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SUNDANESE ETHNOMATHEMATICS: MATHEMATICAL ACTIVITIES IN ESTIMATING, MEASURING, AND MAKING PATTERNS

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Abstract

Mathematics is a form of culture integrated in all aspects of society, wherever there are, including the sundanese ethnic communities. This enables the mathematical concepts embedded in cultural practices and recognizes that all people develop a special way of doing mathematics called ethnomathematics activities. Sundanese ethnomathematics is mathematics in sundanese culture implemented in community activities. Sundanese ethnic sundanese people living in the area of West Java Indonesia, speaking sundanese language, and having activities reflecting sundanese culture. Sundanese ethnomathematics in this study has three activities, namely estimating, measuring, and making patterns appearing in the activities in term of *kibik* (a unit for measuring volume), *bata* (a unit for measuring surface area), and path *pihuntuan* (a model of cane work).

Keywords: Sundanese Ethnomathematics, Estimating, Measuring, Making Pattern

Abstrak

Matematika merupakan suatu bentuk budaya yang terintegrasi pada seluruh aspek kehidupan masyarakat dimanapun berada, termasuk masyarakat etnis sunda. Hal ini memungkinkan adanya konsep-konsep matematika tertanam di dalam praktek-praktek budaya dan mengakui bahwa semua orang mengembangkan cara khusus dalam melakukan aktivitas matematika yang disebut etnomatematika. Etnomatematika sunda adalah matematika dalam budaya sunda yang diterapkan dalam aktivitas masyarakat etnis sunda. Etnis sunda adalah orang sunda yang mendiami wilayah Jawa Barat Indonesia, berbahasa sunda, dan beraktivitas yang mencerminkan adat budaya sunda. Etnomatematika sunda dalam penelitian ini berupa tiga aktivitas, yaitu: menaksir, mengukur, dan membuat pola. Dari ketiga aktivitas tersebut muncul istilah *kibik* (satuan untuk mengukur volume), *bata* (satuan untuk mengukur luas lahan), dan jalur *pihuntuan* (model ayaman).

Kata kunci: Etnomatematika *Urang* Sunda, Menaksir, Mengukur, Membuat Pola

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Mathematics is a universal knowledge, and underlie the development of science and technology. Mathematics is an inherent knowledge in the activities of life, where every activity is inseparable from mathematical activity (Nurhasanah, Kusumah, & Sabandar, 2017; Prahmana, Zulkardi, & Hartono, 2012). In the market, in the fields, and in various places of human activity. Mathematical phenomenon is always present, even many human activities are unwittingly part of mathematics (Sembiring, 2010; Young, 2017). In other words, that the math is very close to the culture in the context of the behavior or habit that has existed since ancient times and is done for generations.

In historical perspective, mathematics grew and evolved from cultural customs or generally accepted and agreed upon. See, how the birth of geometry in the days of Babylon and ancient Egyptian civilization around 5000 BC or 4000 BC to 500 BC (Prahmana, et all. 2016). The use of visible geometry of constructions ancient civilizations, such as irrigation, flood control, drainage of swamps and large buildings. In ancient Egypt, the geometry used to construct the boundaries of land on the banks of the Nile due to flooding. Floods continue to hit banks of the Nile has removed the boundaries of land owned by the local community. Egyptians strived to redefine the boundaries of the land, without reducing the area of previously owned. The Egyptians later found a long and extensive measurement system as agreed land boundary demarcation by the community and used to solve the problem when the land is tilled flooded.

In a further development, the Babylonian and ancient Egyptian civilization is regarded as the forerunner of the birth of the branches of knowledge of mathematics, i.e. geometry. Knowledge that appears first is the culture, such as: experiment, observation, assumed / estimated or activities that are intuitive, then evolved into a standard and universal knowledge. Geometry is then subjected golden peak in the era of Euclid (300 BC) with the construction of knowledge of geometry through an axiomatic system. Basic geometric forms have been widely used in previous community culture as *primitive concept* (knowledge base, a concept which is not defined). Links between this concepts gave birth to the definitions, postulates / axioms and theorems that build a deductive system. Deductive system is then accepted as the mathematical knowledge and placing geometry as a branch of mathematics.

Referring to how mathematics is found, the historical facts show that the birth of mathematics cannot be separated from the culture from one era to the next. The fact, therefore, very appropriate if mathematics is seen as a product of culture (Sardjiyo & Pannen, 2005). Because mathematics is a cultural product, the development of mathematics would not be separated from the development of existing culture. In contrast, the extent of mathematical knowledge is growing and has implications for how mathematics influence the development of culture in order to achieve a civilization.

Basically, the human civilization is inseparable from the development of culture and mathematics. Nevertheless, because of the way to get it is different, not least appear skeptical that many people are actually culture cannot be separated from mathematical activity, but not be considered separately or illumination for the development of mathematics today. This search is a study called ethnomathematics. Ethnomathematics is mathematics applied by certain cultural groups, labor groups / farmers, children of a certain class of society, the professional classes, etc. (D'Ambrosio, 1985; Gerdes, 1994). Culture in this context has a broad and unique perspective as well as attached to the customs of the people, for example: gardening, playing, creating, and solving a problem, how to dress, and so on.

In particular ethnicity, culture inherent in society are typical and may vary with other ethnic groups. For example, how sundanese measuring unit numbers and objects usually calculated by using the tools of the group (Abdullah, 2017), such as:

1. *Sajodo,* describe two pairs of different types, is used to describe the number of couples, one partner is composed of two types.
2. *Salosin*, describe the same number equal to 12.
3. *Sakodi,* describe the same number equal to 20.
4. *Salikur,* describe the same number equal to 21.
5. *Salawe,* describe the same number equal to 25.
6. *Saraju,* describe the same number equal to 40.
7. *Sawidak,* describe the same number equal to 60
8. *Sagros,* describe the same number equal to 144.
9. *Salaksa,* describe the same number equal to 10.000.
10. *Saketi,* describe the same number equal to 100.000.
11. *Sayuta,* describe the same number equal to 1.000.000.
12. *Saeuheum,* describe the numbers aplenty, equal to infinite.

In using time sundanese described through the symbols of expressions adapted to the natural conditions (Abdullah, 2017), such as:

1. *Wanci tumorék,* equivalent to hours of 00.30 pm, describe the time was sleeping soundly.
2. *Wanci janari leutik,* equivalent to hours of 01.30 pm, describe a good time to get ready for the evening prayer and vulnerable time of the crime.
3. *Wanci disada rorongkéng,* equivalent to hours of 02.30 pm, the time *kongkorongok* sound of rooster once.
4. *Wanci haliwawar,* equivalent to hours of 03.00 pm until 03.30 pm, the time *kongkorongok* sound of rooster twice, describes the night time will end, people started to prepare the afternoon activities and portray a good time for the evening prayer.
5. *Wanci harieum beungeut,* equivalent to hours of 05.15 pm, describes the time it was still dark, and will soon be turned into lunch, preparation for work.
6. *Wanci carancang tihang,* equivalent to hours of 05.30 pm, describe the timing remain unclear, but it can be viewed with vague, describing a great time to get ready to go to start the job.
7. *Wanci haneut moyan,* equivalent to hours 07.00 pm until 09.00 pm, describe the perfect time to enjoy the fresh sunshine.
8. *Wanci pecat sawed,* equivalent to hours 10.00 pm, describes the use of buffalo resting time in helping people work, is currently working on the fields in preparation for planting.
9. *Wanci manceran,* equivalent to hours 12.00 pm, describes the time the sun was right overhead and the weather was very hot.
10. *Wanci lingsir panonpoe,* equivalent to hours 15.00 pm, describe the time is approaching human activity in the work will end.

11. *Wanci sariak layung,* equivalent to hours 17.30 pm hour, depicts a sun almost set, but the light still looks beautiful, lunch will soon change with the night.
12. *Wanci sareupna,* equivalent to hours 17.45 pm hour before sunset, describing it is time stops of human activities, especially the children to get some rest.
13. *Wanci sanekala,* equivalent to hours 18.00 pm, before sunset, usually used to scare young children as soon turn during the night.
14. *Wanci reureuh budak,* equivalent to hours 19.00 pm until 20.00 pm, depict the children had slept soundly for the rest.
15. *Wanci tengah peting-jemplang-jempling,* equivalent to hours 24.00 pm, it's time to sleep soundly.
16. *Ba'da subuh, ba'da lohor, ba'da ashar, ba'da magrib, and ba'da Isha,* indicating the time after the prayer, usually used to invite important meetings in the community.

In games sundanese, the rules thick with mathematics, such as: *bubudugan, gatrik, galah* (concept of chance, subtraction, and summation), *dam-daman, lelempengan, encrak, sunda manda, congklak* (the concept of arithmetic operations and modulo), *pecle* (the concept of geometry, symmetry folding, and nets), *etc.,* and more sundanese culture is very strong with a mathematical activity.

Behind the terms mentioned above, in fact many behaviors and habits sundanese interesting for further study. The behavior and habits seen from sundanese activity in doing three activities, namely: estimate, measure and make patterns. In the assessing activity, the term *kibik* used sundanese to estimate the volume of logs (either already finished or still in the forest), the volume of stone or brick (usually collected at the home page), and so forth.

In making pattern activity emerges *pihuntuan* term. *Pihuntuan* a benchmark *(ugeran)* used to construct sundanese bamboo craft that became typical of Sunda. In the measuring activity (eg in land measuring paddies, fields, and gardens) the term *bata. Bata* shows land area is measured and is equal to $14\frac{2}{7}$ m^2, or they sometimes made up his number to 14 m^2. It is unique from the use of this term *bata* is how the activity sundanese conducting measurements on fields or gardens form an irregular (non-Euclidean geometry).

The third addition to the above activities, there are many more behaviors and customs sundanese that can be categorized in ethnomathematics. Although all three activities that becomes a moot point in this study do not represent the whole culture of sunda (sundanese cultural exploration), but focus on mathematical concepts (shown) are practiced in sundanese culture. In other words how sundanese math according to the customs or habits inherent in their daily lives.

Related to study ethnomathematics, this research focused on two things, namely: (1) how sundanese activity mathematically in everyday life, and (2) how sundanese practice mathematical concepts in the cultural life of their everyday. The first study seeks to unravel the mathematical activity

that unwittingly do sundanese. The knowledge gained from this first study will possibly generate new mathematical knowledge, both from the perspective of mathematics or mathematics education. The second study sought to uncover the extent of the underlying concepts sundanese (in accordance with the understanding) to solve the problems encountered in the reality of life. This second study gives more space on culture-based math learning, namely how to understand a mathematical concept based on contextual issues that arise in sundanese culture. This study fits the idea that D'Ambrosio said that the teaching of mathematics for everyone should be adapted to the culture (Shirley, 1995).

METHOD

The method used in this research is exploratory with an ethnographic approach. Explorative method is a method used to find, explore and find a symptom or event by conducting an assessment of the symptoms (Gulo, 2000; Prahmana, 2017). While the approach of ethnography, is a research approach with the involvement of researchers in the association sunda among the sites selected (Spradley, 2006). The location of this research is Cigandol, Sukasetia Village, District Cisayong, Tasikmalaya district of West Java Province, Indonesia. Geographically, the location of the research lies in the tribal Galunggung. In the history of sunda, Galunggung is the name of a small kingdom that was formerly part of the Sunda Kingdom. The Kingdom of Galunggung is sunda ancestor who became one of the forerunner of the birth of Tasikmalaya district.

The focus of this research is ethnomathematics of sunda in relation to the sundanese culture activities: estimating, measuring and making patterns. Sundanese refers studied subject, and generally behave *nyunda* stay in the township. *Nyunda* behavior is reflected in some selected figures as informants reflect the observed behavior sundanese. To get comprehensive data on study focuses on the study, data were collected through two stages, namely: (1) observation, namely: observing the behavior and habits of sundanese (including the creation of sundanese) the activities of estimating, measuring, and making patterns; and (2) interviews, namely: conduct interviews with some of the indigenous Sunda peoples. After the data is collected, and then do the tabulation of data to look at the symptoms of mathematical intentionally or unintentionally done by sundanese people. The results of this data tabulation further analyzed to see how behaviors sundanese practicing mathematics and mathematical concepts what is practiced in everyday life sundanese.

RESULTS AND DISCUSSION

Ethnomathematics in this study focused on the sundanese community activities in their daily activities: estimating, measuring, and making patterns. Ethnomathematics potential of these three activities in advance tabulated in the form of descriptions of observations of behavior or habits of the sundanese people based on each activity was observed. Observations later confirmed through interviews that transcripted and then tabulated back into supporting data. Description observations and interviews is more fully described in the following description.

Description Sundanese Ethnomathematics

Description sundanese ethnomathematics apparent from the following activities:

Estimate

Estimate is an activity that many do sundanese. Usually activities sundanese estimate used to bid on an object or goods; heavy objects, land area, or volume of a particular object. If estimates one or slip far below the actual size, then the risk estimator will suffer losses. The size estimate used sundanese is *kibik*. *Kibik* is a unit of measure used to estimate the volume of wood poles, mounds of stone, sand volume and so on.

Figure 1. A log

Figure 2. Wood Albasiah in Gardens

Figure 3. Mound Stone

The following an interview describes about using of *kibik* in the daily sundanese.

Researcher	: If *kibik* uses for what, sir?
Leader	: [Sitting on *jojodog*], now for example the pole [meaning: wood beam] 2 m; 2 m length, 10 cm edges.
Researcher	: You mean 10 cm it how? [Describing the sketch wood beam on paper], Come here 10 cm, 10 cm there [Shows size height 10 cm, width 10 cm].
Leader	: Yeah so! [Turning, then pointed at the picture]
Researcher	: And what?
Leader	: Yes, it's called *sakibik* 50 pole!
Researcher	: Meaning? [Still confused]
Leader	: Yes, 100 meters. 50 x 2 [Explaining]. So, if 3 m means $33\frac{1}{2}$.
Researcher	: That is $33\frac{1}{3}$.
Leader	: Rounded, usually $33\frac{1}{2}$.
Researcher	: Continue, if estimating the wood in the garden, how?
Leader	: When estimating timber, see how high, spherical [meaning: timber circumference] how. For example estimated 5 meters high, 50 cm spherical.
Researcher	: How to measure the roundness, how?
Leader	: Eh ...., Had to use a rope.
Researcher	: Continue?
Leader	: It is estimated that 2 meters, 10 pieces?
Researcher	: What is 3 meters, 10 pieces? [Cut sentences]
Leader	: Not likely, because the ends, most cum there are 5 pieces? So, all many only 35 pieces, no one cubic.
Researcher	: Oh, I see!

Leader : But be careful, because the reality is not 10 cm, 8 cm, the original is10 cm.
Researcher : Then loss.
Leader : So, buy and sell our timber should be able to assess under which calculated by others.
Researcher : When calculating how to rock?
Leader : If the stone, calculate the hump, for example, a length of 2 meters, up 50 cm.
Researcher : How! [Trying to draw the beam height and width same]
Leader : Here 50 cm, to here 2 m, so *sakibik*. [Pointing to the picture]

……

Sundanese use the term *kibik* to get to 100. The use of the 1 *kibik (sakibik)* is used to summarize or practical calculations. In an interview that appears to determine the volume of logs: 1 *kibik* = 50 x 2 m = 100 m or 1 *kibik* = $33\frac{1}{2}$ x 3 m = 100.5 m or close to 100 m. Similarly, the stone 2 x 50 = 100. In addition, sundanese also good estimate, using estimated high or low estimates so that the opportunity to experience a loss in buying and selling can be minimized.

Making Patterns

In contrast to the estimate, making the pattern used by sundanese in activities that require precision. Making patterns activity widely used by sundanese when making bamboo handicrafts typical of Sunda land, such as: *dudukuy, aseupan, hihid, ayakan, nyiru, boboko, tampir, telebug, tolomong,* and so on. This activity is a legacy of the ancestor who still preserved.

Figure 4. Some Bamboo Crafts Sundanese *(Boboko, Nyiru, Aseupan, Ayakan, Hihid,* and *Besek)*

In activity of making pattern bamboo handicrafts, sundanese recognize the term *pihuntuan.* This term refers to benchmark or initial pattern used by sundanese to construct a form. Uniquely, this *pihuntuan* determines the next pattern or shape desired. So, if this *pihuntuan* wrong, it can be ascertained that the pattern will then be wrong or even will not achieve the desired shape. Here are excerpts of an interview with leader describe *pihuntuan.*

……

Researcher	: If you make a craft [Meaning: Sunda handicraft products, such as: *nyiru, hihid, ayakan, boboko,* and so on] how, sir?
Leader	: If six, lift three. [Holding up the fingers of the left hand plus the thumb of his right hand, then raised middle finger, index finger, and the left thumb. Do spontaneously]
Researcher	: Do not understand, I mean how?
Leader	: Here's an example [while taking *boboko*]. Well this *pihuntuan* were six.
Researcher	: Which one, sir? [While looking *boboko*]
Leader	: Look in the middle, which form a pattern there and here, his? [Pointing to *pihuntuan*]. Try to count, one, two, three, four, five, six. [Calculating each bamboo sheath that made *pihuntuan*]
Researcher	: There is downward, that this [pointing pattern], which is to the top [Pointing to the adjacent pattern]
Leader	: Yeah, it seemed, were left to the bottom three, beneath two down, continued downward one. That is to the right, to the top three, going up two, and up one. Just the same there and here, Just the opposite. [Shows the pattern mentioned]
Researcher	: Yeah, it's to the bottom, down two, down one, up two, To the top. [Pointing *pihuntuan* left]. So it is not clear pattern.
Leader	: Read it sidedly, dizziness. The goal is that *ngepang tangtung.*
Researcher	: What is *ngepang tangtung*?
Leader	: Yeah, like this [Pointing to the pattern]. Its function is to *pihuntuan.* These four make up the angle [While showing all four corners *boboko*]. Caution difference by making *ayakan*.
Researcher	: What's the difference, sir?
Leader	: The difference in determining *pihuntuan,* consider this [Shows a sieve]. It *pihuntuan* three, the pattern of middle [Pointing at the center of a pattern that is in the middle]. Well, to top one, to the top three, down one, down three, and so on.
Researcher	: Oh ....., so.
Leader	: Look out, be different, if *pihuntuan* six, to construct four angles. So *pihuntuan* six can make *kojong, boboko, telebuk, tolomong*. Which *pihuntuan* three, can prepare one angle and the round, a*seupan, ayakan, tampir*, and *nyiru*.
Researcher	: Why *pihuntuan* of *hihid* is three? [Pointing to *hidid*].
Leader	: Angle one, starting from here [Pointing at an angle *hihid*], can continue to be folded into a quare shape.
Researcher	: Why is that, strange!
Leader	: It's been away from that ancestor.

Based on the interview above, it appears that when sundanese dealing with a very strict pattern. Sundanese can not be playful or use an estimate because the consequences would be fatal once. Note the picture *pihuntuan* which form a pattern four angles, patterns corner one, and pattern circle (in a circle) below.

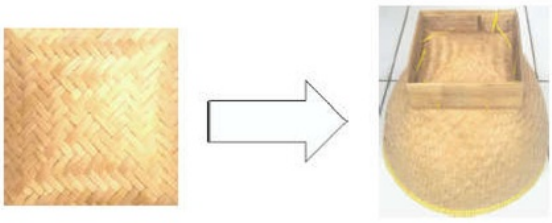

Figure 5. *Pihuntuan* six which resulted in four corner pattern

Pihuntuan six numbers determine *kahandap* (down): 3, 2, 1, is in a position to the left of center; The next row; *kaluhur* (above): 2, 1; *kahandap* (down): 2, 1; *kaluhur* (above): 2, 1; etc. The right position and the position in front of him was the opposite.

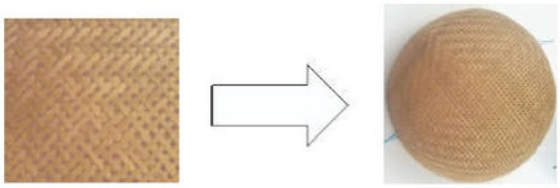

Figure 6. *Pihuntuan* three that produce the corner one and patterns round

Pihuntuan produce a pattern of three consecutive numbers *kaluhur* (above): 1, 3; *kahandap* (down): 1, 3; *kaluhur* (above): 1, 3; *kahandap* (down); 1, 3, and so on. For *juru hiji* (corner one), such as: *aseupan* (shaped like a cone), from a central point with three *pihuntuan* turns leaving path *pihuntuan* three. This path *pihuntuan,* then compiled cone construction of path diameter circle and lines artist. For *buleud* pattern (round / circle), *pihuntuan* path of the central point was to make a line perpendicular to each other. *Pihuntuan* path length from the central point to the edge of the circle (the term *wengku)* are equal in length. Thus, it is not surprising if there are (not all) *nyiru* or *ayakan* shaped hemispherical with *pihuntuan* path from a central point which length is equal to a quarter of the circumference of the ball.

Another uniqueness is found in both kinds of construction geometry *pihuntuan* above. Although the stages of webbing on both *pihuntuan* above is different, but the observation of the pattern formed *ngepang tangtung* appear square patterned row spread, both in *pihuntuan* three and *pihuntuan* six. The pattern is not apparent and is hard to identify its limits, because it can only be observed at a certain distance.

Measure

Measuring a mathematical activity that can not be separated from everyday life sundanese. Many terms that appear in these activities; unit length *(sadepa, sapal, sahasta, sameter, sajengkal, satampah, sadim,* and so on), unit area *(sabata, sahektar, satumbak, saelo, saicak, sabau,* and so on), unit volume *(sakibik, sadam, sakojong, satelebug,* and so on). In addition to term it has become an international force, Sundanese usually use the names of objects used to measure (for example: *sakojong* = one *kojong,* because objects that are used as a measuring tool is *kojong).*

Among a number of terms above, there is a term measure commonly used to measure the area of land, rice fields, namely: *bata*. In connection with this measure, sundanese has a unique term, namely: *ngukur.* So, *ngukur* for sundanese identical to measure the rice field, or a particular land area.

Ngukur for sundanese is to determine how the *bata* area of land he owned. *Sabata* value is 14 m^2 or more precisely $14\frac{2}{7}$ m^2. If this land will be bought and sold, then the size of these *bata* determining land prices agreed through bargaining.

There is a mathematical concept that is used as the basis for determining size this *bata,* namely: the concept *pasagi kurung. Pasagi* term synonymous with square brackets, but to calculate the area *pasagi kurung,* sundanese decide by multiplying length x width. The concept length x width determines the general perception in the sundanese calculate the area of land in units of *bata*.

The following excerpts from interviews reveal how sundanese measure the land area with *bata* unit.

Researcher	: Mister, if one *bata* was how?
Leader	: One *bata* is equal to 14 m^2. But it is actually 100/7. So, if you have a field of 100 m^2 each with 7 *bata*. If 600 m^2, equal to 42 *bata*.
Researcher	: How is it calculated? For example, when measuring model like this [Create and demonstrate a square image with side = 20 meters].
Leader	: Staying count, twenty meters in length, breadth twenty meters; means the length times the width, four hundred square meters. Four times seven how? [While asked to researchers]
Researcher	: Twenty-eight.
Leader	: Well then, twenty-eight *bata*.
Researcher	: What if a model like this? [Drawing an arbitrary triangle with sides each 40 m, 60 m, and 70]
Leader	: Sum, seventy plus sixty how? [Inquiry into researchers]
Researcher	: One hundred and thirty.
Leader	: For the two, which is also divided into two [Pointing to the number 40], continued multiplied, so how much? [Back asked investigators]
Researcher	: One thousand three hundred.
Leader	: Multiplied by seven, so ninety one *bata* [13 x 7 = 91].
Researcher	: Why sir, summed this one and this one, not that this this or is this one? [Pointing to the number 60 and 40; then the numbers 70 and 40]
Leader	: Yes, just like that. [No explanation]
Researcher	: What about this one? [Draw any quadrilateral with side- opposite sides of each 3 m and 5 m, 6 m and 8 m]
Leader	: If it is as it should be partitioned.
Researcher	: Why, did not like the way that earlier? [That way compute arbitrary triangle-shaped land area]
Leader	: It could be, try to count, five plus three divided by two, continued six plus eight halved how?
Researcher	: Twenty-eight.
Leader	: Multiply seven, means the result *sabata* nine six [0.28 x 7 = 1.96]
Researcher	: Why, how could it be?
Leader	: Ick ... try it, for example shaped like this model [While drawing rectangle], here hrirty equal to that of this [Pointing length], next to it twenty equal to that of this [Pointing in width]. Thirty plus thirty divided by two, that is, two twenty plus twenty divided by two, so, six hundred and forty-two *bata.*
Researcher	: If it looked like this [Draw shapes closed curve simple].
Leader	: Partitioned if the like, can be divided into three, four, or five. The hard one that if the shape of the round.

Researcher : How?
Leader : Surrounded wear mine, continue to be made square.
……

As with other units of measure, unit actually has a *bata* raw conversion value, namely, $\frac{100}{7}$ m^2. Even with that number, sundanese seems to have a constant digit 7. For example, to declare 700 m^2, simply multiply 7 x 7 = 49 *bata*. Actual calculation is (700 m^2 x $\frac{7}{100\ \text{m}^2}$) *bata* = 49 *bata*. Thus, the term *bata* appears only for the purpose of conversion.

Bata unit, as revealed in the interview above, a unit area. To find the area of fields, based on the sundanese square or rectangular shape. Conceptually, sundanese assume that any form of a piece of land can basically be formed into a square or rectangle. In this case, it turns out Sundanese have known and long used the concept of approximation.

In the concept of approximation, sundanese also committed to the principles of connectivity with mathematical concepts previously understood. To transform the shape of certain land into square or rectangular shapes are used the following approach.

$$p \ x \ l = \frac{p+p}{2} x \frac{l+l}{2} = \frac{2p}{2} x \frac{2l}{2}$$

for p = l = length and width.

Sundanese may not be aware that such cases occur because of the position and the length and width of a square or rectangle of the same length. When it is established that each pair of different length and width, for example p_1, p_2 or l_1, l_2, then:

$$p \ x \ l \neq \frac{p_1 + p_2}{2} x \frac{l_1 + l_2}{2}$$

Attempts to generalize may have had in mind sundanese, but has not reached the appropriate logic.

Sundanese activities in estimating, measure, and create patterns illustrates that there has long been a mathematical activity and hereditary nature. This activity is so embedded in their daily lives and cultural in nature, both in the context that consciously or unconsciously. Some of the activities carried out sundanese seems to really apply mathematical concepts, such as: unit conversion *kibik* in estimating, estimating unit conversion and the use of *bata* in the formula length x width to determine the extent of a particular land. In addition, there are also activities that develop mathematical concepts, such as in the context of pattern formation *pihuntuan.*

In principle, the basic terms of measurement used sundanese, such as: *kibik* and *bata* has strict rules. Tightness of the two measures can be explained as follows.

- 1 *kibik*, value with 50 wooden poles (each length of 2 m; square-shaped end with a side length of 10 cm). Woods shaped beam at the timber area of the base = 100 cm^2. Due to the length of 2 m

= 200 cm, the volume of 1 cm^2 poles = 100 x 200 cm = 20,000 cm^3. Thus, 1 *kibik* = 50 x 20.000 cm^3 = 1.000.000 cm^3 = 1 m^3. When the pole 3 m long, a lot of wood, Meaning, one *kibik* = $33\frac{1}{3}$ x 30.000 cm^3 = 1.000.000 cm^3 = 1 m^3.

- 1 *bata* = $14\frac{2}{7}$ m^2, that is to say to 100 m^2 = (100 : $14\frac{2}{7}$) *bata* = 7 *bata*.

By looking stringency in the use of both terms of these measurements, it seems sundanese use the terms to replace a similar term. The goal for the practicality of its use in the reference side. For example the use of *kibik* in the activities of estimating, generally wood poles for house building measuring 2 m, 3 m, 4 m and 5 m with a rectangular wood measuring 10 cm x 10 cm. So, if there are 25 pieces of wooden poles with a length of 5 m, it is easy to guess that the volume of the entire timber is one quarter of *kibik*. Sundanese clever estimate using *kibik* units are typically good also in bargaining, when buying timber remained in the forest with a contract system.

Then, why in the measurement using the term *bata*, sundanese ignore accuracy. Try concern, depending on the calculation one of the leader sundanese in determining the land area with *bata* unit when compared with the mathematical concepts used.

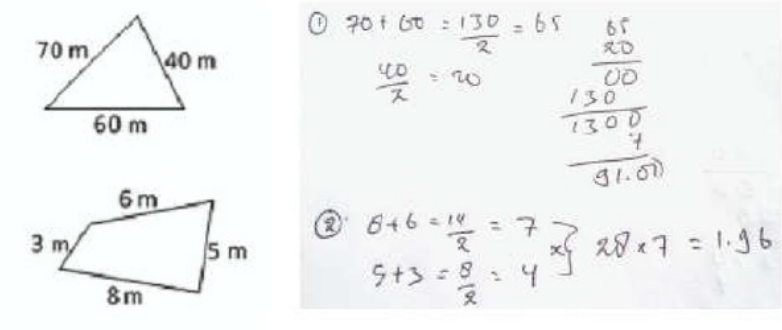

Figure 7. The results of calculation by a leader of sunda in determining land

Let us compare the results using a formula Heron and Brahmagupta (Posamentier & Stepelman, 1990), as follows

- Suppose a = 40 m, b = 60 m, and c = 70 m, with s = = $\frac{1}{2}(40+60+70)=85$m, the area of the triangle is

$$L=\sqrt{s(s-a)(s-b)(s-c)}=\sqrt{85.45.25.15}=\sqrt{1.434375}=1197{,}65\text{m}^2.$$

In units of *bata*, 1197.65 x $\frac{7}{100}$ *bata* = 83.84 *bata*.

- Suppose a = 3 m, b = 6 m, c = 5 m and d = 8 m, with $s = \frac{1}{2}(3+6+5+8) = 11$ m, the area of the quadrilateral is

$$L = \sqrt{(s-a)(s-b)(s-c)(s-d)} = \sqrt{8.5.6.3} = \sqrt{720} = 26.83 \text{ m}^2.$$

Be converted into units of *bata*, 26.83 x $\frac{7}{100}$ *bata* = 1.88 *bata*

It seems that there are very significant differences in outcomes between the calculation results with mathematical concept leader of sunda are already known. Even so, sundanese could actually use the concept of partitioning results will not be much different. Thus the concept of partitioning into the shape of a square or rectangular acceptable mathematically (we say as a perceptual transformation), but for a transformation in the form of a mathematical equation cannot be accepted, because generalizations are wrong.

In contrast to the estimating and measuring activities, activities create patterns can be considered as the full rules and very strict. Tightness in the activities making pattern arranged by *pihuntuan* as the basic construction of a form. Patterns 3-2-1 with *pihuntuan* six is contruction corner four, while the pattern is 1-3 with *pihuntuan* three is the construction corner one and circles. Construction corner one, corner four, and the next ring is set by the central point *pihuntuan* that form paths *pihuntuan*. Corner one has three path *pihuntuan*, corner four have four path *pihuntuan*, and circles also have four path *pihuntuan*.

When observed more closely, track *pihuntuan* has several functions: (1) forming a circular pattern (*ayakan, nyiru, aseupan*), and (2) form *kepang tangtung* symmetrical (present in all webbing). Both of these functions are closely related according to researchers with mathematical concepts. Craft *ayakan* and *nyiru* formed parabolic, so that the path *pihuntuan* in both woven seems easily traced with parabolic equation. So also in *aseupan*, because *aseupan* formed conical, then the path *pihuntuan* easily traced to the concept of a cone (path *pihuntuan* is the painter path on the cone).

As with the patterns of *kepang tangtung* formed. Pattern *kepang tangtung* turned out to construct various geometric patterns. Geometric pattern observed is a row of square construction are divergent. This geometric pattern is quite difficult to detect because it can only be observed at a certain distance (need to search further).

What was done by sundanese of the three activities above is actually only a small part of the Sundanese culture which is very viscous with a mathematical activity. Regardless of whether a mathematical concepts are strictly applied by sundanese, sundanese cultural activities can inspire understanding of mathematical concepts that already exist and the development of mathematical concepts that need to explore further. In other words, sundanese culture is the inspiration that can be used as an alternative source of learning for a different mathematical understanding.

CONCLUSIONS

Based on the findings and the focus of the proposed research, some conclusions can be delivered. Sundanese in performing mathematical activities based on the valuesinherent in everyday practical sundanese culture. This is reflected in the activity measure is based on objects that are used, and the estimate based on cultural activities carried out for generations. For the size of the basic concepts and activities make patterns, sundanese apply mathematical concepts are very strict. Knowledge partitions on application basic concepts of size and pattern *pihuntuan* in constructing certain geometric patterns really inspire the implementation and development of mathematical concepts were amazing. However, for the application of mathematical concepts in relation to measuring the activity of mathematical rules do not meet the agreed (seen from how to make generalizations are false).

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