Ethnomatematics: how does cigugur traditional community use palintangan on farming

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Abstract. This study discusses the way of Cigugur traditional community in Indonesia doing their calculating on farming. By using realist ethnography, this study reports objectively the information that collected from participant in the Cigugur traditional community through observation, interviews, documentation, and field notes. The findings from this study show that the farming system carried out by the community used formal mathematics principles. The hari cycle and pasaran cycle in Sundanese are as the same as the concept of relations and functions in mathematics. The function in question is injective function. The results of the relations between day “hari” and “pasaran” can be expressed in an order pair to pair. To determine a finest day, the mathematical concepts used by the Cigugur traditional community are the concepts of addition and the concept of comparison. The sum concept is used to add the values of each day to the value of each pasaran. Meanwhile, the concept of comparison is used to compare the value of the sum results with the criteria for determining the finest day for tandur. Ethnomatematics provides different perspectives regarding mathematical conceptuality.

1. Introduction
The formal process carried out in working with mathematics tends to adhere the rigid rules. The transformation of the ability to think from concrete to abstract or vice versa, becomes a difficult activity in learning mathematics. In this case, it is necessary to strengthen the role of applied mathematics in daily life. It shows that mathematics education is an important foundation of science in education [1]. In addition, the role and function of mathematics are also important in the development of people’s lives. Mathematics as part of the science is inseparable from cultural developments Mathematical education needs to be placed as a result and the process of developing a culture. The culture is born because of the ability of human to care about their environment so they are still worthy of living time after time. The culture is seen as a manifestation of the life of every person or group of people who always change nature. It is a human effort, the struggle of every person or group in determining the future to face the challenges of every change.

Education and culture are two things that structurally cannot be separated from one another, both as objects and subjects of scientific studies. Mathematics is a cultural knowledge that grows and develop to connect human needs [2] Mathematics is seen as a tool to meet human needs in living their daily life.
Involving mathematics in every effort to elevate the knowledge is an important value contained in mathematics. In its development, it has always been the subject and object of study primarily aimed at meeting one's needs in life.

This function is a mathematical concept that is oriented towards social goals and cultural goals. So, if mathematics has such social and cultural interests, it is necessary to consider mathematical concepts that will be learned in school and how to teach them [3]. This conception provides an opportunity for someone to learn some parts of the mathematical concepts that are important in living their lives as social beings. However, the value and nature of mathematics will remain in its form to be maintained and developed continually as an integral part in realizing mathematics ideally. Mathematical values related to the nature of mathematics are derived and applied from how a different mathematician culture develops mathematics itself [4].

From the point of view above, it concludes that mathematics and culture are integrated. The slices of the set between cultural anthropology and mathematics and the use of mathematical modeling refer to Ethnomathematics [5]. An important basis for the thinking of Ethnomathematics, based on two things, namely the concept of mathematics and culture as a result of human thought and information processing in the individual cognitive structure. This is done to meet their needs, especially in their social interactions to meet their daily needs. Ethnomathematics is a study in the context of the mathematical culture of society, especially related to mathematical ideas and activities carried out by the community [6].

The context is the original one that is owned by a community. So ethnomatematics can be interpreted as a slice between the authenticity of the socio-cultural context of society with mathematical concepts and activities. On the other hand, ethnomathematics as a way to research mathematics education, study the cultural roots of mathematical ideas given by ethnic, social or professional groups, in other words, ethnomathematics studies seek to follow anthropological studies, trying to identify mathematical problems starting from other knowledge in its form and rationality [7].

At the present, ethnomathematics has become one of the trends in research. The emerge of ethnomathematics as a field of research reflects the growing awareness of the diversity of mathematical activities carried out by people with different kinds of cultures [6]. Pragmatically the main reason underlying the pattern of mathematical development is through the transmission and distribution of mathematical knowledge to help people solve problems in their daily reality [8]. In this regard, it is important to note that there is a difference between mathematics being studied and mathematics known by someone, because not all mathematics that can be applied is applied in everyday life [9].

So, it needs to be explored further about the position of mathematics in social construction. The close relationship between mathematics and culture so that mathematics not only produces culture, but also is developed by culture, so it is important to incorporate mathematics from all cultures [10]. The position of mathematics in social construction provides an understanding that mathematical activity is inseparable from one's social activities in social life. However, practically it has become a common view that mathematics is always related to the practical problems of calculating and recording numbers [11]. This practical problem is usually faced by ordinary people. Ordinary people usually use calculations and recording numbers in everyday life and have even become part of the community, especially in certain indigenous communities.

In 2017 the Indonesian government decided 538 traditional communities and 133 traditional villages. Traditional community is the community that recognized based on customs that are owned and preserved. One of them in Indonesia is the Cigugur traditional community which belongs to the Sundanese tribe. Geographically it is located in Cigugur village of Kuningan District, West Java. A culture that is still maintained is the culture of calculating or predicting the finest days especially in farming. Sundanese people recognize the belief of calculations in all every aspect [12]. It is called Palintangan in Sundanese Language.

Some other terms known by Sundanese people regarding calculations are Tunuk (Naga Village Community in Tasikmalaya District) Tunduk (Ciwidey in Bandung District), Kolenjer (Baduy in Lebak District of Banten) [12]. While Cigugur Traditional community uses Palintangan, especially in
determining a finest day for planting rice. Based on the background above and the preliminary study conducted by the researcher, this article discusses the ethnomatematics study of Palintangan as a determinant of good days, especially in growing rice. Whether we realize it or not, all human activities in the world are carried out based on precise calculations according to the natural conditions in which they live [13]. Therefore, this article will reveal: (1) How to do calculations in the handicap system of the Cigugur traditional community?; (2) What days is considered as finest day by the Cigugur traditional community in planting rice?

2. Methods

This research is a qualitative research that gives greater emphasis to the holistic descriptions that describe in detail about a phenomenon. The study was conducted in Cigugur traditional community, Kuningan District, West Java, Indonesia. In this study, the approach used was the ethnography approach with the realist ethnography category. The exploration of ethnomathematics in this study used six dimensions of basic universal mathematical activity: counting, locating, measuring, designing, playing, and explaining [14]. To adjust to the research objectives, the researcher only uses a number of ethnographic concepts that are relevant to the objectives of the research to be carried out, namely: culture, contextualization, emic perspective, thick description, member checking, and non-judgmental orientation. Data collection in this study was carried out by observation, interviews, documents, field notes, audio recordings, photos and video recordings. Data collection in this study adopted the design of the ethnomathematics study that Alangui had done [15].

| Table 1. The study design ethnomathematics |
|--------------------------------------------|
| **Generic Question** | **Initial Answer** | **Critical Construct** | **Specific Activity** |
| Where to look the focus ethnomathematics research in Cigugur Society to get the primary data. | Cultural practices in a Cultural context, namely the use of the palintangan in determining a good day to plant the rice. | Culture | Conduct interviews with people who have knowledge of barriers, especially those who have knowledge of palintangan. |
| How to look the focus ethnomathematics research in Cigugur Society. | Investigating aspects of QRS (Qualitative, Relational, and Spatial) on determining good days in growing rice. | Alternative Thinking | Determine what QRS ideas are contained in determining good days in growing rice. |
| What it is (finding the possibility of mathematical concepts). | Proof of alternative Concepts | Philosophical Mathematics | Identify criteria for justifying external customary rules in determining good days in planting as mathematical activities. |
| What it means (change the finding to mathematical models) | Significant value of culture and mathematics | Methodology anthropology | Describe the relationship between two forms of knowledge (mathematics and culture). The new mathematical concept was found in determining good days in growing rice. |

The technique of analysis used in this study are content analysis technique, triangulation technique and finding patterns. Content analysis technique will explain in detail about the traditions carried out by research objects so that valid data can be found. The flow of analysis using content analysis is shown in figure 1 below.
Figure 1. Content Analysis Technique

The data analysis activity of this research is carried out interactively and continues until the data is saturated. The steps of data analysis are reduction, data display and conclusion drawing / verification. The process of data analysis begins by examining all data collected from various sources. Notes are distinguished through descriptive notes and reflective notes. Descriptive notes better present events that take place in research while reflective notes highlight more on the frame of mind, ideas so that the contents display comments from the author on existing phenomena. After being studied and studied, the next step is to reduce data so that it finally makes an abstraction. Abstract is an attempt to make a core summary of the research. Then the next step is to arrange one by one and categorization and the final step is to interpret the meaning of the data obtained.

3. Results and Discussion
Cultural diversity is the wealth of the Indonesian people, including the system of local culture that existed in every ethnic in Indonesia. Therefore, the embodiment of this local cultural system generally shows the existence of a local wisdom from a tribe to harmonize with the surrounding environment, in accordance with his life view. Local wisdom is typically practiced in people's lives in an area by applying local knowledge in accordance with the character and behavior of the community as their identity. Dewey states that cultural concepts include various activities and practices in understanding individual thoughts and actions [16].

Calculating is one of the local geniuses that is interesting to be investigated. It is related to mathematical activity which is one of the oldest human civilizations on earth. Calculating is a simple mathematical activity that can never be released in daily activities. The result of calculating the number of things can be called a number, which can be written in the number of symbol. In addition it is carried out as a routine activity in life. It is also done in unique or exclusive activities. One of the unique calculating activities in Sundanese culture is Palintangan or deciding a good day through calculation. This provides reinforcement because of that the cultural context plays an important role in mathematics and science lessons [17].

The Cigugur traditional Community which is part of the Sundanese tribe use Palintangan to determine a finest day especially in planting rice. After finding a day which is the finest, they usually prepares paramodana (sumbisive). Paramodana has the meaning of a recitation, miajen i maparin kamurahannana, oge miajen ka urang anu ngarupi tina murah asih Gusti (for offerings, the results of giving the gift of life as a form of God's love) Sasajen (Offerings) is giving the result of nature production (crops) as an expressions of gratitude for the gifts we receive from Pangeran Si Kang Sawiji-Wiji (God Almighty). The Paramodana is done before planting that provided by the Cigugur traditional community.

The ingredients or component of it are as follows: hanjuang, daun papaliasan, jeruk nipsis, jawer kotok, caringin daun, daun kamuning, tamiang daun, seureuh, jeung duwegan kalapa hejo. It can be seen in figure 2 below.
Palintangan is a knowledge system in the cultural structure of Sundanese. Palintangan is included in one of the local wisdom that is owned by Sundanese in agrarian society that deals with mathematical activities. However, as it was explained earlier, there are several different terms in certain areas to determine finest days, such as kolenjer, tunuk and Tunduk. Unlike the Sundanese, in Bali the term Palintangan is known as the science of astrology which is used to predict the nature and the character of man. Palintangan in sundanese term is used to determine when farmers grow rice (tandur), taught from generation to generation, so that the culture is preserved.

Palintangan is used with the aim of obtaining the harvest that is in accordance with what is desired. However, regarding the truth of the results of calculations carried out by Sundanese, it depends on the beliefs of a person or group of people, so what is expected from the intention or work does not miss too far or even has a negative impact [12]. Palintangan is based on the calculation of day and pasaran names. Every day has a different pasaran, with a cycle that always repeats every day. In order to make it easier to understand the pair between the hari (as a day) cycle and the pasaran cycle, the cycle is shown as follows.

![Figure 3. The cycle of day and pasaran](image)

In mathematics the cycle can be interpreted as a relation and function, where one hari has one pasaran. Examples of applications are: ahad;manis, senen;pahing, salasa;puhun, rebo;wage,
kemis, kaliwon, jumaah, manis, saptu, pahing, and so on. From these two cycles, we can determine the days that are considered good for planting rice. Each hari and pasaran has certain values that are used to calculate good days. Giving values for each day is based on the references described in table 2 below:

| Name of Hari | Value |
|--------------|-------|
| Ahad (as Sunday) | 5     |
| Senen (as Monday) | 4     |
| Salasa (as Tuesday) | 3     |
| Rebo (as Wednesday) | 7     |
| Kemis (as Thursday) | 8     |
| Jumaah (as Friday) | 6     |
| Saptu (as Saturday) | 9     |

Meanwhile, the values in each pasaran that are referenced are shown in the following table 3.

| Name of Pasaran | Value |
|-----------------|-------|
| Manis | 5 |
| Pahing | 9 |
| Puhun | 7 |
| Wage | 4 |
| Kaliwon | 8 |

Determination of a good day, based on a combination of hari and pasaran by summing the value of the hari and the pasaran value. For example, ahad and manis mean 5 + 5 = 10. Furthermore, the criteria used to determine the time before tandur (as a planting rice) there are 4 things that must be remembered in accordance with numbuk (as a right on).

| Value | Criteria | Meaning |
|-------|----------|---------|
| 1 | Sungut (as mouth) | Seeur nyarios jeung seeur dicarioskeun as always talk a lot and the work that will be done is always a reading material so the results are not satisfactory. |
| 2 | Irung (as nose) | Ka ambeu ku hama as Smell by pests. |
| 3 | Mata (as eye) | Katempo ku hama as the rice planted by us is seen by pests so that pests attack the rice we plant. |
| 4 | Ceuli (as ear) | Mung kapireng wungkul as only heard so that the rice plants planted by us are only heard by pests and pests not knowing our rice plants. |

A good calculation for tandur is numbuk di ceuli or in other words, the amount between the value of the day and the pasaran amounts to 4 or multiples there of. In order to make it easier to understand, a matrix is shown as follows.
Table 5. Determination of good days

| Day and Value | Manis | Pasaran and Value | Wage | Kaliwon | Total good day | Good day       |
|---------------|-------|-------------------|------|---------|---------------|---------------|
| Ahad          | 5     | 10                | 12   | 9       | 13            | 1 Ahad Puhun  |
| Senen         | 4     | 9                 | 13   | 11      | 8             | 12            | 1 Senen Wage |
| Salasa        | 3     | 8                 | 12   | 10      | 11            | 2 Salasa Manis & Salasa Pahing |
| Rebo          | 7     | 12                | 16   | 14      | 11            | 15            | 2 Rebo Manis & Rebo Pahing |
| Kemis         | 8     | 13                | 17   | 15      | 12            | 16            | 2 Kemis Wage & Kemis Kaliwon |
| Jumaah        | 6     | 11                | 15   | 13      | 10            | 14            | 0             |
| Saptu         | 9     | 14                | 18   | 16      | 13            | 17            | 1 Saptu Puhun |

Based on the table above, it can be concluded that there are 35 pairs between the hari cycle and the pasaran cycle, of the 35 pairs there are only 9 days which are considered as “finest” which can be used to planting rice. From the mathematical aspects of the hari cycle and the pasaran cycle in figure 3 is the concept of relations and functions. The function in question is injective function. The results of the relations between day and pasaran can be expressed in an ordered pair of pairs, eg set A and B. A = {ahad, senen, salasa, rebo, kemis, jumaah, saptu} and B = {manis, pahing, puhun, wage, kaliwon}. Set A x B is shown in table 5 above, A x B = 35. To determine a good day, the mathematical concepts used by the Cigugur traditional community are the concepts of addition and the concept of comparison. The sum concept is used to add the values of each hari to the value of each pasaran. Meanwhile, the concept of comparison is used to compare the value of the sum results with the criteria for determining the finest day for tandur.

Based on the description above, the mathematical concept turns out to be inseparable from the daily life of the community, especially in carrying out calculation activities. Mathematics can be seen as a very important science because it is produced and used in human activities. Mathematics, both in general and specifically integrated with human life, is difficult to separate from one another. Thus, the role of mathematics can be said as the backbone that can be used to investigate scientific technology and activities in human development [18]. In other words, the ethnomatematic power generated in this study challenges the assumption that mathematics is only produced by mathematicians [19]. Ethnomathematics provides a good way to express mathematical concepts that grow and develop naturally in certain people’s lives according to their daily needs.

4. Conclusion

Palintangan is a calculating system that included in a cultural system of knowledge to calculate/ forecast finest day belonging to the belief system (religion) in the study of Sundanese culture. Palintangan as a cultural product related to mathematical activities. This calculation system uses mathematical concepts, especially the concepts of relations and functions, the concept of addition and the concept of comparison. Based on this study, ethnomathematics studies can be used to reveal mathematics ideally and activities used in certain cultures. Thus, in terms of concepts and applications, mathematics can have different forms from other cultures. Formally, Cigugur traditional community did not studying mathematics, but they understood the concepts of relations and functions, the concept of addition and the concept of comparative application. Unwittingly, they use mathematical principles to begin their work in supporting their livelihoods in farming without them knowing it. Thus, it can be concluded that ethnomathematics are complex and dynamic representations that are influenced by socio-cultural factors regarding the application of mathematics in the life of a cultural community. Mathematics is the art of thinking and communicating the idea of a cultural product, its development is in accordance with the culture that grows and develops in the community in an area.
References

[1] A. Umay, “The ability of mathematical reasoning,” *Hacettepe Univ. J. Educ. Fac.*, vol. 24, pp. 234–243, 2003.

[2] G. Knijnik, “Ethno-Mathematical Approach in Mathematical Education: a Matter of Political Power,” *Learn. Math.*, vol. 13, no. 2, pp. 23–25, 1993.

[3] A. Noyes, *Rethinking School Mathematics*, vol. 1. London: PCP Sage Publications Company, 2007.

[4] A. J. Bishop, “Mathematics Teaching and Democratic Education,” *Eur. J. Teach. Educ.*, vol. 25, no. 1, pp. 77–81, 2002.

[5] D. C. Orey and M. Rosa, “Ethnomathematics: Cultural Assertions and Challenges Toward Pedagogical Action,” *J. Math. Cult.*, vol. 1, no. May 2006, pp. 139–148, 2004.

[6] P. Gerdes, “Ethnomathematics as a New Research Field, Illustrated by Studies of Mathematical Ideas in African History,” *Sci. Cult. Divers. Filing a gap Hist. Sci. Cuad. Quipu*, vol. 5, pp. 10–34, 2001.

[7] M. do C. S. Domite, “Notes on teacher education: an ethnomathematical perspective,” 2004, pp. 17–28.

[8] K. Francois and B. Van Kerkhove, “Ethnomathematics and the philosophy of mathematics (education),” no. January, pp. 121–154, 2010.

[9] B. Ojose, “Mathematics Literacy: Are We Able To Put The Mathematics We Learn Into Everyday Use?,” *J. Math. Educ.*, vol. 4, no. 1, pp. 89–100, 2011.

[10] G. Knijnik, “Brazilian peasant mathematics, school mathematics and adult education,” *Adults Learn. Math.*, vol. 2, no. 2, pp. 54–62, 2007.

[11] B. G. Kartasasimta and Wahyudin, *Sejarah dan Filsafat Matematika*. Jakarta: Universitas Terbuka, 2014.

[12] E. Suryatamana, D. U. Ahmad, E. Ane, and T. Wartini, *Paririmbon Sunda (Jawa Barat)*. Jakarta: Direktorat Jenderal Kebudayaan, 1992.

[13] Haryanto, N. Toto, Subanji, and Abadyo, “Ethnomathematics in Arfak (West Papua Indonesia): Hidden Mathematics on knot of Rumah Kaki Seribu,” *Educ. Res. Rev.*, vol. 11, no. 7, pp. 420–425, 2016.

[14] Turmudi, D. Juandi, A. S. Hidayat, E. Puspita, and A. S. Ulum, “Exploring Ethnomathematics: How the baduy of indonesie use traditional mathematics skills in weaving,” *Int. J. Control Theory Appl.*, vol. 9, no. 23, pp. 323–339, 2016.

[15] M. A. Syahrin, T. Turmudi, and E. Puspita, “Study ethnomathematics of aboge (alif, rebo, wage) calendar as determinant of the great days of Islam and traditional ceremony in Cirebon Kasepuhan Palace,” *AIP Conf. Proc.*, vol. 1708, 2016.

[16] R. Miettinen, “The concept of experiential learning and John Dewey’s theory of reflective thought and action,” *Int. J. Lifelong Educ.*, vol. 19, no. 1, pp. 54–72, 2000.

[17] R. E. Simamora, S. Saragih, and H. Siregar, “Improving Students’ Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context,” vol. 14, no. 1, pp. 61–72, 2019.

[18] L. A. Aikpitanyi and L. Eraikhuemen, “Mathematics Teachers’ Use of Ethnomathematics Approach in Mathematics Teaching in Edo State,” *J. Educ. Pract.*, vol. 8, no. 4, pp. 34–38, 2017.

[19] M. C. Borba, “Teaching mathematics: Ethnomathematics, the voice of sociocultural groups,” *Clear. House*, vol. 65, no. 3, pp. 134–135, 1992.