Exploration of ethnomathematics on the kampung naga indigenous peoples

R Hermanto$^{1,2}$, Wahyudin$^2$, E Nurlaelah$^2$

$^1$Universitas Siliwangi, Jl. Siliwangi No. 24, Tasikmalaya, Indonesia
$^2$Universitas Pendidikan Indonesia, Jl. Setiabudi No. 229, Bandung, Indonesia

Email: redihermanto@unsil.ac.id

Abstract. Ethnomathematics is a study that observes how certain groups of people understand, articulate, and use mathematical concepts or ideas in their lives. The indigenous people of Kampung Naga have a diversity of cultures, traditions, and value systems that are still well cared and maintained until today. This cultural activity is patterned, structured, and has a form in everyday life and has become a belief that is embedded in the form of local wisdom. This study aims to explore the concept of ethnomathematics that emerged and was pragmatically involved in the daily life activities of the Kampung Naga indigenous people based on a review of aspects of mathematics. This research is a qualitative study using ethnographic models.

1. Introduction

Indonesia is a nation that is rich in culture. The existence and noble values of culture play an essential role in the life of the nation and state. The existence of culture and the diversity of the noble values of culture possessed by the Indonesian people are a means of building the character of citizens. Countries that can maintain and preserve cultural values can develop well and be able to minimize the social ailments of the community. Based on this, cultural integration in the field of education is one solution in instilling the noble values of culture for future generations.

Informal education, one of the subjects that can facilitate the integration process in mathematics. Mathematics and culture are two things that are strictly related and can be mutually explained through various cultures and activities of people's lives [1,2,3]. People use mathematics in their daily lives so that mathematics has become one with culture. Therefore, mathematics is always present in social activities and human activities [4,5].

The involvement of mathematics in daily human activities is not only found in the culture of modern society or academics, but mathematics is also present in the lives of traditional communities or indigenous peoples. For example in Tasikmalaya, West Java, the Kampung Naga indigenous people, they were able to design geometric structures, play activities, make hunting equipment, instinctively geometric crafts without ever taking formal education about geometric concepts. This also occurs in several other indigenous communities such as Baduy [6], Cirebon [7], Java [8] and Dayak [9], also in the world as reported in Africa [10], Incas in Peru [11], Micronesia [12], India [13], Portugal [14].

Although mathematics is always present in every human activity, but not a few ways of thinking that people have not used mathematics in everyday life, in general, the mathematics that develops in society has not yet reached its function in solving everyday problems [15]. Though there are many economic benefits that can be obtained if applying mathematics in overcoming everyday problems such as the pattern of farming, trading, transportation, and social activities even in decision-making.
and policy, through a cultural approach, mathematics can be more meaningful and provide a solution in responding to real community challenges [16].

From education, the context of mathematics taken from culture provides concepts that can be developed in the curriculum and learning to train how students provide views or solutions to everyday problems. It is this cultural context that will train students' thinking that can provide a more realistic learning experience [17]. The real learning experience must be an essential concern so that students do not feel bored in learning and get more meaningful motivation in school.

On the other hand, school mathematics now stands alone so formally, and as if it is detached from the culture [18]. Mathematics is regarded as something neutral and free from culture (culturally-free) [19]. The mathematics that is far from everyday life is the fruit of the absolute paradigm that develops in society that is a view that considers that mathematics is a perfect science with objective truth, far from the affairs of human life. As a result, students feel less benefit from learning mathematics. Even if it is developed more deeply, there are many ways to teach mathematics from the culture or the surrounding environment. A variety of everyday community activities contain elements of mathematics such as counting, measuring, designing, and even traditional games that are still popular with children today.

One of the problems in education is the learning process that only conveys what is written in the curriculum without linking it to the contextual problems that students often encounter daily. One study states that most prospective teachers make the context of the question through their imagination and not infrequently the question is actually not logical for students' thinking and can never really be found in everyday life [20]. In implementing problem-based learning, the most significant difficulty for prospective teachers is to present problems related to the real context. Therefore, studying mathematics from an aesthetic point of view can be an alternative to enriching contextual knowledge in mathematics learning.

Mathematicians expressed their opinions about mathematics based on their perspectives, abilities, and understanding. Mathematics can be seen as a product of human intellectual thought and as a thought process. Intellectual thinking can be encouraged by problems of thought alone and problems that concern real life every day. Mathematics deals with ideas (ideas), mathematics is not a sign as a result of pencil strokes, not a collection of physical objects in the form of triangles, but in the form of ideas represented by physical objects. So, there are three main characteristics of mathematics. First, mathematics is an object found and created by humans. Second, mathematics is not created by itself but arises from activities whose objects are available, as well as from the needs of science and everyday life. Third, once created, a mathematical object Haswell-determined properties. Therefore we need a way to teach mathematics that is initiated from facts to formality, not from concepts that are then explained through examples of questions and contexts [21].

The domain of study that can be used to show the relationship between mathematics and culture is ethnomathematics. Ethnomathematics is considered as the study of knowledge which is primarily related to cultural groups and their ownership, which makes it closely related to reality and can be expressed by language, which is usually different from that used by mathematics. Ethnomathematics can also be seen as a domain of research studies that examine the way a group of people in a particular culture understand, express, and use cultural concepts and practices described by researchers as mathematical things [22, 23].

The idea of integrating culture in mathematics is not wrong. Utilizing mathematics as a vehicle for cultural integration and the flow of globalization in the form of the development of information technology is undoubtedly more natural because mathematics itself comes from culture. Mathematics originally came from various cultures and can be a source of inspiration for students from their own culture. The primary and extreme assumptions need to be stated in ethnomathematics research. Correctly, the assumption reads "all formal forms of mathematics education are processes of cultural interaction, so that every student (also a teacher) has experience in the form of cultural conflicts in the process [23]. It is in accordance with the concept of mathematics education which was initiated by the D'Ambrosio ethnomathematics originator who said that before school and (also) outside of school.
almost all children in the world had become 'mature' meaning they were able to develop the ability to use numbers, counting, and using several inference patterns, but the school provides a formal approach to these facts which results in psychological blockages [23].

The reason for the importance of reviewing ethnomathematics can be seen from two aspects, namely cultural and educational aspects. According to cultural aspects, the same activities in a different society are likely to use a different mathematical mindset so that that in-depth study can be a primary reference for the development of mathematics. It has been much evidenced by the fact that most mathematical patterns begin with induction, which is the result of observing a phenomenon in the field. In terms of education, mathematics educators should consider ethnic-education so that students feel the usefulness of mathematics itself [24].

Noting the critical role of ethnomathematics in the development of mathematical education, further exploration and inventory of cultures in Indonesia is needed. It is deemed necessary because cultural diversity in Indonesia is a vast potential for in-depth exploration. Therefore, cultural exploration activities in an area in Indonesia can be expressly stated as research in mathematics education. One area that has diverse cultures and still maintains its tradition and existence to date is in Kampung Naga, Tasikmalaya Regency. The Kampung Naga indigenous people from generation to generation still maintain and inherit traditions from generation to generation [25].

The involvement of mathematics has a crucial role in the daily activities of the indigenous people of Kampung Naga so that until now the traditions can still be maintained and inherited. It is just that they do not know and do not realize that they are mathematical. One proof that the indigenous people of Kampung Naga also know mathematics is shown by the skills of the indigenous people of Kampung Naga in making various crafts and designing constructs in the form of geometry. Also, traditional houses in Kampung Naga, conditions for mathematical concepts that can be explored more deeply, especially regarding the elements or beliefs of the indigenous people of Kampung Naga in calculating/determining the time of making/renovating traditional houses that have been maintained for generations.

The study of a culture can be viewed from several aspects, namely mathematics aspects, mathematical modeling, and cultural anthropology. For example, the skills of the indigenous people of Kampung Naga in making various crafts when examined from a mathematical aspect it was evident that they were familiar with the concept of geometry which was part of mathematics. From the aspects of mathematical modeling can be explored how their processes describe the way of thinking mathematically, they may be able to construct a geometric construct in its way (different from what is taught in school). Mathematical modeling that is based on people’s thinking is what will add to the richness of the study of mathematics education. From the anthropological concept of culture they may not see it as a mathematician but instead viewed from a humanitarian point of view that they must work to fulfill their life needs by making a variety of exciting crafts.

Crafts made by the indigenous people of Kampung Naga use many ingredients from nature, such as bamboo [26]. They make it with a limited amount and are sold to tourists visiting their area. From an economic standpoint, it would be mathematically more profitable if they could produce more quantities of goods for sale in bulk. However, from an aesthetic point of view, they think that nature should be used well and as needed not to be exploited thoroughly. The researcher views that studying culture from various perspectives will produce more comprehensive and prudent knowledge. Therefore, mathematical researchers who observe culture not only see it from a mathematical point of view but also speak from culture and character values.

Based on the things described earlier, the researchers felt interested in studying the cultural ethnomathematics of the Kampung Naga indigenous people for several reasons, including ethnomathematics research which had a high urgency which was also becoming a trend in the field of education and culture; there are many cultures that characterize the Kampung Naga indigenous community and are local, regional wisdom, and the role of formal education in Kampung Naga is very minimal. Also, the philosophy of the Kampung Naga indigenous community which is full of meaning is the main attraction for researchers, namely learning from nature, learning with nature, and learning
for nature. The purpose of this study is to examine the concepts of ethnomathematics on culture, and the mindset of the Kampung Naga indigenous people analyzed based on a review of mathematical aspects. The researcher intends to explore the ethnomathematics concepts of the Kampung Naga indigenous people that emerge and are involved more pragmatically in daily life.

2. Method
This research is qualitative research using ethnographic models. Ethnography is one of the research models that have more to do with anthropology, studying cultural events, presenting the life view of subjects that are the object of study. Another opinion reveals that ethnography seeks to understand the relationship between culture and behavior, with a culture that refers to beliefs, values, concepts, practices, and attitudes of certain groups.

The source of research data was selected purposively with specific considerations and objectives. The sources of data taken in this study are those who understand the activities of the indigenous people of Kampung Naga in making a variety of crafts and designing constructs in the form of geometry and digging deeper into the elements or beliefs of the Kampung Naga indigenous people in calculating/determining the time of making/renovating houses adat.

This research was conducted in Kampung Naga Neglasari Village, Salawu Sub-District, Tasikmalaya District, West Java, Indonesia. Data collection in this study aims to gather information from various sources. This information is obtained through observation, interviews, field notes, and document analysis. The study was conducted in the range of January to April 2019.

3. Results and Discussion
Based on the cultural activities that develop in the Kampung Naga community, we can see that there are many contexts of lessons that they have applied in real terms. They have learned the language well, even the traditional language of Sunda Buhun, which is now almost undergoing widespread changes in West Javanese society in general. Lots of cultural activities that contain elements of mathematics. These activities can be seen in community activities such as counting, measuring, and build designs. The following is described in detail the activities of the people of Kampung Naga that have mathematical nuances.

3.1. Counting Activity
Counts related to the question "how much." Most of the people of Kampung Naga, especially children, use their fingers as a tool to count. The technique of counting is not much different from society in general, only the cultural language they use is in Sundanese: hiji, dua, tilu, opat, lima, genep, tujuh, dalapan, salapan, and sapuluh. The numbers show numbers one to ten. Most of the people of Kampung Naga use numbers to count the number of livestock, the number of hunting equipment, the number of families and even the number of families and homes that exist in the village. In terms of counting, there is no difference in principle with the community in general apart from the language aspects used.

3.2. Measuring Activity
Measuring is generally related to the question "how much (length, length/width/height, and length)." To express a lot, the Kampung Naga community uses several terms such as: saiket (one tie), sakeupeul (one head), sacanggeum (one open hand grip), salosin (one dozen), sakodi (one score), satasbeh (one round of prayer beads 99), saliter (one liter), sajolang (one large basin), sasendok (one spoon), sagelas (one glass). To declare length, the people of Kampung Naga use terms such as sajeungkal (one inch), sadeupa (along the stretch of left and right hands), saawi (along with bamboo trees) usually used to express the height/depth. They recognize remote units in the form of meters and centimeters, but in everyday life, they often use measurements in local languages. To state the old size, the people of Kampung Naga usually use a number of terms as follows: sabedug (one day, from 7 to 12), saweton/sanaptu (a deadline determined based on the day of birth), for example, those born on
Wednesday, then saweton means 7 days because Wednesday has 7 meaning, in other words, different days have different meanings, katujuhna (seventh day) is usually used to indicate the seventh day of someone who has died, and this is used for praying together, sawindu (eight years), sapurnama (from full moon to full moon).

3.3. Build Design Activity
Creating a design is a mathematical context that is a feature of almost all indigenous peoples everywhere. It is because the lives of indigenous people are usually synonymous with traditional and well-organized buildings. Making design is synonymous with the use of geometric concepts in real life. On one side, the people of Kampung Naga did not study mathematics (geometry) formally through school, but they were able to develop it so well that it made it special. There are many types of everyday equipment that contain geometric elements, the content of wadah runtah, pager, dulag/bedug, aseupan, and nyiru.

3.3.1. Wadah Runtah
The wadah runtah is a garbage dump made by the community to facilitate visitors/tourists visiting Kampung Naga. We will find this container along the road after we enter the Kampung Naga area.

![Wadah Runtah](image1.jpg)

Based on Figure 1, it can be seen that the crumbling container has an ellipsoid geometric shape whose surface is made of woven bamboo.

3.3.2. Pager
Pager, or better known as the fence, is a barrier for the Kampung Naga community. Pager is arranged from bamboo which is cut to the same size and then woven with a more loose design. Beeper design is also inseparable from the concept of geometry, namely alignment (Figure 2).

![Pager](image2.jpg)

3.3.3. Dulag/Bedug
Dulag/bedug or more popular by calling drum also forms part of the traditional equipment of the Kampung Naga community. The function of dulag in Kampung Naga is significant, namely as a warning or a call to perform prayer services. Occasionally dulag is used for news or gathering gatherings. Its role is significant because the people of Kampung Naga do not use electricity in their
daily lives. The shape of the dulag resembles a tube-shaped build made of wood whose perforated center (Figure 3). One of the bases is covered with sheepskin or buffalo skin. The severity of the punch and the quality of the skin determine the quality of the sound produced.

![Figure 3. Bedug/Dulag](image)

3.3.4. Aseupan

Aseupan is cooking equipment used for steaming rice or other food on the stove. The shape of the single intake is by constructing cone geometry (Figure 4).

![Figure 4. Aseupan](image)

The people of Kampung Naga made the intake by combining woven bamboo in the form of cone nets which were affixed to a circular ring of bamboo.

3.3.5. Nyiru

Nyiru is around household appliance made of woven bamboo and is used to win rice. Based on Figure 5, it can be seen that it resembles the shape of circular geometry. If observed, it has a perfect circle shape.

![Figure 5. Nyiru](image)

3.4. Provisions in the making/ renovating residential houses

The residence of the indigenous people of Kampung Naga is a traditional house that is thick with Sundanese traditional traditions so that in the pre-construction process until after construction there are rules that should not be violated by the owner who will build or renovate the house. The rules of building a house in Kampung Naga are certainly made transparent so that no deviant actions will hinder development. Several things must be considered in making a house building. One of them is in
determining the size of the building area to be built according to the day of birth of the husband and wife partner as residents of the house.

Birthday is used by the people of Kampung Naga to measure the area of the house to be built. The land area to be used to build a house must pay attention to the day of birth that will occupy it, where every day has a specific value, for example, Monday = 4; Tuesday = 3; Wednesday = 7; Thursday = 8; Friday = 6; Saturday = 9; and Sunday = 5. This calculation is not used anymore, because now every house building in Kampung Naga already has its owner who will be inherited from its descendants, but this calculation is used by predecessors when land to build residential buildings is still available. Currently, the calculation based on the birthday is usually used if there are residents of Kampung Naga who will renovate their homes. In its calculations, the people of Kampung Naga have their procedures, namely:

\[ A_B = V_H \times V_W \]

Information:
\( A_B \) = Area of the house to be built.
\( V_H \) = Value of day based on husband's birthday
\( V_W \) = Value of day based on wife's birthday

The results obtained from \( A_B \) must be divided by 3, resulting in numbers of numbers (1 and 2). This \( panghurip \) number is needed because it is believed that fortune is always there. If the remainder of the distribution of \( A_B \) by number 3 is left 0 (zero), it means that there is no number of \( panghurip \), so the sustenance will be bungblas (no sustenance comes).

For example, there is a married couple who will build or renovate a house. Husband's birthday on Monday while the wife is born on Wednesday, then: \( V_H = 4 \) and \( V_W = 7 \), so that \( A_B = V_H \times V_W = 28 \mod 3 = 1 \) (\( panghurip \) number). Based on the calculation results, it is obtained that the \( panghurip \) number is equal to 1, then the house to be built is 28 m\(^2\). If the \( panghurip \) number is equal to 0, then the size of the side length must be changed to a decimal number, so that the left-hand number is at least 1 m\(^2\). For example, if \( V_H = 8 \) and \( V_W = 6 \), so that \( A_B = 48 \mod 3 = 0 \). The thing to do is to subtract \( A_B \) by 1 (\( panghurip \) number), so that the building must be 47 m\(^2\), but it is necessary to find a length combination, and the width of the house is in the form of decimal numbers, so that the area is close to 47 m\(^2\) (length = 4 deupa and sajeungkal; width = 3 deupa and sajeungkal) where sadeupa = ± 1.7 meters and sajeungkal = ± 0.28 meters. Based on the illustration above, it turns out that the Kampung Naga indigenous people have carried out mathematical activities, even though in reality, they did not realize that they were doing mathematical activities.

4. Conclusion
Based on the results of the discussion above, the conclusions from this study are as follows. First, various cultural activities of the Kampung Naga indigenous people contain elements of mathematics. These activities can be seen from community activities such as counting, measuring, and making bamboo-based equipment through the weaving process. Counting and measuring activities involve elements of mathematics that involve regional cultural patterns by using Sundanese terms while making equipment is carried out in order to fulfill daily needs by wisely utilizing the surrounding natural wealth. The forms of the equipment contain elements of geometry. Secondly, the Kampung Naga indigenous people have provisions that are still believed today. One of them is the provision in determining the length and size of the lengths of houses that will be made /renovated by applying the modulo three concepts in the calculation.

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