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Exploring ethnomathematics in Central Java

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Exploring ethnomathematics in Central Java

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Abstract. This research was intended to: (1) explore the forms of ethnomathematics and (2) analyze the integration of ethnomathematic at elementary and intermediate educations. This research used surveys as the main method. The data were collected by means of questionnaires, observations and documentation as well as literature reviews. The data were then analyzed descriptively and qualitatively. The analyses showed the following results: (1) ethnomathematics within the cultures of communities in northern coastal areas of Java Island were in the forms of: (a) cultural buildings (Menara Kudus), (b) non-cultural buildings, traditional foods and (c) batik motifs, and (2) various forms of ethnomathematics in the communities studied relate to the concepts of mathematics that they could be integrated into mathematic learning-teaching activities both in elementary and intermediate levels.

1. Introduction

Ethnomathematics, which relates closely with daily matters in the society, was explored within the RME (Realistic Mathematical Education). This is in line with Freudental and Gravemeijer views, stating mathematics as human daily activities [1]. According to Freud [2], mathematics should be connected to reality, close to children and relevant to the societal daily life. This point of view involves mathematics not only as a subject, but also as human activities closely related to the local cultures.

Gravemeijer [3] described the uses of real cases (contextual problems), which are very significant within the RME. Real cases are intended to support the processes of reinventions, which may encourage students to solve mathematic-related cases by using formal mathematics. By using RME, it is hoped that students will be able to solve mathematical problems. This research focused on various forms of ethno-mathematics which develop in the cultures of communities in Northern Coastal Areas of Java.

Masingila & King [4] stated: "Ethnomathematics refers to any form of cultural knowledge or social activity, characterizing a social or a cultural group, as a mathematical knowledge or activity". [5] Bishop pointed out that all formal mathematical educations constitute a cultural interaction process in which every student experience the culture within the process. Therefore, formal education for mathematics could not be separated from various cultural phenomena surrounding it. Freudenthal [6] stated: "Mathematics must be connected to reality" (Mathematics should be close to the learners and connected to daily life situations).

Schoenfield [7, 8] pointed out as follow: "The world of mathematical culture would encourage students to think of mathematics as an integral part of daily life. It would improve the abilities of students to make relationships among mathematical concepts in different contexts and to develop understandings, by solving various mathematical problems both individually and collectively, within their own surroundings.

2. Methods

This research used surveys conducted in several cultural sites in Northern Coastal Areas of Java. The locations and the study subjects were selected purposively. The surveys consisted of literature studies, field data collections, data descriptions and data analyses in factual models. This research took several real field activities as follow: (1) explore the forms of ethno-mathematics and (2) analyze the integration of ethnomathematic-based RME at elementary and intermediate education processes.

The needed data were collected by means of questionnaires, observations, documentation and literature reviews. These techniques for data collections were complementing one among the other. The data were then analyzed both descriptively and qualitatively.

3. Results and Discussions

This research has identified various forms of ethnomathematics in the study locations and then integrated them, through real case situations, into mathematical learning-teaching activities both in elementary and intermediate levels. Several cases relating to the square areas of cube, prism and tube surfaces were solved using Polya steps.

3.1. Rectangles

Most of residents of Talang District, Tegal Regency, are known for their skills in producing fences, one of which is showed in Figure 1. The fence in the figure, in the form of a 2m x 1m rectangle, is made from iron bars. When an individual produces the fence, what length of iron bar is needed?

Figure 1. Fence

Figure 2. Shipyard

3.2. Parallelograms

In Tegal, there is a plant for producing workshop for seep docking as shown in Figure 2. The crane is lifting an iron construction in the form of a parallelogram.

3.3. Rhombuses

Most of the residents of Debong District, Tegal Ragency, are hand crafters of batik. One motive for the Tegal batik is in the form of rhombuses as shown in Figure 3.

3.4. The square area of Cubes

Many traditional fishermen from Tegal use ‘lukah’ for fishing. This lukah is in the form of a cube and caught only small fishes. See Figure 4. The figure is a cube and one of its faces. To find the square area of the whole cube means finding out the square areas of the cube faces. Every face of the cube is in the form of a square (Figure 6).

Figure 3. Batik Tegalan

Figure 4. Lukah

Figure 5. Gubug

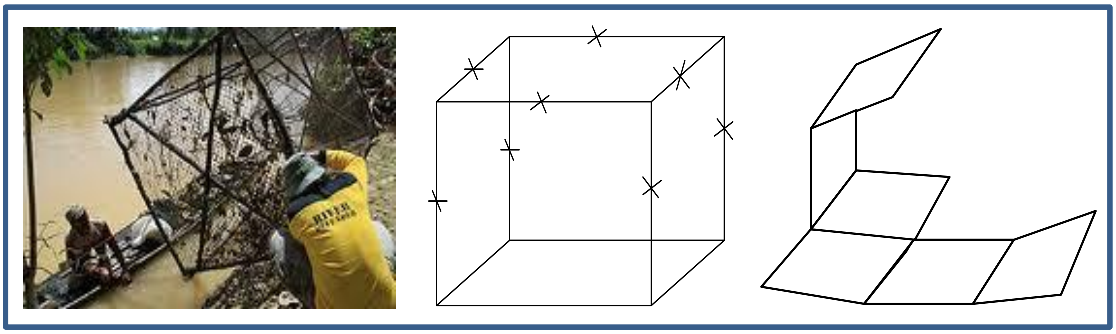

Figure 6. Square area of Cubes

The numbers of the cube faces are 6
The square area of every face is …, therefore
The square area of the whole cube is …

3.5. The square area of Prism

3.5.1. Case-1

In nearly all areas in Pati, there is always a small cottage in the middle of the rice filed. The cottage is used as a shelter from the sunshine and at the same time as a resting area (see Figure 5). The roof of the cottage is in the form of a prism (Figure 7).

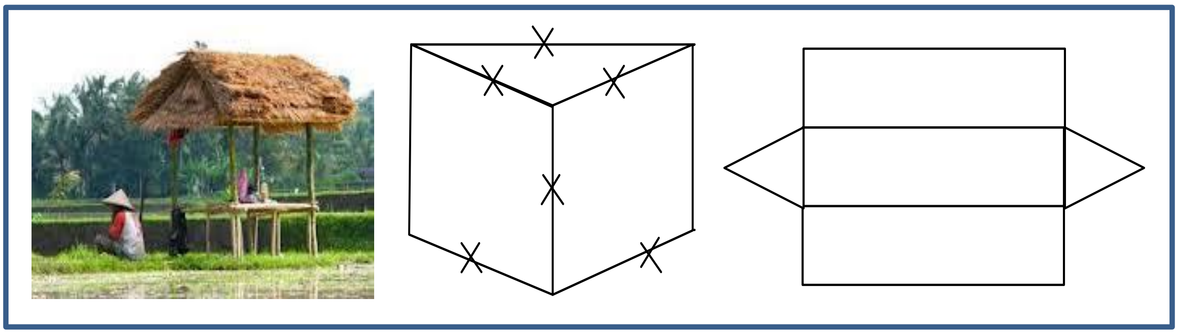

Figure 7. Square area of Prism

The square area of the whole prism = the square areas of the 2 triangles + the square areas of the 3 rectangles = 2 x … + 3x …

3.5.2. Case-2

Samin village is a very pure area in Pati. Cultures and modern developments from outside world could hardly enter into the village. Houses in this village are pure and original, one of which is shown in Figure 8. The roof of the house is in the form of a triangle prism. If the base of the prism is a symmetrical triangle with its side of 6m length and the height of the prism is 8 m, calculate the square area of the whole prism!

Figure 8. Houses of Kampung Naga

Figure 9. Getuk Lindri

Figure 10. Kudus Tower

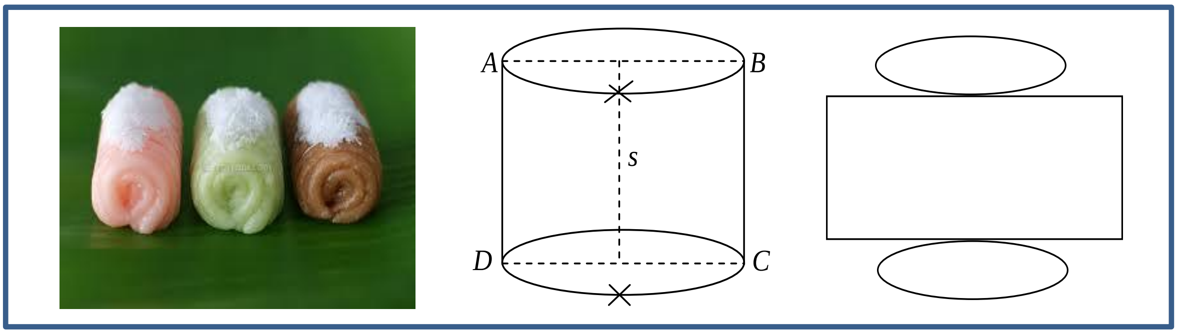

Figure 11. Square area of Cylinders

Solution:

1. Understanding the problems

   Known: a triangle-prism roof, the base of the prism is a symmetrical triangle with its side is of 6m length, the height of the prism is 8m,

   Problem: what is the square area of the whole prism?

2. Planning a solution

   Because the base of the prism is a symmetrical triangle with its side of 6m length and the height of the prism is 8m, the square area of the whole prism is: *2 x the square area of the base + 3 x the square area of the rectangle (there are 2 bases and 3 rectangles)*

3. Implementing the solution as planned

   The square of the whole prism is: 2 base square areas + 3 rectangle square areas, or 2 (1/2 base x height) + 3 (length x wide) = 79.14

4. Checking out what have been done.

The square area of the whole prism is 79.14 m^2

3.6. The square area of Cylinders

One special traditional paste of Central Java is getuk lindri, which can be found in most traditional markets. Getuk lindri is very nice when it is consumed together with a cup of coffee. Getuk lindri can be identified as a cylinder (see Figure 9). The square area of the whole cylinder. See Figure 9.

The square area of cylinders

= square area of the base + square area of the top + square area of the body, or

= … + … + …

= …

3.7. Sinus Rules

Menara Kudus (Kudus Tower) was built in 956 H by Sheikh Jafar Shodiq (Sunan Muria), one of great wali spreading Islamic teachings in Java Island. Menara Kudus is located in Kauman village, about 1.5 km outside the Kudus City. Look at Figure 10. The Tower is in the form of a flat triangle. When a, b and c are the sides of the ABC triangle, then sinus formula can be used for finding out the square area of the triangle.

$$\Delta \text{ ACD}, \sin A = \frac{CD}{AC} \text{ maka } CD = b.\sin A \quad (1)$$

$$\Delta \text{ BDC}, \sin B = \frac{CD}{BC} \text{maka } CD = a.\sin B \quad (2)$$

$$a.\sin B = b.\sin A, \text{ maka } \frac{a}{\sin A} = \frac{b}{\sin B} \quad (3)$$

analog

$$\frac{a}{\sin A} = \frac{c}{\sin C} \quad (4)$$

so:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

4. Conclusions

From the above description, the following conclusions can be drawn. (1) Ethnomathematics within the cultures of communities in Northern Coastal Areas of Java Island were in the forms of: (a) cultural buildings, (b) non-cultural buildings, (c) traditional foods and (d) batik motifs; (2) Various forms of ethno-mathematics in the communities studied by this research relate to the concepts of mathematics that these forms of ethno-mathematics could be integrated into mathematic learning-teaching activities both in elementary and intermediate levels.

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