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Mathematical Concepts in *"Desa Na Ualu"* Batak Toba Tribe

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ABSTRACT
The Batak Toba tribe has known the journey of the moon and stars every day since ancient times. Batak people are accustomed to observing the rising and setting of the sun, observing the location of the stars in the sky, observing the light of the *Panenabolon* horizon and comparing it to the state of the wind and weather and dividing the direction of the cardinal directions point into eight called *Desa Na Ualu* (eight cardinal directions) namely purba (east), anggoni (southeast), dangsina (south), nariti (southwest), pastima (west), manabia (northwest), utara (north), irisanna (northeast). This is proof that the Toba Batak tribe has known the eight cardinal directions since ancient times. The symbol of the *Desa Na Ualu* can often be found in *Gorga* in the Batak Traditional House and other artifacts. This research would discuss and demonstrate mathematical concepts in *Desa Na Ualu* (eight cardinal directions) namely: the concept of points, lines, angles and map of the cardinal direction.

Keywords: desa na ualu, point, line, corner, cardinal direction.

INTRODUCTION

The Batak tribe is one of the largest ethnic groups in Indonesia, based on a census from the Central Statistics Agency in 2010. This name is a collective theme to identify several ethnic groups living in and originating from the West and East Coasts in North Sumatra Province. The ethnic groups categorized as Batak are Toba, Karo, Pakpak, Simalungun, Angkola, and Mandailing. Batak is a group of tribes that inhabit most of North Sumatra. But people often consider Batak only to the Toba tribe, even though Batak is not only represented by the Toba tribe. So there is no Batak culture and language, but the cultures and languages of Toba, Karo, Simalungun and other allied tribes (Wikipedia, 2020).

The Batak Toba is a cultural unity. Batak Toba people do not have to live in the geographic area of Toba, although the origin was Toba. Like other ethnic groups, the Batak Toba people migrate to areas that are more promising for a better life. For example, the majority of indigenous people in Silindung are Hutabarat, Panggabean, Simorangkir, Hutagalung, Hutapea and Lumbantobing clans, even though the six clans were descendants of Guru Mangaloksa, one of King Hasibuan's sons in the Toba region.

Likewise, the Nasution clan, most of whom live in the Padangsidimpuan region, is Siahaan clan's relative in Balige, of course, these two clans were descendants of the same ancestor. The Batak Toba as a cultural entity can certainly spread to various directions across the geographical boundaries of its ancestral origin such as Sianjur Mulamula which is located on the slopes of Mount Pusuk Buhit about 45 minutes drive from Pangururan (the capital of Samosir Regency).

Batak people have known the journey of the moon and stars every day since ancient times. *Batak parhalaan* (Astrology Book) is a reflection of *pane nabolon* (natural law) of every human being. This means that what will happen tomorrow, what a new child will become, what is one's

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destiny, ritual feast, lost items and good steps for the Batak people must begin with opening the book of parhalaan because this has been a habit since ancient times.

"Batak people are accustomed to observing the rising and setting of the sun, observing the location of the stars in the sky, observing the light of the *Panenabolon* horizon and comparing it to the state of the wind and weather and dividing the direction of the cardinal directions point into eight called *Desa Na Ualu* (eight cardinal directions) namely" (Generasi Batak, January 17th, 2014):

1. *Purba* means east
2. *Anggoni* means southeast
3. *Dangsina* means south
4. *Nariti* means southwest
5. *Pastima* means west
6. *Manabia* means northwest
7. *Utara* means north
8. *Irisanna* means northeast

"*Desa Na Ualu* means the corner of the world or the eight cardinal directions. This proves that the Batak people have known the eight points of the wind long ago. The symbol of the *Desa Na Ualu* can often be found in *Gorga* in the Batak Traditional House and other artifacts. Here are the eight cardinal directions according to the Batak" (Lifepatch, November 6th, 2017):

1. *Purba* in the east as a symbol of the beginning of life activities on earth where the Sun began to show golden rays, the 'golden' element represents this cardinal direction.
2. *Anggoni* in the southeast, where the sun has raised leaning towards the earth shining redder color, then the 'Suasa' element is created.
3. *Dangsina* in the South illustrates that the sun has emitted brightly colored rays of life, then the 'Silver' element is created.
4. *Nariti* in the Southwest depicts the atmosphere of the Sun in a position almost perpendicular above the head so that the light emitted is so blazing and testing the resilience of the earth that ultimately the ground becomes 'Rock'.
5. *Pastima* in the west illustrates the position of the sun right above the head so that all the sun's energy hits the earth's surface which causes the stone turning into black, and then 'Tin' element is created.
6. *Manabia* in the Southwest is affected by the movement of the sun that begins to lean toward the sunset so that sunlight will slowly reduce its intensity and the color starts to go reddish, then 'Copper' element is created.
7. *Utara* in the North direction is affected by the movement of sunlight that tends to sink, then the 'iron' element is created.
8. Finally *Desa Irisanna* in the Northeast where the position of the sun is just one step away to get rest, then the 'Wood' element is created.

When *Desa Na Ualu* (the eight cardinal directions) of the Toba Batak tribe is depicted on a flat plane geometry, it will form a circle which is divided into several sectors consisting of a collection of points, lines, and angles, and all of these are part of the concept studied in geometry (mathematics), which we then call mathematical concepts.

Mathematics is a basic science that has become a tool for learning other sciences. Therefore, mastery of mathematics is absolutely necessary and mathematical concepts must be understood correctly from an early age. This is because concepts in mathematics are a series of causes and effects or a concept is arranged based on previous concepts and will be the basis for further concepts so that a wrong understanding of a mathematical concept will result in a misunderstanding of subsequent concepts.

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The concepts in mathematics are arranged in a hierarchical, structured, logical and systematic manner starting from simple concepts to complex concepts. Because of the importance of concepts, there should not be missed steps/stages of concepts in learning mathematics. The concepts in mathematics have links with one another, so students must be given more opportunities to see the linkages of these concepts with other materials. It is intended that students can understand mathematical material in depth.

Farrel and Farmer (Musliana, 2007: 7) defines the concept as a classification of objects, the features of objects or events that are determined by abstracting them. Furthermore, Gagne (Arsat, 2007: 8) argues that concepts in mathematics are abstract ideas that convince people in classifying objects or events into examples or not examples of a particular object. For example, a student has understood the concept of the area of a triangle, and then the student will be able to distinguish the formula of the area of a triangle and the formula for another flat area.

Then Soedjadji (2000: 11) says that concepts in mathematics are generally composed of previous concepts. For example, the concept of rank is composed of the concept of multiplication, the concept of the area of a triangle is composed of the concept of the area of a rectangle, and the concept of the area of a trapezoid is composed of the concept of the area of a triangle. This means that the previous concepts understood by students are needed to construct a new concept.

Desa Na Ualu as in figure 1 below, a geometrical structure consisting of a set of points and a set of lines which is also a combination of a set of points, and the set of angles that two or more lines meet at the base, the following geometrical drawing of *Desa Na Ualu* are presented*:*

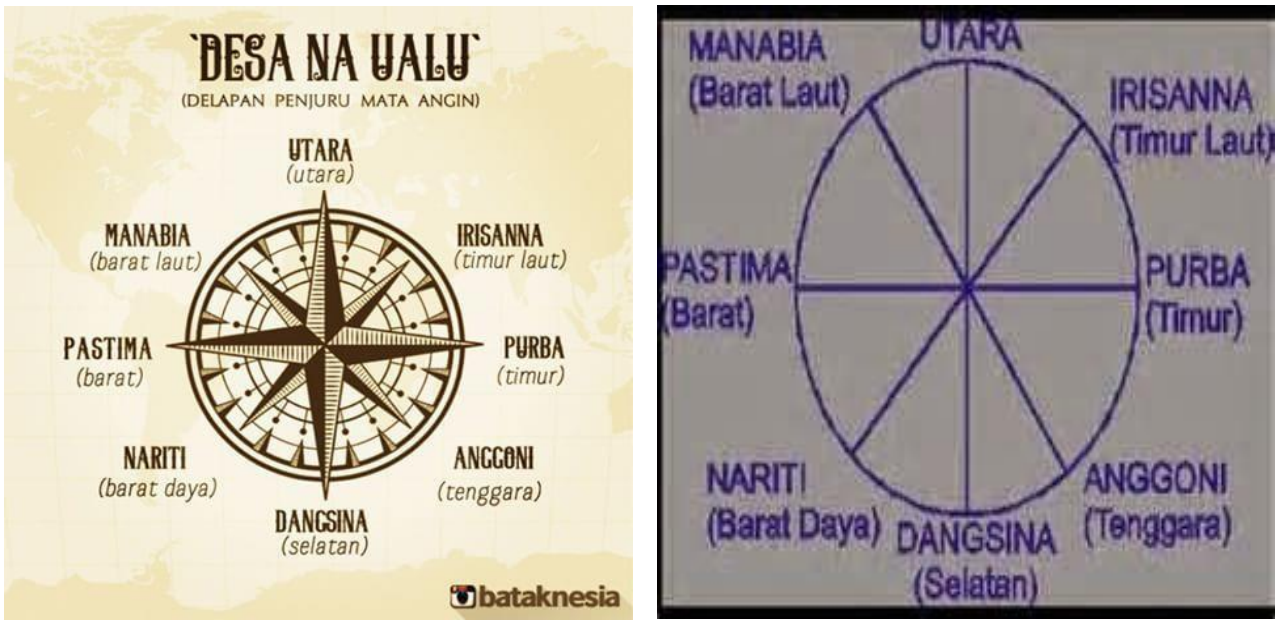

Figure 1. *Desa Na Ualu* (Eight Cardinal Directions) Batak Toba Tribe

METHOD

This study used qualitative research with an ethnographic approach, ethnographic methods are used to describe, explain and analyze the cultural elements of a society or ethnic group. (Spradley, 2006).

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RESULT AND DISCUSSION

It is well known that mathematics is a deductive science whose truth concepts are interrelated. The truth of a concept is based on concepts that existed before and underlies subsequent concepts. To begin this whole set of mathematics, a basic concept is needed. This concept is usually not defined and is only a convention among mathematicians, but all parties will have the same picture of this concept. For example, the concept of a point, there is no definition for a point, but everyone has the same picture about this point.

This base concept is then used to develop definitions, axioms or theorems for further concepts. Geometry is one of the systems in mathematics, and the existence of basic concepts such as this point is very important in the preparation of the geometry system.

1. Concepts of Points and Lines

Several basic concepts are needed in compiling a geometry system, such as:

- **Point**; the point has no dimensions and is symbolized by a small point " **.** ". A point is usually denoted by an uppercase letter, A, B, C, and so on;
- lines; a line is an infinite collection of points and is therefore infinite in length; A-line is usually denoted by lowercase letters: a, b, c, and so on; The following is an illustration of a line:

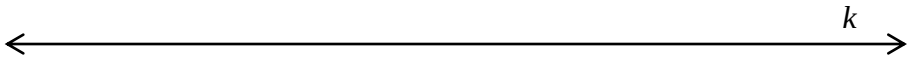

Figure 2. Line *k*

The arrows on the left and right end of the illustration above show that the line is of unlimited length both to the left and to the right.

- through; if a point P lies on the line k then it says line k through point P;

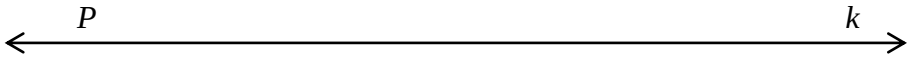

Figure 3. Point P is inside the line k

- **Between**; if on a line there are points whose position is A-B-C, then it says point B between A and C.

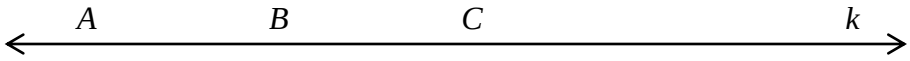

Figure 4. Point B is located between points A and C

- In the visualized image of *Desa Na Ualu* Batak Toba tribe, we can clearly see the concept of lines in the visualization of the image which is the result of an infinite collection of the number of points in all line segments (point concept)
- In visualized image of *Desa Na Ualu* Batak Toba tribe, we can also find mathematical concepts, namely the concept of the center of the circle and is a reference point so that the same distance is formed between each point with a curved line of the circle, hereinafter this is called the radius of the circle (bowstring in the concept of circle) and 2 times the radius of the circle then called the circle diameter.

2. Angular Concept

An angle is a combination of two lines of light that are not opposite and whose base points coincide. The base point is called the corner point. In the preparation of geometry, the angle can also be formed by two line segments that one endpoint coincident.

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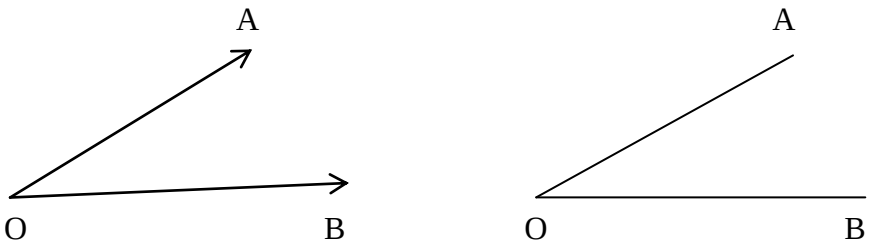

Figure 5. AOB angle

At the angle of AOB (denoted by ∠ AOB), the vertex is O, while the OA and OB lines are called angular legs respectively.

As stated in the definition that an angle is a combination of two rays of a line whose base points coincide, then ∠ AOB is a set of all points both in OA and OB or can be written as

$$\angle AOB = \{x | x \in OA \cup OB\}$$

The size of an angle is intended as the amount of stretch formed by the two legs of the angle. The angle is expressed in units of degrees (denoted by °) or in radians. One of the tools used to measure angles is an arcdegree. The scale in a degree arc is usually started from 0^o to 180^o. Based on the magnitude, the angles can be classified into 3 groups:

a. Taper angle is the angle of magnitude between 0^o and 90^o;
b. Right angle, is a large angle = 90^o;
c. Blunt angle is the angle between 90^o and 180^o.
d. Straight angle, is a large angle = 180^o
e. Reflex angle is the angle of magnitude between 180^o and 360^o.

In the visualized image of *Desa Na Ualu Batak Toba Tribe*, we can clearly see the concept of angles as follows:

1. The angle of one full turn is equal to 360^o.
2. The angle ½ full rotation is equal to 180^o and is called a straight angle.
3. The angle ¼ full rotation is equal to 90^o and is called a right angle.
4. The large-angle formed between each point of cardinal directions symbolized by a line in the picture of *Desa Na Ualu Suku Batak Toba* is equal to 45^o.
5. The angle is equal to 45^o further referred to as the smallest angle formed at *Desa Na Ualu Suku Batak Toba*
6. While the largest angle formed at *Desa Na Ualu Suku Batak Toba* is equal to $360^o - 45^o = 315^o$.
7. Angles that are formed between two line segments in the adjacent cardinal directions point are called mathematical angles.
8. The smallest angle formed between *utara* and *irisanna* = 45^o and the biggest angle formed = $360^o - 45^o = 315^o$.
9. The smallest angle formed between *utara* and *purba* = 90^o and the biggest angle formed = $360^o - 90^o = 270^o$.
10. The smallest angle formed between *utara* and *anggoni* = 135^o and the biggest angle formed = $360^o - 135^o = 225^o$.
11. The smallest angle formed between *utara* and *dangsina* = 180^o and the biggest angle formed = $360^o - 45^o = 180^o$.

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12. The smallest angle formed between *utara* and *nariti* = 135^o and the biggest angle formed = $360^o - 135^o = 225^o$.
13. The smallest angle formed between *utara* and *pastima* = 90^o and the biggest angle formed = $360^o - 90^o = 270^o$.
14. The smallest angle formed between *utara* and *manabia* = 45^o and the biggest angle formed = $360^o - 45^o = 315^o$.
15. The magnitude of the angle formed at each point at *Desa Na Ualu Batak Toba Tribe*, need to be clarified by using the phrase *"searah jarum jam"* and *"berlawanan arah jarum jam"*, besides still being able to use the concept of the smallest angle and the biggest angle.

3. The Concept of Cardinal Direction Map

In the visualized image of *Desa Na Ualu suku Batak Toba*, the concept is not much different from the concept of the Cardinal Direction Map in mathematics learning, directions consisting of eight directions:

1. North: lies between northwest and northeast
2. Northeast: lies between north and east
3. East: lies between northeast and southeast
4. Southeast: lies between east and south
5. South: lies between southeast and southwest
6. Southwest: lies between south and west
7. West: lies between the southwest and northwest
8. Northwest: lies between west and north

The smallest angle between two adjacent points of the direction is::

1. If the cardinal directions map is divided into 8 cardinal directions then the smallest angle formed is 45^o
2. If the cardinal directions map is divided into 16 cardinal directions then the smallest angle formed is $22{,}5^o$

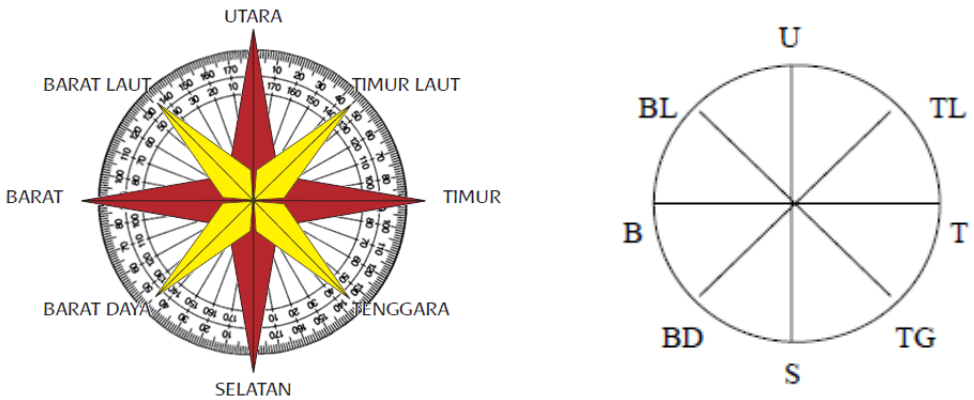

Figure 6. Map of the Eight Cardinal Directions

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CONCLUSION

Based on the entire description above, the following conclusions can be obtained:

1. *Desa Na Ualu* (eight cardinal directions) namely purba (north), anggoni (southeast), dangsina (south), nariti (southwest), pastima (west), manabia (northwest), utara (north), irisanna (northeast), proved that the Batak Toba tribe had known the eight cardinal directions, astrology (astronomy) and mathematical concepts (geometry) since ancient times.
2. *Desa Na Ualu* contains mathematical concepts, namely the concept of geometry on a flat plane and its exploration such as the concepts of points, lines, angles, and map of the cardinal directions.

REFERENCES

Arsat. 2007. Meningkatkan Pemahaman Konsep Luas Bangun Datar Melalui Representasi Enaktif, Ikonik dan Simbolik pada Siswa kelas SDN 8 Baruga Kendari. Skripsi. Kendari: FKIP Universitas Haluoleo Kendari.

Desa Na Ulau Sisingamangaraja XII. (2017. November 6). Diakses pada Januari 28, 2020, dari Lifepatch : https://lifepatch.org/Si_Singamangaraja_XII#Desa_Naualu

Istilah Waktu dalam Bahasa Batak. (2014, Januari 17). Diakses pada Januari 28, 2020, dari Generasi Batak : http://gen-batak.blogspot.com/2014/01/istilah-waktu-dalam-bahasa-batak.html

Musliana. 2007. Pengaruh Penggunaan Model Pembelajaran Konstrutivis Terhadap Prestasi Belajar Matematika Siswa Kelas IV SDN 11 Abeli. Skripsi. Kendari: FKIP Universitas Haluoleo

Suku Batak. (2020, Januari 19). Diakses pada Januari 28, 2020, dari Wikipedia : dari https://id.wikipedia.org/wiki/Suku_Batak

Soedjadji, R. 2000. Kiat Pendidikan Matematika Di Indonesia. Jakarta: Dirjen DIKTI.

Spradley, P. James (2007). *Metode Etnografi*. Yopgyakarta : Tiara Wacana.