Ethnomathematics of fish catching exploration in Musi River

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Abstract. The activities of the people catching fish at the bottom of the Musi River contain cultural elements which indirectly contain mathematical concepts. So far, fishing activity has only been seen from the economic aspect but not from the cultural concept associated with mathematics. So that the formulation of the problem in this research is to identify the ethnomathematic aspects of fishing activities in the Musi River. The method used in this research is descriptive qualitative. The data obtained were then analyzed by using ethnomathematic aspects according to Alan J. Bishop. Data collection was carried out by field studies, interviews and documentation. Sources of data in this research were 10 peoples who directly catch fish in the Musi River. The results of the research can be concluded that there are ethnomathematic aspects of fishing activity in the Musi River, namely determining the location, measuring, and designing. Thus ethnomathematics in the Musi River can be used in junior high school mathematics learning, namely in the material of cartesian coordinates, sets, social arithmetic, velocity, distance, and geometry.

1. Introduction
Palembang city has a river that is connected to the high seas, so that it has enormous natural resource potential. This potential is found in the fisheries sector, because it is supported by the presence of the Musi River with a length of 750 km and a longest width of 1.35 km [1]. This causes Musi River to be used for all community activities [2]. The daily activities contain cultural elements related to designing or calculating [3]. Likewise, community activities in fishing activities on the Musi River also contain cultural elements. Indirectly, fishing in the Musi River contains a mathematical concept.

The daily culture of the people in the Musi River can be used as a basis for learning mathematics. Mathematics emerges and develops as a product of community culture which is directly adjacent to daily activities [4]. Mathematics is also a cultural product used for problem solving [5]. The concept of mathematics has a relationship with the culture of daily activities. The cultural linkages of daily activities can be identified into mathematical concepts in the hope that students learn mathematics more easily. In addition, culture can be identified in the mathematics learning process [6][7]. The process of learning mathematics in schools contains elements of local culture [8]. Mathematics and culture is known as Ethnomathematics which was originally introduced by a mathematician from Brazil in 1977. Ethnomathematics, using students’ own culture, can increase students’ nationalism [9]. Learning mathematics, using students’ culture, can be used as a context for learning mathematics [10].

The results of previous research on ethnomathematics showed that there are five mathematical aspects of calculating the results of the treasure hunt in the Musi River [11]. Community activities in
the Payakumbuh Livestock Market, namely the marosok tradition contain ethnomathematic values [12]. In the culture of the Larantuka people, there is a mathematical activity, namely calculating the materials needed for the construction of a house [13]. This research focuses on ethnomathematics in fishing activity in the Musi River. So far, fishing activity has only been seen from the economic aspect but not from the cultural concept associated with mathematics. So that the formulation of the problem in this research is to identify the ethnomathematic aspects of fishing activities in the Musi River.

2. Methods
The research method used is qualitative with an ethnographic approach. Qualitative is used to describe how to catch fish and what are the tools used to catch fish in the Musi River. Then, the researchers connect fishing activity with mathematics. Ethnography is used to observe fishing activities in the Musi River through field studies, documentation and interviews. The results of the observations were then analyzed by using mathematical activity in ethnomathematics according to Alan J. Bishop. Mathematical activities in ethnomathematics, according to Alan J. Bishop, are counting, locating, measuring, designing, playing/games, and explaining [14]. This research was conducted in Palembang City, South Sumatra Province, precisely on the Musi River. The subjects used in this study were 10 people who were directly involved in fishing in the Musi River using traditional lift nets, drift nets, throwing nets and long lines.

The data analysis technique used in this study is a qualitative one developed by Miles, Huberman and Saldana [15] which has 3 stages as follows: data reduction, data presentation and conclusion. Data reduction is used for the process of selecting data obtained from the field. Presentation of data includes the data that have been reduced. The results of field data are arranged in accordance with information to provide conclusions. After the data is presented, conclusions will be drawn so that they can answer the research objectives.

3. Result and discussion
The Musi River has a very big role to support the daily activities of the people in Palembang. The Musi River not merely as a means of transport and make a living alone [16]. The Musi River is directly connected to the high seas, so the Musi River is used by Palembang community people to fulfill their daily needs, one of which is fishing. The Musi River has various types of fish, according to Bahri there are 86 types of fish from 22 fish families [17]. The types of equipment used to catch fish are ring nets, trawls, hela trawls, rakes, lift nets, dropping tools, gill nets, traps, fishing rods, clamping and wounding tools as well as other fishing gear [18].

Fishing gear in the Musi River is used from generation to generation. This tool is used as a traditional medium to meet the needs of everyday life. However, fishing in the Musi River implies a mathematical concept. In addition, fishing in the Musi River is a cultural concept, because fishing in the Musi River has the characteristics of local culture. The local culture in question is passed down from generation to generation. Until now, it is still used in fishing activities in the Musi River. Thus, fishing activity in the Musi River contains an ethnomathematic concept.

Ethnomathematics was first introduced by Ubirana D'Ambrosio a mathematician from Brazil. Ethnomathematics consists of three words ethno, mathema and tics, ethno-mathematics is a cultural activity that develops in society related to the concept of mathematics [19][20]. Ethnomathematic research is related to traditionally told mathematics, traditional indigenous culture, daily life activities, social and cultural influences on mathematics education [21]. According to Alan J Bishop, mathematical activities in ethnomathematics are counting, locating, measuring, designing, playing, and explaining [14]. This research focuses on fishing activities in the Musi River.

3.1. Ethnomathematic aspects of fishing in the Musi River
The results of field studies, observations and interviews show that there are ethnomathematic aspects of fishing in the Musi River. Table 1 shows the relationship between the ethnomathematic aspects toward fishing activity in the Musi River which has a content in junior high school mathematics.
3.2. Ethnomathematic aspects of determining location
Musi River is a river located in Palembang City. The river that divides the city into an area opposite the downstream and across the upstream. People in Palembang depend on the Musi River for their livelihood by using the river for fishing activities. Communities in the Musi River in their daily activities indirectly use ethnomathematic aspects, namely determining the location. Determining the location in question is to determine the fishing location. The number of fish in the river is also determined by the water conditions in the river such as tides and ebbs. Determining the location in fishing has a mathematical relationship, which is connected with the cartesian coordinate material.

| Ethnomathematic Aspects | Observed indicators | Materials of Junior High School Mathematics |
|-------------------------|---------------------|---------------------------------------------|
| Locating                | Fishing Location    | Cartesian Coordinate                        |
|                         | Fishing Results     | Weight                                      |
| Measuring               | Water Depth         | Social Arithmetic                           |
|                         | Kind of Fish        | Distance                                    |
| Designing               | Lift Nets           | Rectangular pyramid                         |
|                         | Drift Nets          | Rectangle                                   |
|                         | Throwing/Casting    | Rhombus (Belah ketupat)                     |
|                         | Nets                | Cone                                        |
|                         | Longline (Rawai)    | Distance                                    |

3.3. Ethnomathematic aspects of measuring
The ethnomathematic aspect of measuring which is done in fishing can be seen from the number of fish caught in relation to heavy material. Measuring activity can also be seen from the measurement of the water depth of the Musi River only by submerging the equipment used for fishing. The types of fish that are obtained contain set material. The proceeds from selling fish that are obtained apply social arithmetic material. Measuring can also be seen from the amount of fuel used by the boat for transportation in catching fish. As well as the speed of the boat when catching fish as from one point to another with fishing gear. Thus, the ethnomathematic aspect of measuring fishing in the Musi River indirectly contains mathematical concepts, namely weight, set, social arithmetic, speed and distance.

3.4. Ethnomathematic aspects of designing
Designing activity can be seen from how to independently assemble fishing gear. The tool designed indirectly contains mathematical concepts, namely in geometric material. This geometric construct is implemented in fishing tools such as lift nets, drift nets, throwing nets, and long lines.

3.4.1. Lift net. The lift net, which is known as tangkul, by Palembang people, is one of the tools to catch fish on the banks of the Musi River. Lift nets consist of a stalk and frame with the main material of bamboo. The ends of the bamboo stalks are strung and tied with ropes, so that when the stalk is lifted, the frame will also be lifted. Each end of the frame is tied with a net. Lift nets are used in water conditions that are not large and have little tide. How to use the lift net is put in the water until the top is seen of the water surface, then leave it for 5-10 minutes before lifting it so that the fish enter the lift net. This can be seen in figure 1.
3.4.2. Drift net. Drift nets or long nets are part of the community's fishing gear in the Musi River. The nets are made of materials, namely nylon thread, floats and ballast. The buoy is located at the top which is used as a distance mark while the ballast is at the bottom so that the net drifting can be stretched perfectly. The net uses nylon thread with the aim of trapping the fish passing through the net. The drifting/floating net which mathematically contains a geometric concept, which is a rectangular shape, while the net hole is a rhombus shape which can be seen in figure 2.

3.4.3. Throwing nets. The throwing net, known as jalo by the Palembang people, is a tool used to catch fish on the banks of rivers. Using a throwing net, which is a large number of fish will be obtained by one throw by estimating the points where fish are suspected. The throwing net contains the mathematical concept of having a cone shape, shown in figure 3.
3.4.4. **Longline.** Longline or better known as mewari by the Palembang people is part of traditional fishing gear. Longline is a series of fishing rods that are used together. The longline consists of a series of main ropes, buoys, weights, main ropes on the front and back. The buoy is installed at a certain distance, the main rope is the length of the line and several short ropes are hung with the hook with a certain distance. At the end of the short rope tied a hook which is given bait. The number of longline’s hooks are ranged from 100–200 points. Longline is used by Palembang people to catch fish in rivers which indirectly uses mathematical concepts. This can be seen from the way to design the longline, namely the distance of the fishing line, float, weight and length of the main line as in figure 4.

4. **Conclusion**
The results of the research can be concluded that there are ethnomathematic aspects in society related to fishing in the Musi River. Ethnomathematic aspects of fishing in the Musi River are determining the location, measuring, and designing. Ethnomathematic aspects determine the location related to Cartesian coordinate material, measuring aspects related to heavy matter, set, social arithmetic, velocity, distance. The aspect of designing the tools used in fishing is related to material geometry. Ethnomathematics in the Musi River can be used in junior high school mathematics learning, namely in Cartesian coordination, set, social arithmetic, velocity, distance, and geometry.

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References

[1] Syarifudin A 2017 MATEC Web Conf. 101 04026
[2] Melki, Isnansetyo A, Widada J and Murwantoko 2018 Hayati J. Biosci. 25 198–205
[3] Zaenuri, Teguh A W P B and Dwidayati N 2017 Int. J. Educ. Res. 5 161–8
[4] Martyanti A and Suhartini 2018 IndoMath Indones. Math. Educ. 1 35–41
[5] Darmayasa J B 2018 J. Nas. Pendidik. Mat. 2 9–23
[6] Maure L M, Fábrega D, Nava M C and Marimón O G 2018 Acad. Journals - Educ. Res. Rev. 13 307–18
[7] Vasquez E L 2017 J. Educ. Hum. Dev. 6 117–27
[8] Sroyer A M, Nainggolan J and Hutabarat I M 2018 Form. J. IIm. Pendidik. Mat. 8 175–84
[9] Dwidayati Z, Nurkaromah and Suyitno A 2019 KnE Social Sciences 32 759–74
[10] Turmudi 2017 Proc. Seminar Nasional Matematika dan Pendidikan Matematika (2nd Senatik) (Semarang: Universitas PGRI Semarang)
[11] Malalina, Putri R I I, Zulkardi and Yusuf Hartono 2020 Numer. J. Mat. dan Pendidik. Mat. 4 31–40
[12] Annisa H, Asnawi M H and Susanti E 2020 Proc. SI MaNIs (Seminar Nasional Integrasi Matematika dan Nilai-Nilai Islami) (Malang: Universitas Islam Negeri Malang) pp 285–8
[13] Agustini N K A, Leton S I and Fernandez A J 2019 Asimtot J. Kependidikan Mat. 1 27–32
[14] Dominikus W S 2018 Ethnomatematika Adonara (Kupang: Media Nusa Creative)
[15] Miles M B, Huberman A M and Saldana J 2014 Qualitative data analysis (Arizona: SAGE Publications, Inc)
[16] Bambang W, Ari S, Susilo K and W F A 2016 Dimens. J. Archit. Built Environ. 43 85–92
[17] Samitra D and Rozi Z F 2018 J. Biota 4 1–6
[18] Kementrian Kelautan dan Perikanan 2017 Buku Saku Pengolahan Data Alat Tangkap (Jakarta: Kementrian Kelautan dan Perikanan)
[19] D’Ambrosio U 2001 Ethnomathematics. Link Between Traditions and Modernity (Rotterdam: Sense)
[20] D’Ambrosio U and Rosa M 2017 Ethnomathematics and Its Pedagogical Action in Mathematics Education Ethnomathematics and its Diverse Approaches for Mathematics Education (Cham: Springer International Publishing)
[21] Naresh N 2015 Rev. Latinoam. Etnomatemática 8 450–71.