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Local Wisdom: Mathematics Among Angler's Activities

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ABSTRACT

Ethno-mathematics or mathematics carried by ethnics in a particular area is a nation treasure that can build future Indonesian educational characters. This article describes how angler in Indonesia uses mathematics in their daily activities and its potential to be context in designing learning activities for school mathematics. Uses interviews, video typing, and observing, we manage our work, took a part in fishing with anglers from Demak and Kendal, Central Java, Indonesia. There three kind of activities carried by anglers we identified uses mathematics. First, the way anglers navigate their position without any navigation tools, or even compass show that how well they performed their spatial ability. Second, the way they spreads fishing net shows how anglers masters certain geometrical shape in a certain situation. Third, the way anglers drive the boat heading for wave or follow fishing tract show how they understand angle. Two out of three will be good context in learning mathematics based on good context criteria; anglers navigation, and angle correction.

Keywords: *ethnomathematics, design research, learning activity, geometry*

INTRODUCTION

Mathematics is a human activity, so to make students acquire the whole understanding, mathematics should be experientially real for students (Freudenthal, 2006). To make mathematics experimentally real to them, mathematics should be presented in contextual problems. Contexts play a significant role in learning mathematics. Context in instructional purposes plays as environment where they can experimentally real the problem (Van den Heuvel-Panhuizen, M., 1999). In this role, context makes problems easy to be grasp the purpose of problem by students. There are plenty of situation in real world can be used as the contextual problems for students to learn mathematics. Even, OECD classifies real- world contexts in four categories, i.e. personal, occupational, societal, and scientific contexts. (OECD, 2018 p: 61-62).

Even though context plays significant role in learning mathematics, many school mathematics textbooks do not include context in the activities. Mathematics is still presented as procedural knowledge as formula student can obtain without reinvention. That kind of approach will not facilitate them to study. Student masters calculation and recalling knowledge without knowing mean behind the algorithms. Perform correct computation or recalling knowledge does not lead student to be able to interpret and apply the concept in context (Koay, 1998). It means that mathematics become useless. It is also contradicting to our national curricula purpose to develop mathematics literation. In brief way, mathematics literacy is ability to put mathematics student learn from school to everyday situation (Ojose, B., 2011).

Several researcher who focus in design research has carried designing learning material using context. Zabeta, M., Hartono, Y., & Putri, R. I. I. (2015) have been designing fraction using Palembang food context. Prahmana, R. C. I., Zulkardi, Z., & Hartono, Y. (2012) develop multiplication using indonesian traditional game in third grade. Nizar, H., & Putri, R. I. I. (2018) Develop PISA-Like Mathematics Problem Using sport Context. From those designs, it is understandable that ethno mathematics is still rarely used in mathematics context.

Ethnomathematics shares identical definitions among mathematics educators. d'Amboise, U. (1985) explains ethno mathematics as the mathematics practiced by identifiable cultural groups such as, tribal societies in a nation, employee groups, certain age category, people of profession, etc. other educators define ethno mathematics from the proof of activities. Powell, A. B., & Frankenstein, M. (Eds.). (1997) classifies ethno mathematics as code of language of sociocultural expression of mathematics knowledge. In these both views, two main characters of ethnomathematics are practiced by groups, and, expressed in language codes.

Indonesia has many societal group that carry mathematics in their daily activities. Farmers, anglers, carpenters, traders, are several examples of group's people using mathematics that can be identified as ethno mathematics. Farmers carrying geometrical shape in layouting the field to get the maximum sunlight exposure. Anglers using Geometrical shape in catching the fish.

Even there are lots of ethnomathematics identifiable, not all of them can be context in learning mathematics. Van den Heuvel-Panhuizen, M., (1999) establishes criteria of good context. Context should enhance the accessibility of problem, Context contribute to the latitude and longitude of the problem, and context can provide strategies.
This article explains how angler in Indonesia uses mathematics in their daily activities and its potential to be context in designing learning activities for school mathematics.

2. RESEARCH METHODOLOGY

This article is part of the research designing learning material for school mathematics using ethno mathematics that uses Design Research proposed by Gravemeijer (2015). From first phase of design research call Preliminary design, we did several steps consist of Site visit, Literature and school competencies review, Ethno mathematics identification, designing learning trajectory. Data of ethno mathematics obtained by interviews, video typing, and observing. Data taken analyzed using video fragmentation, video transcription, and classification.

3. RESULT AND DISCUSSION

We manage our work, took a part in fishing with anglers from Demak and Kendal, Central Java, Indonesia to deeply in touch with them and record all activities in which ethnomathematics can be found. From the site visit, we got three kind activities identified using mathematics.

3.1 Spatial Ability: Navigate Position Using Three Points Triangulation

Anglers navigate their position without any navigation tools, or even compass. It shows that how well they performed excellent spatial ability. Most of fishing activities are carried out in the night to avoid sunburn and make use of the tide, several are in the twilight. In the night, there are no light in the sea. Only stars and moon light. If it is cloudy, it will lead to dark sky. In this condition, lights from mainland become a navigation instructions to the anglers.

Figure 1 Lights from mainlands

Using position of lights from three recognized places, for example port, lighthouse, and settlement in the highland, anglers know in which position they are. Figure 2. Illustrate anglers position from the mainlands' peninsula.

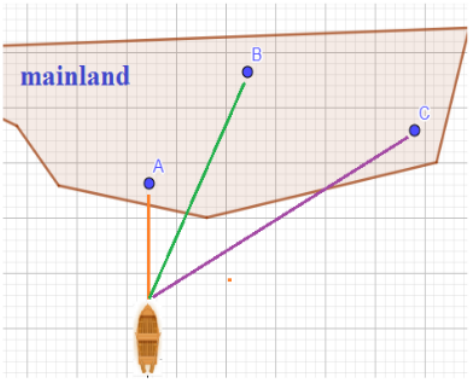

Figure 2 Navigation using triangulation of point

Anglers navigate their position by looking at their orientation to three recognized places. In this position, angler navigate that they are in the front of A, next to right side is B, and the one on the far right is C. It means that they are in the front of peninsula. Different angle point of view will make an understanding.

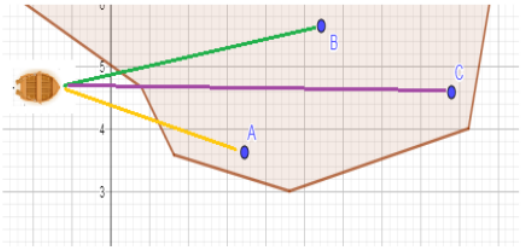

Figure 3 Another point of view to make differences

In this position, angler navigate them in the right of peninsula. Point C lays in the front of them, point B is in the left side, and point A in the right side.
By understand these triangulation, anglers do not need a compass to navigate their fishing voyage. The way anglers navigate their position without any navigation tools, or even compass show that how well they performed their spatial ability.

3.2 Carry Out Appropriate Geometrical Shape in Certain Condition

In spreading fishing nets, anglers carry geometrical shape in certain condition. When catching fish in high seas, it is difficult to collecting fish without strategies. They spread the net following circle shape, then they repeat the pattern to the center of circle. Spreading about two kms long nets, the net is neatly arranged and broad enough to make large area. Figure 4 is an example.

Figure 4 Spreading net in circular shape

To make assure that angler sure that this shape gives the largest area than another shapes, we question them with other shape like explained in figure 5.

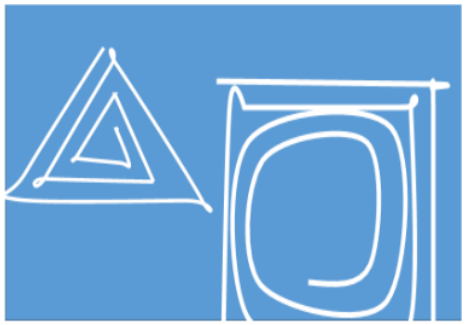

Figure 5 Another shapes to be questioned to anglers.

Researcher : are you sure that circle makes the largest area? What about these shapes? (pointing to figure 5)

Anglers : Triangle give a narrow area, and square will not give the larger area and it is difficult to make both shapes.

Researcher : How do you know that?

Anglers : It must!

Script 1. Interview about shape with the largest area

In the other place, when they want to spread net in the bay, they do another shape like explained in figure 6.

Figure 6 Net spreading in the one side when it is spreading in the bay.

The way they spreads fishing net shows how anglers masters certain geometrical shape in a certain situation.

3.3 Understand Angle

The way anglers drive the boat heading for wave or follow fishing tract show how they understand angle. In the high sea or beaches, angler experiencing difficulties face up to the sea wave. The manage their boat always heading the wave. Angler steer the boat perpendicular to waves roll. The situation can be illustrated as figure 7.

Figure 7 Angler steer the boat perpendicularly to wave roll

Boat should be place from initial direction by making correction in adding a measure of angle to be perpendicular to wave as in figure 8.

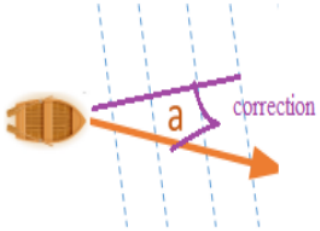

Figure 8 Angle correction of a degree in driving boat for making the boat keep on track

Making direction in such a measure of angle also being carried when angler face out of sea wave.

3.4 Identifying Anglers Ability as Ethnomathematics

The three activities can be classified as ethnomathematics because these three activities meet the criteria: practiced by groups, and, expressed in language codes (d'Amboise, U. (1985, Powell, A. B., & Frankenstein, M. (Eds.). 1997).

3.5 Classifying Ethnomathematics to be Good Context in Mathematics School

To examine whether three atnomathics are good context in mathematics or not, We consider the criteria of good context proposed by van den Heuvel-Panhuizen, M., (1999). Context should enhance the accessibility of problem, Context contribute to the latitude and longitude of the problems and context can provide strategies.

For the first ability, navigation using triangulation of point, it can be seen that this situation provide rich context and rich problem. It enhance the accessibility of problem because there will be lots of variable in this context. The different point of view from the picture with provides student different strategies.

For the second ability, carrying out appropriate geometrical shape in certain condition will not profitable to be context because the variation of the shape making largest area is limited only in circle shape. Beside that, making shape in the ather shape is not common to be carried. It lead to conclusion that this context can not enhance the accessibility of problem.

For the third ability, Understand angle may will be a good context. It make student grasp to the situation, and provides strategies for student.

Even the identification end with two of three will be good context in learning mathematic, it need to be examined in the next steps of Design Research as proposed by Gravemeijer (2015).

4. CONCLUSION

There three kind of activities carried by anglers we identified uses mathematics. First, the way anglers navigate their position without any navigation tools, or even compass show that how well they performed their spatial ability. Second, the way they spreads fishing net shows how anglers masters certain geometrical shape in a certain situation. Third, the way anglers drive the boat heading for wave or follow fishing tract show how they understand angle. Two out of three will be good context in learning mathematics based on good context criteria; anglers navigation, and angle correction

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