Ethnomathemtical Exploration of Palue Cultural Tribe and Its Integration Toward Learning Process at Elementary School in Nusa Tenggara Timur

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Article Info	Abstract
	This study aims to explore the existing forms of ethnomatematics in the Palue society and to analyze its relation to mathematical concepts in elementary school. In this study, qualitative data were obtained through observation of the community's activity and arterfak used in the activity. The other data were also obtained through interviews with the Palue community. The data are analyzed theoretically using theories relating to the relationship of ethnomatematics with the concepts of mathematics in elementary school. The results show that the ethnomatematic forms that exist in the Palue society culture include forms of artifacts used in traditional ceremonies, dances, livelihoods, tenun ikat activities and traditional games. These social activities have a certain relationship to mathematical concepts in elementary schools, namely the concept of numeral operations, two deminsion concept (square, rectangle, triangle, circle, rhombus, and kite), geometry concept (tubes, shperis, and cones) as well as concepts of the measurement (measurement of the length, mass, and time). Based on this matter, it can be concluded that Palue society in Palue culture contained elements of ethnomatematics that can be integrated in the mathematics learning in elementary school.

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INTRODUCTION

Mathematic concepts in human's thoughts are sometimes different with the mathematic concepts that exist in a daily life (Zaenuri & Dwiyanti, 2018). It also occurred in the school environment. Students have experiences about math in their daily life but they often have difficulties to learn math in the school. This phenomenon related with Hierbet and Carpenter opinion that math is assumed as one of the difficult course and it often affected toward the low learning outcomes of the students (Saironi & Sukestiyarno, 2017). This condition also oceured in the students at Palue. They claimed that mathematic is the most difficult lesson. Students' skill in understanding math can be categorized lower than other courses. The evidence can be seen on the result of observation and interview of teachers and students in the Palue, students who reached minimum criteria of mastery learning 65 in learning mathematic lees than 50%. This condition is assumed as the impact of un-contextual learning activities. There are many differences between mathematics that is taught in the school and in the students' daily life even there is not relation. The low quality of mathematics education is not inseparable from the quality of learning that is designed and managed by teachers (Dwidayati, 2018). To bridge the gap is needed a learning innovation that connects the mathematical concepts which exist in school and students' mathematics experience in their everyday life is urgent.

Mathematics is known as abstract subject, therefore students need a real form of the concept to improve their understanding. On the other hand, students can also gain knowledge of mathematics outside structured educational systems or schools (Rachmawati, 2012). The students' activities in their daily life closely related to mathematics (Dwidayati, 2018), in which they can learn the mathematics from their activities, artifacts, and ideas that existed in their daily life and culture. Therefore, teachers are expected to develop the learning activities that utilize local wisdom as the learning resource (Rosdiyah, et al., 2013).

Culture is the result of creation, taste, and intention (Koentjaraningrat, 2000). Culture is acquired knowledge, which is used by people to interpret an experience and to give a birth of social behavior (Spradley, 2006). Culture closely related to community life. Culture shapes the patterns and structures in the society. Palue tribe is people who lived in north of Flores island. The culture of Palue tribe has a big influence to the Palue society to preserve variation and unique of their culture. They also keep their maintain it up to now. In addition, young generation of Palue tribe still preserved their culture till now. Patterns and structures of communities' life cannot be separated with the culture. It can be seen in their local belief such as believe in the highest existence of *Era wula watu tana* and ancestral spirits that are still preserved till this day.

In the culture of Palue tribe, there were found household equipment that are used in daily life that resembles geometry. One of example is *Pote lo'o* (in Palu'e, Sikka district), it is a container that is used to save betel nut which is made from woven of palm leaves. *Pote lo'o* is like a tube. There are also many artifact and activities which contains etnomathematics.

Based on the explanation above, it is suspected that there are many other forms of ethnomatematics that exist in the daily life activities of Palue tribe. Therefore, the researcher wants to explore the shapes of ethnomathematic that exist in Palue tribe. As Hartoyo (2012) who explore and reveal the shapes of ethnomatematics that is existing in Dayak cultural society. Meanwhile Aristiyawan, et.al, (2012) found that the shapes of ethnomathematics in Baduy cultural society, Abi, et al., (2015) explored ethnomathematics in Amanuban tribe NTT and he related with the mathematic concepts in elementary school, and Yusuf, at al., (2010) investigated ethnomathematic shapes in traditional play of Hausa tribe, Nigeria. The research had a unique if comparing with the research before. In this research the writer get the activity of explored than artifacts that is used in the daily activities that have ethnomatemathematics element.

The result of exploration ethnomatematic shapes in the palue tribe culture can be integrated with mathematic concept in elementary school. The purpose is to help the students to understand the mathematic concept based on their experiences in their daily life and to give them a new atmosphere in the learning process. Teaching and learning activities in the classroom should be supported by surrounding as a way to help students in understanding mathematics course (Pujianto & Masrukan, 2016). Moreover, the implementation of ethnomatematic concept is need to the teachers to give opportunity to the students to be active participation in the class (Fujiati & Zaenuri, 2014).

In the same line, Sirate (2012) stated that ethnomathematic can be implemented in teaching and learning process at the level of elementary school and Tandaliling (2013) developed teaching learning mathematic based on ethnomatematic approach in the local culture of Dayak Kanayatn tribe at the level of elementary school. Zaenuri, et.al., (2017) stated that the application of ethnomathematic approach in coastal area increased students understanding toward math. On the other hand, it can improve students understanding of the culture, and maintain cultural value in their life. Palue tribe also have the culture unique that helped the student to learn mathematics about number operation and geometry.

Ethnomathematic was consists of two word *ethno* and *matematic*. *Ethno* means ethnic and *mathematic* means mathematics. Then, the terminology of ethnomathematics is called ethnomatematic that was proposed by D'Ambrosio- an expert of mathematic from Brazil in 1977. D'Ambrosio in Rosa & Orey (2011) defined ethnomatematic; mathematic that is practiced in local culture of society such as tribe, labor, children from certain ages, and professional class. Furthermore, D'Ambrosio stated that the goal of the existence of ethnomatics is to recognize that there are different ways of doing mathematics by considering academic mathematic and society ethnomathematic is taking into account the different modes in the different cultures to negotiate their math practices (how to group, count, measure, design buildings or play tools, etc.). This tendency is used as one of technique for explaining, knowing, understanding, performing coding activities, measuring, classifying, and concluding (Kaselin, 2013).

Referring to Rosa & Orey (2014) and Katsap & Silverman (2008) argued that the ethnomatematic has indicators: (a) consistent shapes, (b) having a certain properties (as in geometry); (c) having a mathematical pattern; (d) having a certain mathematical rule of the game; and (e) having a connection with calculating, measuring, weighing, and systematically sorting.

METHODS

Descriptive qualitative is used in this study. It is used to explore objects (artifacts) and activities of Palue tribe which has ethnomathematic element. Exploration was done by observing and conducting interviews on *lakimosa* (chief of Palue tribe) and Palue tribe's stakeholder. Observations were conducted by observing the activities of Palue society. Interviews were conducted on indigenous elders (Lakimosa) from 9 diffrent traditional ceremony society customary units in Palue, society and leader community in Palue Island. Interview was conducted to find out information about cultural society of Palue tribe based on the activities that were done by society of Palue tribe.

Palue community activities can be depicted in their cummunity pattern such farmers, fisherman, belief systems, traditional ceremonies, livelihoods, and games. These activities have relation to the ethnomatematic or mathematical forms.

RESULTS AND DISCUSSION

Based on observations on activities, artifacts, and interviews that were conducted on *Mosalaki* (chief of tribe), it can be described as in the following. The results of the study are grouped based on activities that were conducted by the communities, which have relation to

traditional ceremonies, livelihoods, bundle weave activities and traditional games.

a. Traditional Ceremonies

The traditional ceremonies performed by Palue people that is *pati karapahu* and *thu dheu,* which have the same meaning as the restoration of human relationship with the universe and the creator (described as the highest form of *era wula watu tana*) and give an honor to the ancestral spirits. The ceremonies were held one time in five years.

b. Dance

Togo and *misa* are commonly dance that always be done by Palue tribe. *Togo* is a dance that is done by young people on a full moon or when it will carry a peanut harvest. *Misa* dances are performed by making a circle. Meanwhile, *Togo* dance is a dance that is performed during traditional ceremonies. While, *ko* and *maba* are musical instruments that is used to accompany *misa* and *togo* dances. *Ko* is made from bronze, resembles a circle. *Maba* is made from skin of goat or buffalo and it resembles a tube.

Meanwhile, *Lambu* is a costume that is wear by *Togo* and *Misa* dancers. *Lambu* is a Palue custom, which is sewn without sleeves and has rectangular shape. While, *koma* (earing) and *mone* (bracelet) are accessories that are used by female dancers but sometimes-male dancers also wear them *Koma* is an earring that is made from gold and it has similar shape with rhombus shape. *Mone* is a bracelet that is made from elephant tusk. Elephant tusk is also used as a *belis* or dowry in marriage ceremony.

c. Livelihood

The dominant livelihood Palue people is farming and fishing. Farming activities are conducted in the dry land that relies on the rain as the water resources. The Palue's agricultural products from the fields include various yams (*uwi, hura, uwi kaju*), corn (*keo*), and beans (*pue, wewe, koroure*). To determine the harvest, the community has its own measurement.

The measurement of corn harvest usually is calculated by four (such as the multiple of four corncob) (*dhali ne rua or liwu*). The other calculated corn, then wrapped and tied up to ten pieces (*liwu rua ha dhali*) forming a circle of corn called *powe*. Then, the corn is arranged or hung on in a stick or bamboo, and it is also hung on palm tree (*dhua*). Corn that has been prepared on wood or bamboo is called *keo powe ne*.

Meanwhile, Palue people usually count the the results of harvest peanut using *Lekhe* (coconut shell) and *mbele*. *Mbele* is made from alumunium and beams shaped. One *lekhe* has three quarters of a kilogram. While, *mbele* has variation sizes: 5 kilograms, 13 kilograms and 20 kilograms.

It will different when Palue people count the results of coconut harvest or called *liwu nio*. *Liwu nio* is the activity to calculate the amount of coconut harvest that is counted by two pieces (*ha rope*) or four pieces *(ha liwu),* and ten *liwu* (*ha subu* in one time. *Liwu nio* is the activity of calculating coconut after harvest (*podhe nio*). Moreover, coconut should be tied using its own skin in a group that consisted of two or four coconuts before counted.

d. Tenun Ikat Activities

The sarong weaving (*dhama*) activity starts from cotton processing to be yarn. Then, the yarn is stretched out on a *lele*, then it is spun and rolled onto a small stone so that it looks like a ball or in Palue language called *kapa wolo ne*. Further, this activity is called *polo kapa*.

Rolls of yarn stretched on a rectangular wood or in Palue language called *raa* to determine the length of the sarong. The length of *Ra'a*'s nine span of adult woman (*pagha hiwa*) and the width is four span of adult women (*pagha pa*). Then the yarn is tied to make a motif and it is colored and woven to be sarong.

The sarongs which is wear by men called *nae*, while the sarong which is used by women called *dhama*. The size between *nae* and *dhama* are different. *Nae* has the length a half of *dhama*. *Nae* and *dhama* motif are *wua wela* (triangle) and *widhi mata* (rhombus).

e. Traditional Games

Palue tribe has several traditional games such as *peti leke* and *sendi koti*. *Peti leke* is a game

that tests the dexterity of throwing the shell. The shell is made to resemble a kite with one of the certain sharp angles used to plug the shell into the ground.

The rules of the game in *peti leke* is every player should give their three shells which is placed or plugged in the back of them. The first *leke* till fifth is placed closely. The distance of each *leke* is one foot step of child, while the sixth leke is placed further back. The distance of the sixth *leke* to the fifth is five steps of child's foot. In the process of playing the game, if the player succcesful to fall first till fifth *leke*, it can be claimed that it can be their own. Furthermore, when the player succesfullly fall the sixth *leke* before he falls the five *leke* in front of him that means sixth *leke* becomes his own and he officially win the game. Meanwhile, *sendi koti* is spin game (*koti*). It is made from branch or stem of Kusambi wood. Further, it is played by two people.

The Relation of Ethnomathematic in Palue Culture and Mathematics Concept in Elementary School

a. Numeral Operation Concept

Palue cultural tribe has relation with ethnomathematic concept in terms of operation number namely addition, subtraction, division, and multiplication. Addition and subtraction concept related to *peti leke* game (Figure 1a). It is because *peti leke* game has a rule that the winner is someone who successfully get *leke* by falling it in standing position. Meanwhile, someone who lose many *leke* defined that he failed the game.

In one session of the *peti leke* game, the winner will get additional *leke* (*shell*) and another will lose one *leke.* This phenomen can be related to the concept of subtraction and addition in the number 1,2,3,4,.., and in the same number.

Multiplication and division concept related to the activity of *liwu nio* (Figure 1.b) and *powe keo* (Figure 1.c). It can be seen from the activity of counting coconut in two pieces (*ha dhali*) or in four pieces (*haliwu)* and ten pieces (*subhu*). It also occurred when Palue tribe save the result of harvest corn. The ten corn will be tied to be one group called *haute.*

Figure 1a. Peti Leke

Figure 1b. Liwu Nio

Figure 1c. Keo Powene

Figure 1. Relation Between Ethnomathematical Shape and Numeral Operation Concept

To count coconut harvest amount, Palue society doesn't need to count one by one but they count coconut and corn based on the classification of *liwu, subhu,* and *ute.* When they count the harvest, they automatically do an activity of counting many times. This activity related to the concept of multiplication.

b. Two Dimension Concept

Flat build concept which has ethnomathematic relation toward Palue tribe culture including: square, rectangle, circle, triangle, kite and rhombus concept.

Square Concept

Lele is one of square concept that related to ethnomethematic in Palue tribe (shown in Figure 2). When *Lele* is stretched with the yarn, it can be seen that it has the same four sides and has four angles. The elements of *lele* are the same with elements of square.
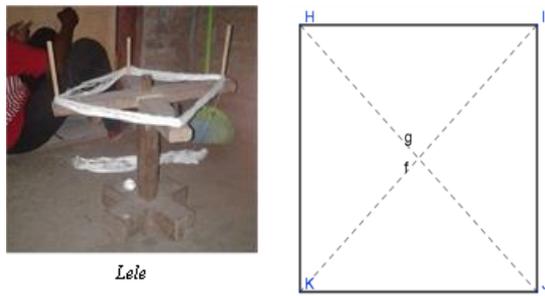
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Figure 2. Relation Between Ethnomathematic
Concept and Square Concept

Rectangular Concept

Ethnomatematic shapes which has similar shapes with rectangular are *raa, dhama, lambu,* floor pattern *togo* dance, dan *seto* (as shown in Figure 3). Those related to rectangular because they have the same elements as much as rectangular have. They have the same sides facing each other and have four angles which are the same value.

Raa

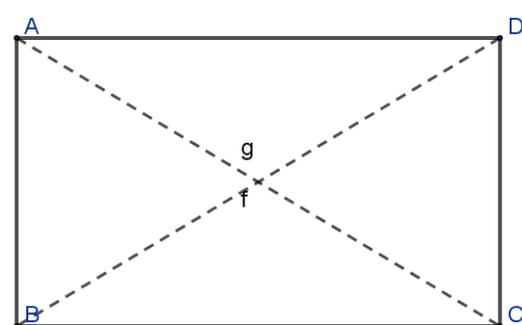
Dhama

Lambu

Pola gerakan tarian *togo dheu*

Seto

Figure 3. Relation Between Ethnomathematic Shape and Rectangular Shape

Circle Concepts

Ethnomatematical culture of Palue Tribe which is related to circle (as shown in the Figure 4) is *mone, ko* and the pattern of *misa* dance. They have relation with ethnomathematic in terms of element of the circle. They are rounded and curve

with a degree 360^0 and they have no angles but they have a central point.

Mone

Figure 4. Relation Between Ethnomathematic Shape and Circle Shape

Triangle Concept

Ethnomatematical culture of Palue Tribe which is related to triangle (shown in Figure 5) is *wua wela*. *Wua Wela* is one of the motif of *dhama* (sarong) or *nae* (sarong for male) which we can see from the shape, it has elements which is forming a flat plane, having three sides, and having three angles then if it is summed to be 180^0.
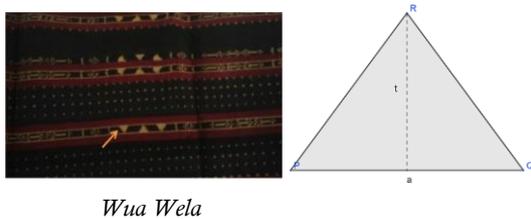

Wua Wela

Figure 5. Relation Between Ethnomathematic Shape and Triangle Shape

Kite Concept

Leke petine is one of ethnomathematics shap that related to the kite (as shown in Figure 6). *Leke petine* is a shell used in the crib *leke* game. The *leke petine* is seen from its shape, it has four-sided shape with two pairs of different sides of length, four vertices, and a pair of opposite and congruent angles. In addition *peti leke* was claimed that has similar shape with kite.
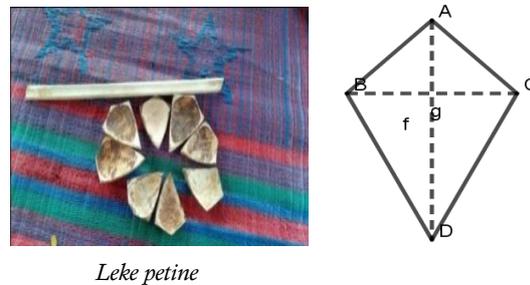

Leke petine

Figure 6. Relation Between Ethnomathematic Shape and Kite Shape

Rhombus Concept

The ethnomatematic concept that has relation toward the rhombus are *widhi mata* and *koma* (as shown in Figure 7). They have four sides that are the same length and not perpendicular, having four equal and opposite angles. The elements are possessed by *koma* and *widhi mata* that can be assumed that they related to the shape of rhombus.

Koma   *Widhi Mata*

Figure 7. Relation Between Ethnomathematic Shape and Rhombus Shape

c. Three Dimension Concept

The concept of build space that is identified similar with ethnomatematics of Palue culture is the concept of a ball and a tube.

Shperis Concept

An ethnomatematic form relates to the ball (shown in Figure 8) that is *kappa wolone. Kapa* *wolone* is a lump of yarn that is made to make easier during the process of stretching the yarn on the assembly before the motive was tide up. *Kapa wolone* is assumed that it related to the ball because the element is only one side and lined by the side of the arch. These elements relate to the properties of shperis.
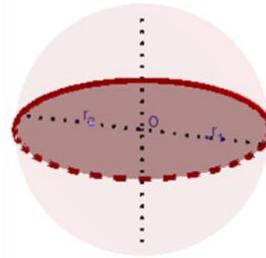

Kapa wolone

Figure 8. Relation Between Ethnomathematic Shape and Ball Concept

Tube Shape

Based on this understanding of the tabular forms in ethnomatematics in the Palue (as shown in Figure 9) are *maba* and *sumbu*. They have space which formed from three sides which each side consist of arch and two circle as a base and cover. They are assumed that they have elements of a tube.
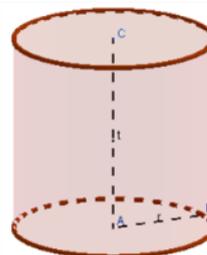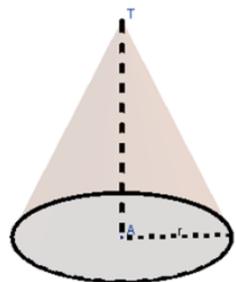

Mabha

Figure 9. Relation Between Ethnomathematic Shape and Tube Concept

Cones Concepts

An identifiable ethnomatematic form relates to the concept of a cone (shown in Figure 10) *koti*. Koti is the top that is played in *sendi koti* game. *Koti* is claimed that it has relation with the cone because it is organized by two side of arch curve and a circle base. In line with cone-shaped elements, it has the sides of the base and the curved plane (shown in the conical webs of Figure 10).

Koti

Figure 10. Relation Between Ethnomathematic Shape and Cone Concept

d. Measurement

Measurement is one of process of providing on the physical quality of length,

capacity, volume, area, angle, weight and temperature. There are several forms of ethnomathematica in Palue tribe cultural which relates to concept of measurement of length and volume.

Measurement of Length

It is used to measure the length of object. In mathematics learning in primary school, there is length measurement with nonstandard units. Further, in Palue tribe culture, there is also nonstandard measurement. Measurement of length used *pagha (*rebound) and *reba* (depa) that related to nonstandard length measurement concept in palue tribe community. For instance, to measure the length of *raa* (assembly), they used *paga* (span) and they used *rebha* (depa) to measure *peli lunthune* (aur bamboo).

In the Palue Tribe society, the length of a sarong is determined by the length of the *raa* (assembly). The longer and the width of a sarong have the higher price. The size of *raa* is often used that is nine *paga* (span) and the width of the *paga* (span) is an adult female span.

Volume Measurement

To count the result of coconut harvest, Palue tribe often used *lekhe* or *mbele.* One *lekhe* is the same as 500 grams. Meanwhile, one *mbele* has variation size start from 5 kilograms, 13 kilograms and 20 kilograms.

Time measurement

In every day life, human cannot be separated with their knowledge about the time. Therefore, time measurement is very important. Time measurement related to a traditional calendar of Palue society as in the following Table 1.

Table 1. Time Measurement in Palue Tribe

Traditional Measurement	Time Measurement
Era	Day
Mere	Night
Ha mi ha thai	Three day
Wula	Month
To	Year
Wula wajane = musim hujan	Rainy session January - April
Wula era cha ne = musim kemarau	Dry session Mei - November

CONCLUSION

Ethnomatematics is a mathematical source which comes from cultural activity. Culture is the result of creation, works, and intention. Palue tribe activities can be depicted by their patterns in their daily life such farmer, fishermen, belief system, traditional ceremonies, livelihood, and games. All of ethnomathematic shapes can be seen in traditional ceremonies such as the movement of *misa* and *togo,* musical instrument *ko* and *mabo*, *lambu, liwu nio, powe keo, lekhe, dhama, kapa wolone, lele, wua wela, widhi mata, peti lekhe,* and *sendi koti*. The forms of ethnomathematic which related to the mathematics concepts are: number operation system, two dimension concept (square, rectangular, circle, triangle, kite, and rhombus), geometry concept (tube, cones, and shperis) and measurement concept. It means that Palue cultural tribe has mathematical elements which can be integrated into the mathematical concept in elementary school.

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