Mathematical learning by utilizing loce, manggarai traditional mats

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Abstract. This study discussed the exploration of mathematical concepts in Traditional Mat, Loce, as a product of Manggarai culture. This study aimed to describe the mathematical ideas contained in the Traditional Mat, Loce, Manggarai and how the linkages between the concepts found in the traditional mats, Loce, Manggarai and the topic of learning in schools. This research was qualitative research with ethnographic methods. Data collections were carried out through observation, interviews, and documentation. The subjects in this study consisted of 4 people, namely community leaders who could carry out Rojok Loce activities and the craftsmen. The results of this study indicated that there were several mathematical concepts found in the traditional mat, Loce, and had links in the topic of Mathematics learning in the school, namely the idea of fraction distribution, measurement, burial and measurement of the area of the flat building. The concept of fraction is when a craftsman mats a strand of pandanus leaves into several parts with an unequal size, the idea of measurement is still using traditional measurements of pagat and depa which are used to measure the length and width of the mat, the concept of mating during the mat making process the same form unit square to produce a mat and the concept of measuring the area of flat building when the mat is finished.

1. Introduction

Mathematics was born and developed because of the human desire to systematize life experiences, organize and make it more understandable so that the learning of mathematics in school must take into consideration the culture in which mathematics appears [1–4]. Achor, Imoko, and Uloko in [1] stated that by examining how mathematics arises and is used in local cultures in the learning process, students could gain a better understanding about the conceptualizing of mathematics as the development of structures and systems of ideas involving a number, pattern, logic and spatial configuration. Furthermore, Aikpitanyi and Eraikhuem in [2] explained that the teaching and learning approach of mathematics needs to be built on the students’ previous knowledge, taking into account the culture in which the student originates, namely by involving background, playing environment, and their social life. And then Presmeg in [3] said that educators need to be aware that mathematics is a product of culture and that student ethnicity can be used effectively in learning school mathematics. The connection between mathematical content and the culture of students becomes essential to make a bridge between the real world and the world of work [4]. Therefore, it is clear that mathematics has a great responsibility as a provision for the development of the mindset of the nation's children, citizens and can live appropriately for the advancement of the development of knowledge and preservation of mathematics.

Nowadays, the reason for learning mathematics is deemed to be difficult is because mathematics is kept away from the environment. Teachers tend to teach students to the examples in textbooks that have nothing to do with the living situation so that it has an impact on the results obtained by students.
Teaching mathematics in school is too formal, so the mathematics that children find in everyday life is very different from what they find in school. The local cultural approach to learning mathematics needs to be applied so that students' mastery is more perfect.

Indonesia, with its cultural diversity, should incorporate local cultural values into mathematics learning, so that mathematics is not considered a science that is far from the reality of life. This is because, in cultural activities, there are mathematical ideas which are considered as essential things in mathematics learning. Therefore learning mathematics needs to provide content/bridging between mathematics in the everyday world based on local culture and mathematics in school. As one of the countries known for its diversity of countries, which has its uniqueness of each ethnicity, Indonesian culture has developed from a small unitary area leading to a spacious local unit. Along with the development of technology and science, culture began to disappear from the dictionary of generations of cultural heirs.

Rojok is an indigenous culture of Manggarai, Flores, NTT that still maintains its existence amidst the onslaught of globalization. This Rojok culture has been carried out by the community for a long time. The types of cultural products produced by Rojok are Loce (Mat), Doku (sifting rice), Roka (traditional backpack), Bakuk (large basket), Luni (small basket), and any basket as a container for household use and other customary needs. The raw material in producing the plaits, namely pandan leaves (Pandanus amaryllifolius) or in the Manggarai language is known as saung re’a.

The usefulness of each of these products in the lives of Manggarai people is that mat is used to drain the seat and also sleep. Roka is used to store equipment while gardening and when tapping rice. Then the basket is used to store food ingredients when traveling to the market. The basket is decorated with paintings (lace ndoreng) in black and white so that it looks beautiful from a combination of colors that also matches the paintings, namely mbaru niaa which is round and lingko in the shape of a network Bakuk is used to store rice when gardening, luni is used to store betel nut and doku is used to help clean rice pulp.

Of the many local products as a result of Manggarai Loce's human activities, one of the essential products is preserved for each generation because these products are always needed at the time of the Manggarai traditional ceremony, namely at reception. The process of making mats (Loce) uses repetition of a pattern that is cross between each strand of pandanus leaves so that it forms a rectangle with each other squeezing and there is no distance between the gaps to make it look neat — then combined with specific colors to look beautiful. In the process of making the craftsman measure the mat using traditional measurements of finger-aided fingers, namely pagat and depa. The manggarai people's mat products are generally rectangular. Furthermore, how traditional mat is applied to mathematics learning in schools as a learning media first needs to be studied what concepts are contained in the traditional mat (Loce) so that the ethnomathematics study of Loce Manggarai becomes an interesting study to be explored more deeply.

Ethnomathematics in Indonesia is not a new science but has been known since the introduction of mathematics itself. But this scientific discipline was realized after several scientists introduced the name ethnomathematics to be part of mathematics. After that, ethnomathematics began to be developed through the study of various relevant sciences. So, there has been a lot of development, especially in learning applications in schools. The relationship between mathematics and culture,
according to experts, is known as ethnomathematics [5–7]. Biembengut in [6] defines ethnomathematics as a way for a culture to understand and use mathematics in everyday life, which is usually associated with exciting and informative cultural problems and mathematically rich information. Furthermore, Rosa & Orey in [8] states that ethnomathematics is the practice of mathematics from cultural groups that can be identified and considered as the study of mathematical ideas found in certain cultures. Meanwhile, Abdullah in [5] states that ethnomathematics shifts mathematics from the place where it has been established and developed (universities and schools) and spread it to the world, in the diversity of cultures and their daily activities.

So, ethnomathematics refers to a different form of mathematics as a cultural activity that aims more than doing mathematics. Where the mathematical activity is an activity in which an abstracting process takes place from real experience in everyday life into mathematics or vice versa, includes activities of grouping, counting, measuring, designing buildings or tools, making patterns, counting, locating, playing, explaining, and others. Therefore, this research was conducted to answer any mathematical concept questions contained in the traditional Manggarai Loce and how the linkages between the concepts found and the topic of learning in the school.

2. **Rojok Loce, Manggarai Traditional Mat**

   In the Manggarai language, the mat is known as *Loce*. The existence of *Loce* cannot be separated from the lives of Manggarai people. *Loce* is a handicraft product of Manggarai women. The weaving activities carried out by Manggarai women by utilizing *saung re’a* as the main ingredients are known as *rojok Loce*. *Rojok Loce* is carried out by Manggarai women during their free afternoons until evening at their homes. In the 2009 Ethnic Exhibition catalog entitled "*Tikar, Kesenian Perempuan Manggarai*," it was mentioned that *Loce* was a work of art made by Manggarai women. Almost all Manggarai women know weaving mats except those raised in cities or raised in overseas places [9]. The function of *Loce* the Manggarai people in daily life are to cover the everyday seating, cover the bed, dry the harvested rice, and so on. Besides, *Loce* also has a particular function, for example in the Manggarai people's wedding ceremony or other custom events, used as a sitting mat when receiving family guests in the requesting process, and several others.

   The types of *Loce* produced by the Manggarai people are divided into two parts:

1. **Size of Loce**
   Judging from the size of *Loce* it can be divided into two parts, namely *Loce koe*, and *Loce mese*. Sometimes *Loce* is produced with tiny size, which can only be occupied by two people. Whereas *Loce* is made for the capacity of many people, it is also used for seating for guests and also for sunbathing harvests by people in ancient times.

2. **Loce motives**
   Based on the Loce motif divided into two parts:
   a. *Loce Tembas / Loce Laco*
      It is a *Loce* that is not combined with any color. *Loce Tembas* serves as a daily seat and is also used for sleeping. And also, this permeation can be used to hang the harvest by the community in the past.
   b. *Loce Umpuk*
      *Loce umpuk* is a Loce that is produced with a combination of colors so that it looks beautiful. It serves as a seat for guests during traditional events or is explicitly used for general purposes. In addition to some of the *Loce* functions described in the previous section, *Loce* can also be traded to support the economic needs of the household, and some even can maintain their life with the *Loce* business.

3. **Method**
   This study uses an ethnographic qualitative approach with the type of field research or the natural environment as a direct data source. Qualitative research is research that uses natural settings, intending to interpret phenomena that occur and are carried out by way of involving various existing methods[10]. A qualitative approach is a research procedure that produces descriptive, speech, or writing data and observable behavior from the people (subject) itself. This research was conducted to
explore the mathematical concepts contained in traditional manggarai mats and how they relate to the topic of mathematics learning in schools.

This research was conducted in Pateng Lesu Village, Ndoso District, West Manggarai Regency, East Nusa Tenggara Province, a rural area in East Nusa Tenggara, Indonesia. The subjects in this study are community leaders Pateng Lesu Village and four subjects who work as traditional mat weavers. This is due to the value of the knowledge of the abilities possessed by the subject regarding cultural conditions related to inheritance from ancestors or ancestors, namely Rojok Loce activities carried out by a group of people in the local community. In this case, the selected informants are people who have expertise or ability in weaving, or it can be said that the subjects of this study are people who are considered able to answer the formulation of the problem to be studied. The data collection tool is the researcher himself using data and information collection techniques related to the formulation of the problem that is the focus of this research, the researcher uses data triangulation which combines observation, interview, and documentation techniques.

4. Result and Discussion

Based on the results of interviews, observation, documentation, and direct exploration, it is known that the culture of Rojok Loce has been cultivated since ancient times. This local Loce product is made from the necessary ingredients of pandan leaves/saung réa. There are three stages of forming, namely the preparation stage of the material, the stage of the weaving process, and the final stage. The time needed to weave the mat is approximately two weeks.

The mathematical concepts found in Loce, Manggarai traditional mats can be described in the following sections.

a. Fractions

The Mathematical concept found shows that there is a concept of fraction operation which is located in Rojok activities, namely when a mat craftsman cuts strands of pandan leaves. If the Fraction in Mathematics learning is the division of two integers with divided numbers called the numerator, and the divider number is called the denominator.

The concept in the process of making a traditional (Loce) Manggarai mat, which is a fraction distribution operation, is found when a mat craftsman divides pieces of pandanus leaves into several parts. It was found that the fragments of the Rea carried by the mat craftsmen approached the 1/3 fraction in the Mathematical concept, namely from a pandanus leaf divided into three lata for ordinary loce, also approaching fractions 1/4 for Loce Umpuk with large sizes of each of the pieces of Re'a is not the same. This can help the teacher in the learning process that aims to make it easier for students to understand the concept of fraction sharing by utilizing the contextual situation of Rojok Loce as a medium in classroom learning. In other words, the initial motivation to encourage students to learn about the concept of fractions, especially for students in Manggarai, can be started by introducing the activity of making Loce - an activity that is already familiar with their daily experience. Starting from these concrete activities, students begin to learn to recognize fractions (in general) which are then taken slowly to understand the concepts of fractions in mathematics.

b. Unstandard Length Measurement

At the time of research based on data obtained from research subjects, it was found that mat craftsmen also carried out measurement activities in making Loce, namely using traditional measurements with finger aids with units in the form of pagat and depa. Measurements using the pagat's fingers are calculated from the thumb to the middle and front fingers when the hand is stretched from the middle finger of the left arm to the middle finger of the right arm. To measure the length and width of the Loce desired by a woven craftsman, the researchers saw that they were still using a tool to measure the non-standard units, namely pagat and depa. However, these methods can also be used as informal initial steps to introduce the concept of formal measurement. In this way, students can try to find out for themselves whether the use of pagat and depa can
provide consistent and accurate measurement results. From the results of these trials, they were then invited to learn about concepts and measurement tools that are valid and reliable.

c. Regular Tessellation

A tessellation of a flat surface is the tiling of a plane using one or more geometric shapes, called tiles, with no overlaps and no gaps. In mathematics, tessellations can be generalized to higher dimensions and a variety of geometries. A periodic tiling has a repeating pattern.

![Figure 2. Tessellation in Loce](image)

In the picture shown above is a build that is formed by repeating the same pattern to cover a building constructed from pieces of pandan leaves (saung re’a) and made intersecting not mutually tends between the wake and also has no gap / no distance between wake. Builds that are formed are many irregular facets.

This can show that in the process of making traditional mats (Loce) Manggarai there is a concept of tessellation principle which is used by a mat craftsman by using the same repetition pattern to form a mat that is made like a rectangular flat with different color compositions so that it looks beautiful with exciting motifs.

d. Area Measurement

Based on the research findings, it is shown that a mat produced by a mat craftsman generally resembles a flat building that is a rectangle formed from square units. A mat craftsman determines the size of the mat usually uses traditional measurements with non-standard units. The size can be expressed in units of area, not standard pagat which will be converted to standard international units to determine the length and width of the resulting mat.

This shows that a teacher can construct concepts that are used in everyday life in the formal learning process. It is made with the aim that students feel mathematics is not far from reality and can easily understand how to calculate the area of a flat build before using formulas or formulas. Therefore, in the learning process in the classroom, students are directed to pay attention to daily activities in cultural life, namely Rojok Loce. In the following section, an illustration will be drawn up with plots such as woven mats that have been made to connect concrete objects to the formal learning process.

The results of the above studies generally show that natural objects or daily activities that are familiar with the child's world can be used as useful learning tools. These objects or activities can reduce the abstractness of mathematical ideas so that they are easier to understand [2,11,12]. In each object or activity contained mathematical concepts that can be explored further for the benefit of learning. Moreover, these objects or activities can be a means that makes it easier for us to communicate mathematical ideas to students. Students can use them as a means of expressing mathematical ideas or understanding both in writing and verbally. This can also be a unique way to motivate students to be more enthusiastic in learning mathematics[13]. To gain a deeper understanding of mathematics,
parental involvement should take into consideration [14]. This is needed so that parents can explain the mathematical concepts in local culture inherited from generation to generation to their children in a family atmosphere that leads to the growth of their children's intelligence.

5. Conclusion
The results of the exploration of the mathematical concept in Loce Manggarai contain mathematical concepts such as Operation Fractions related to the distribution of strands of pandan leaves at the time of preparation of materials. Besides, that, the Traditional Measurement system concept, namely pagat and depa, is used when calculating the Loce size. Then the idea of Flat Build Carving which is related to repetition of patterns carried out by mat craftsmen when weaving to cover each field so as to form a Mat in the shape of a Rectangle and the Concept of Area Build a flat rectangle associated with the results of Loke which is in the form of a flat building between the mathematical concepts found in the traditional mat (Loce) manggarai and the topic of learning in school is the concept of Fractions in Elementary School Class IV education units. Besides, the theory of Measurement in Elementary School Class IV education units. Then the primary material for burial in the SD IV Class IV Education Unit and the idea of measuring the flat building area of the SD IV Grade Education Unit.

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References
[1] Achor E E, Imoko B I and Uloko E S 2009 Effect of ethnomathematics teaching approach on senior secondary students ‘ achievement and retention in locus 4 385–90
[2] Aikpitanyi L A and Eraikhumen L 2017 Mathematics Teachers ’ Use of Ethnomathematics Approach in Mathematics Teaching in Edo State J. Educ. Pract. 8 34–8
[3] Presmeg N C 2014 Ethnomathematics in Teacher Education J. Math. Teach. Educ. 1 317–39
[4] Irfan M, Setiana D S, Ningsih E F, Kusumaningtyas W and Widodo S A 2019 Traditional ceremony ki ageng wonolelo as mathematics learning media J. Phys. Conf. Ser. 1175 1–6
[5] Abdullah A S 2017 ETHNOMATHEMATICS IN PERSPECTIVE OF SUNDAANESE J. Math. Educ. 8 1–16
[6] Biembengut M S 2016 Mathematical modelling , problem solving , project and ethnomathematics : Confluent points CERME 9 - Ninth Congress of the European Society for Research in Mathematics Education, (Prague, Czech Republic: Naďa Vondrová) pp 816–20
[7] Rosa M and Orey D C 2011 Ethnomathematics: the cultural aspects of mathematics Etnomatemática: os aspectos culturais da matemática 4 32–54
[8] Rosa M and Orey D C 2013 Ethnomodeling as a Research Theoretical Framework on Ethnomathematics and Mathematical Modeling J. Urban Math. Educ. 6 62–80
[9] Nggoro A M 2006 Budaya Manggarai: Selayang Pandang (Ruteng: Nusa Indah)
[10] Creswell J W 2012 Educational Research ed M Smith, Paul A.;Robb Christina; Buchholtz (Boston: Pearson Education Inc.)
[11] Orey D C and Rosa M 2016 Ethnomathematics: Teaching and Learning Mathematics from a Multicultural Perspective J. Math. Cult. 6 57–78
[12] Matang R 2002 The Role of Ethnomathematics in Mathematics Education in Papua New Guinea: Implications for mathematics curriculum 24 27–37
[13] D’Ambrosio U 2001 What is ethnomathematics , and how can it help children in schools ? Teach. Child. Math. 7 308–11
[14] Makur A P, Prahmana R C I and Gunur B 2019 How mathematics attitude of mothers in rural area affects their children ’ s achievement J. Phys. Conf. Ser. 1188 012009