathematics as the topic. The type of this research was qualitative research with ethnographic approach. The data collection methods used were observation and interview. The subjects of this research consisted of 2 persons; they were foremen who made the woven bamboo handicrafts, kukusan, ereg, tenong and nyiru. Ethnomathematics emerged when the woven craftsmen carried out the activities to measure, calculate and design. When the process of measuring the thickness of the bamboo whittles came, the measurement concept was meters (m). During the process of calculating the drying time of bamboo and the amount of bamboo whittles, comparative concept of value appeared. During the design process, the concept of quadrilateral and number sequences emerged. The result of this research was geometry teaching material in the form of test package. The question of test package was pointed for the students of class VIII at middle school. The question of Test Package covered 4 C5 and 1 C6 questions.

1. Introduction
Indonesia is one of the largest archipelago countries in the world with five large islands and has more than seventeen thousand islands[1]. The diversity of Indonesian culture covers language, ethnicity, religion, culture, activity or custom, song, dance, and others[2]. One of tribes in Indonesia that possesses variety of cultures is Osing tribe. Osing tribe is an ancient Javanese tribe which is a native of Banyuwangi regency. As an agrarian society, Osing tribe adheres to traditional institutions that become ancestral testaments, it is related to individual life cycle and social sphere [3], One example is the relationship between the activities of woven bamboo craftsmen including kukusan, ereg, tenong and nyiru and mathematics.

The relationship between the activity and culture with mathematics is called ethnomathematics. Ethnomathematics are defined as habit used by a cultural group in mathematical activities. Mathematics is one of the subjects playing an important role in the world of education as it is one of the basic sciences in various disciplines that develops human thinking [4]–[7]. Mathematics is actually used by everyone. Mathematics and its learning make the property of
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2. Research Method
The research method used was qualitative with ethnographic approach. Qualitative research is a research method used to examine the natural object conditions, in which the researcher becomes a key instrument, data collection, data analysis that is inductive, and the results of research emphasizing the meaning rather than generalization [10]. Ethnography is defined as the study of life and culture of a society or ethnicity, for instance are custom, habit, law, art, religion, and language [11].

The data collection methods used were observation and interview. This research took place in Gintangan Village, Banyuwangi Regency, East Java, Indonesia. The research subjects were woven craftsmen who lived in the area. They were 2 people who worked at the craft place. People in the village of Gintangan did activities almost every day at the craft place. The environment in the village was also very good as a place to make woven bamboo handicrafts; therefore their handicrafts were quite varied.

The preliminary stage was done by determining the topic, area, and subject of the research. During the data collection method, observation and interview were carried out. The instrument validity test on the observation and interview was carried out by two mathematics education lecturers. After being validated, the observation guidelines were declared valid with the score of 2.8 while the interview guidelines were declared valid with the score of 2.75 then it was proceed to the next stage. The data collection method was done by observing the making of woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru* and interviewing the craftsmen. This research was conducted to obtain the data in accordance with the objective. The data analysis stage was grouped with the results of the research, and then the data were arranged according to the focus of the research problem and the research objective, which was to find out the mathematical elements found in the manufacture of woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru*. At the conclusion stage, the researchers drew conclusion from the results of data analysis referring to the formulation of the problem. At the stage of making geometry teaching material in the form of the question of test package, the preparation of questions was conducted based on the results of observation on the process of making woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru*. This teaching material were intended for the seventh grade students who live in Banyuwangi Regency.

3. Result and Discussion
Based on the observations on the making of woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru* and interview with two research subjects, there was ethnomathematics occurred in the process of making woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru*. Ethnomathematics that occurred in the making of woven bamboo handicrafts covering *kukusan*, *ereg*, *tenong*, and *nyiru* were based on the mathematical concepts namely the comparison of values and row numbers. This article focused on ethnomathematics in the making of woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru*. Based on the results of research on the process of making woven bamboo handicrafts including *kukusan*, *ereg*, *tenong*, and *nyiru*, ethnomathematics was obtained which included counting, measuring and
designing activities. Based on observations and interviews of the two research subjects, there was ethnomatematics appeared in the manufacture of woven bamboo handicrafts including counting, measuring, and designing activities. Ethnomatematics first appeared in counting activity. The craftsmen determined the time in the process of drying bamboo using a reference day that took approximately 1 day to dry the bamboo. Ethnomathematics appeared when craftsmen used the reference of the day in determining the process of drying bamboo, appeared mathematical concepts that was proportional relationship. The thicker the bamboo whittles, the time needed to dry bamboo was also relatively long, and vice versa, if the bamboo whittles was getting thinner, then the time needed to dry the bamboo whittles was also relatively fast. The second ethnomathematics was also seen when counting activities. The woven bamboo craftsmen when determining the amount of bamboo whittles for the *kukusan* based on the load and *itukan*, while for *ereg, nyiru, and tenong* the craftsmen used a diameter reference. Ethnomathematics appeared when craftsmen used the load reference or *itukan* on the *kukusan* and when using the diameter reference on *ereg, nyiru, and tenong*. In determining the amount of bamboo whittles on the *kukusan, ereg, nyiru, and tenong*, appeared a mathematical concept that was proportional relationship. The greater the load and diameter, the more bamboo whittles were needed, and vice versa, the smaller the charge and diameter, the less bamboo whittles were needed. Other ethnomathematics arose when craftsmen determined the type of bamboo that was good for making woven bamboo handicrafts. In this activity ethnomathematics arose when determining the type of bamboo that was good was the concept of measurement in the cylinder chamber. From the two research subjects it was obtained that bamboo is a structure which resembles the construction of a tube chamber.

Ethnomathematics appeared in figure 1 when the woven bamboo craftsmen determined the bamboo thickness/thinness in the process of bamboo whittling especially on the woven of *kukusan, nyiru, ereg, and tenong* when measuring the size of bamboo whittles. In measuring the size of bamboo whittles, volume concept appeared. Therefore, the thickness of each bamboo whittle of woven bamboo craft obtained 1.5 mm and 2 mm respectively.

![Figure 1. Determining the thickness/thinness of Bamboo whittle](image1)

Ethnomathematics in figure 2 of measurement activity appeared when the woven bamboo craftsmen determined the type of good bamboo to make a woven bamboo handicrafts (*kukusan, nyiru, ereg, dan tenong*), measuring the thickness/thinness of the bamboo in the process of bamboo whittling. The mathematics concept appeared was measurement concept. In this case, each measurement was adjusted to the measurement to be made.

![Figure 2. Slicing Bamboo](image2)

Ethnomathematics in figure 3 of design activity emerged when the woven bamboo craftsmen made the pattern of woven bamboo. In this activity, the woven bamboo craftsmen designed the
pattern of woven bamboo handicraft based in the size of the bamboo whittle. Based on the result of the observation, it was known that the pattern used was quadrilateral woven pattern had different thickness level. Kukusan and nyiru had thickness of about 1.5 mm, while ereg and tenong had thickness of 2 mm. Ethnomathematics in figure 4 when the woven bamboo craftsmen determined the pattern of woven handicraft pattern of kukusan, nyiru, ereg, and tenong by using the concept of rectangular flat shape. In the pipil pattern, there was a distance of each bamboo whittle and after kukusan and ereg woven bamboo handicrafts formed, there was a quadrilateral shape namely square, while in liris pattern there was no distance or it can be said that it was tight and after nyiru and tenong woven bamboo handicrafts formed, there was a quadrilateral shape namely square.

Figure 3. Making Woven Pattern

(a) Woven Nyiru

(b) Woven Tenong

(c) Liris Pattern or 2-2

Figure 4. A Woven with Liris Pattern

(a) Woven Kukusan

(c) Pipil Pattern

(b) Woven Ereg

(d) Combined Pipil Pattern (2-2) and Liris Pattern

Figure 5. A Woven with Pipil Pattern and the combination of Both Patterns

Ethnomathematics recognized in calculation activity could be related to the research done by Ratuanik & Kundrez. Calculation activity done by Ratuanik & Kundrez covered the calculation
of drying time of bamboo whittling. In this research, ethnomathematics emerged when the craftsmen determined the drying time of bamboo in one day and the number of bamboo whittle [9]. The way the woven craftsmen determined the dry level of bamboo whittle was various by using hour or day reference, if the weather felt to be quite hot, the craftsmen needed relative short drying time of 5-6 hours. If the weather was less hot, the craftsmen could have drying time of one day. Besides, the duration determination of bamboo drying time could be seen from the bamboo whittle thickness/thinness. This showed that the two research subjects used hour/day units in the activity of bamboo whittle drying process. In this activity, the direct proportion concept appeared, in which the thicker the bamboo whittle, the longer the time needed to dry it and vice versa. In addition, the craftsmen of woven bamboo handicrafts determined the number of the used bamboo whittle to make kukusan, ereg, tenong, and nyiru woven through a special way or reference especially for kukusan woven. In determining the number of bamboo whittles in kukusan woven, the craftsmen used load per kg reference. The bigger the shape of the kukusan woven, then the more bamboo whittle needed and the smaller the shape of kukusan woven, then the less bamboo whittle needed. To tenong, ereg, dan nyiru woven, the craftsmen looked at its diameter to determine the number of bamboo whittle needed. The diameter of the three woven was big so the total of bamboo whittle needed was more.

Ethnomathematics in the activity of measurement emerged in some activities of woven bamboo craftsmen. In this activity, it can be related to the research conducted by Ratuanik & Kundre. The measurement activity conducted was measuring the length of bamboo and the thickness/thinness of the bamboo whittles [9], [12]. In this research, ethnomathematics in measurement activity appeared when stating the thickness/thinness of bamboo whittle. The activity of measuring the thickness/thinness of bamboo whittle carried out by a craftsman by stating in the form of millimeters (mm) which were 1 mm, 1.5 mm, and 2 mm. In measuring the thickness/thinness of the bamboo whittle from the two research subjects there were no differences in terms of measurement. However, each bamboo craft had different thickness level. Kukusan and nyiru had a thickness of approximately 1.5 mm, while ereg and tenong had 2 mm of thickness.

Ethnomathematics in the designing activity emerged in various activities of woven bamboo craftsmen. The designing activity done by Ratuanik & Kundre and Puspawedi was when the craftsmen determined the pattern of woven bamboo handicrafts[3],[9]. In this research, Ethnomathematics occurred when the woven bamboo craftsmen made the pattern of woven bamboo handicraft and determined the form of its bamboo handicraft especially crafts of kukusan, ereg, tenong, and nyiru.

When making the pattern of woven bamboo handicraft, the craftsmen used pipil motif on the kukusan and ereg crafts. Due to adjust with the function of kukusan and ereg crafts itself. The craftsmen also used liris pattern or motif on the nyiru and tenong crafts. This was also due to adjust with the crafts itself. In addition, there were uniqueness found in kukusan and ereg crafts. In these handicrafts, it found the combination patterns between pipil and liris patterns. The aim of pipil pattern made in both handicrafts due to adjust with the functions, while the aim of liris pattern made in kukusan and ereg crafts used to stick the final results of the crafts. Liris pattern in both handicrafts lied on the tip of the handicrafts. In this activity, the woven bamboo craftsmen did not use any references to make the pattern of the handicrafts.

4. Conclusion
Ethnomathematics in the activities of woven bamboo craftsmen done by Osing community in Gintangan village Banyuwangi. Ethnomathematics in the activities of calculating of emergence when the woven bamboo craftsmen determined time at the process of drying bamboo and determined the number of bamboo whittles to be used to make the handicrafts. In these activities, there was a concept of mathematics that was proportional relationship.
Ethnomathematics in the activities of measurement occurred when the woven bamboo craftsmen determined the kind of bamboo and the thickness of bamboo whittle. In determining the good type of bamboo and the thickness/thinness of bamboo whittle, the tools used were knife and gauge. In these activities the mathematical concept appeared that was measurement. Ethnomathematics in designing activities emerged when farmers made the pattern of woven bamboo handicrafts. When making the patterns of kukusan and ereg crafts, the woven bamboo craftsmen used pipil motif or pattern that were one-by-one or had a distance between the bamboo whittle to be made into a craft. In addition, the woven bamboo craftsmen also used liris motif or pattern in the making of nyiru and tenong crafts. Liris pattern was the pattern in which each of these patterns had no distance between the bamboo whittles. The making of these handicrafts patterns were related to the concept of flat shapes and geometric shapes as well as quadrilateral shape.

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