Hitung Bini: Ethno-Mathematics in Banjarese Society

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Keywords: Hitung Bini, Ethno-mathematics, Arithmetic Operation

Abstract: Banjarese elders who had never attended either formal or non-formal schools have implemented relatively unique arithmetic operation. The arithmetic operation does not use calculators nor writing tools but can produce a quick and precise calculation. This kind of arithmetic operation is commonly used in everyday life and well-known as *hitung bini*. This study aimed to describe *hitung bini* as one of ethno-mathematics found in Banjarese cultures then analyze it from mathematics viewpoints. This study used explorative method with qualitative approach. The data were collected through observation, interview, and documentation. The findings of the study obtained that *hitung bini* operation actually conforms to formal arithmetic procedures in math which includes place value rules and basic arithmetic operation properties such as commutative, associative, distributive, identity and inverse.

1. INTRODUCTION

Ethno-mathematics is a culture product which develops in particular society group and links to mathematical calculation (D'Ambrosio, 2001; Rosa & Orey, 2011). A certain culture product in certain society has its own specialty and distinctive feature which is different from that of other regions. This is due to diversity of cultures that develop in each region.

Indonesia consists of various tribes and ethnic groups which are rich of culture depending on where they live. In Kalimantan, especially South Kalimantan, there is one ethnic group known as Banjarese. Within Banjarese society, there is a unique product of culture, an arithmetic operation, often used in everyday transaction, namely *hitung bini.*

Hitung bini has been inherited through generations and most frequently used now by Banjarese elders. *Hitung bini* users are dominantly women who have never earned formal education. They recognize no formal mathematical standard process. Most of them are illiterate. Therefore, *hitung bini* operation is simply performed orally by relying on good memories.

Peculiarly developing among people who never earned any formal education, *hitung bini* is worth analyzing in terms of how the calculation is performed viewed from formal mathematical procedures. It is necessary to answer if *hitung bini* is relatively fast and accurate in the view of mathematical operation procedures. This study performed an analysis of *hitung bini* as one of ethno-mathematic product from the viewpoint of mathematics.

2. LITERATURE REVIEW

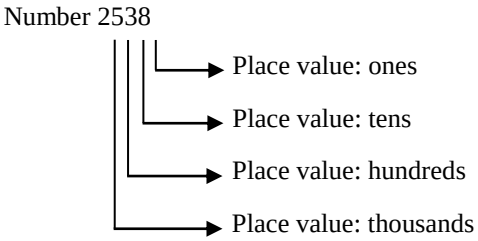
2.1 Mathematics

Mathematics is a science that deals with logic which is arranged consistently and of which the conclusion is drawn deductively (Salam, 1997). Mathematics is a branch of science that learns about calculation. Simple arithmetic operations in math are addition, subtraction, multiplication, and division on either integers or rational numbers. These basic arithmetic operations are most often used in daily life.

Mathematical procedure is one of study objects in mathematics. It consists of orderly arithmetic procedures comprising addition, subtraction, multiplication, and division (Atmaja, 2014). Every procedure has certain rules or properties. The following are the properties in addition, subtraction, multiplication, and division of integers (Bartle & Sherbert, 2000; Sharma, 1993; Rosen, 1993):

Rivilla, S., Lathifaturrahmah, . and Fauzi, Y.
Hitung Bini: Ethno-Mathematics in Banjarese Society.
DOI: 10.5220/0008518901690174
In *Proceedings of the International Conference on Mathematics and Islam (ICMIs 2018)*, pages 169-174
ISBN: 978-989-758-407-7

- Number place value;



- Closure property of addition, subtraction, and multiplication;
- Commutative property of addition and multiplication;
- Associative property of addition and multiplication;
- Possessing identity for addition and multiplication operations;
- Possessing inverse for addition operation;
- Distributive property of addition and subtraction over multiplication;
- Subtraction operation as inverse of addition.

2.2 Ethno-mathematics

Ethno-mathematics was first introduced by Urbiratan D'ambrosio. He is a mathematician from Brazil. Ethno-mathematics is a study about math by discerning the culture where the math emerges and develops. This study tries to view logic and math system from the location in which they develop (D'Ambrosio, 2001; Wahyuni et. al., 2013).

Generally, ethno-mathematics is an interdisciplinary study comprising cultural anthropology, mathematics teaching, and mathematics cognition. Ethno-mathematics is intersection every of these (sub)disciplines.

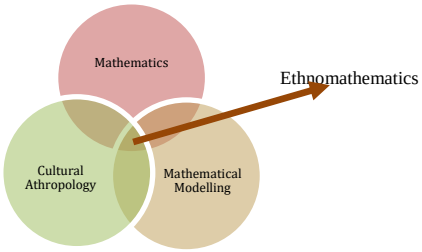


Figure 1: Ethno-mathematics definition according to Rossa and Orey.

In brief, ethno-mathematics can be understood as inherited culture product that blossoms in certain society. It is even sometimes not realized by its users due to the simplicity of its form compared to formal (formalized) math. As a product of culture, ethno-mathematics is not equipped with definition, axiom, lemma, and theorem as formal math.

3. METHODS

This is an explorative study with qualitative approach. This method was chosen to understand deeper about *hitung bini* used in Banjarese society as well as finding its pattern in the view of mathematical procedures (arithmetic operation). The research was conducted in South Kalimantan without determining particular research location. The locations were conditional, depending on where the subjects could be found.

3.1 Research Subject and Object

The research subjects were Banjarese people living in South Kalimantan who use *hitung bini* in their everyday lives. The objects were operation pattern of *hitung bini* used in Banjarese society.

3.2 Data and Data Collection Techniques

There were two kinds of data: main data and supporting data. The main data consisted of data that relates to *hitung bini* operation used in Banjarese society. The supporting data consisted of description about research location and respondents' biodata.

The data were collected through observation and interview.

- The observation was descriptive, focused, and selective. It was used to investigate the steps used in *hitung bini* operation by the users.
- The interview was semi-structured by listening thoroughly and writing along everything said by the respondents related to *hitung bini* used by them.

3.3 Data Analysis Techniques

Data analysis techniques used in this study were (1) data reduction, (2) data display, and (3) conclusion/ verification. Trustworthiness of the data were confirmed through the following processes: (1) credibility test, (2) transferability, (3) dependability, and (4) confirmability (Sugiyono, 2013; Creswell & Clark, 2007).

4. RESULTS AND DISCUSSION

South Kalimantan is a province in Kalimantan island, precisely in South Kalimatan. Banjarmasin is the capital city of this province. The latitude and longitude of South Kalimantan is 10-40 S and 1140-1170 E. This province has total area 37.530,52 km^2. Geographically, South Kalimantan is located in the Southeast of Kalimantan island. It consists of lowland in the North area and in East Coast and highland along Meratus mountain. The lowland of South Kalimantan consists of peat swamp forest while the highland partially consists of tropical forest. The natural resources in this province comprises permanent forest, production forest, protected forest, convention forest, government plantation, coal mine, petroleum, silica sand, iron ore, etc.

South Kalimantan is made of 11 regencies, 2 big cities, 152 districts, and 2007 sub-districts. The regencies are Balangan regency, Banjar regency, Barito Kuala regency, *Hulu Sungai Selatan* regency, *Hulu Sungai Tengah* regency, *Hulu Sungai Utara* regency, Kotabaru regency, Tabalong regency, Tanah Bumbu regency, Tanah Laut regency, Banjarbaru city, and Banjarmasin city. The majority of its people is Moslem. The rest of them are Hindu, Protestant, Catholic, and Buddha. The languages used by its people are Banjarese and Indonesian. Regional songs of South Kalimantan Selatan are Ampar-ampar Pisang and Paris Barantai. Banjarese traditional house is also well-known as *Rumah Bubungan Tinggi*. The following figure is the map of South Kalimantan.

Figure 2: Map of South Kalimantan

Ethnic groups that can be found in South Kalimantan are Banjarese, Javanese, Buginese, Dayaknese, Madurese, Mandarese, Sundanese, Chinese, Bataknese, Balinese etc. However, the majority of South Kalimantan people is Banjarese, which is about 74,34 % of them, comprising three groups: *Banjar Kuala*, *Banjar Pahuluan*, and *Banjar Batang Banyu*. *Banjar Kuala* people are Banjarese who live in Banjarmasin and Martapura area. Banjar Pahuluan people are Banjarese who live in the valley around Nagara river. Banjar Batang Banyu people are Banjarese who live in the valley of Nagara river. Banjarese people came from river flow area, beginning from Bahan river flow, Barito river flow, Martapura river flow, until Tabanio river flow.

Hitung bini operation pattern performed by Banjarese people is divided into four operations: (1) addition, (2) subtraction, (3) multiplication and (4) division.

4.1 Addition

For addition operation, *hitung bini* uses several steps. To perform addition 7250 + 2300, for example, the respondent did the following steps:

- 7250 was transformed into 7000, 200, and 50 while 2300 was transformed into 2000 and 300
- 7000 plus 2000 equals 9000
- 200 plus 300 equals 500
- Then 9000 plus 500 plus 50 equals 9550

Referring to formal (formalized) math, *hitung bini* operation above can be elaborated as follows:

- Addition 7250 + 2300 was performed based on place value (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$(7000 + 200 + 50) + (2000 + 300 + 0) \quad (1)$$

- Using associative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(7000 + 200) + (50 + 2000) + (300 + 0) \quad (2)$$

- Using commutative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(7000 + 200) + (2000 + 50) + (300 + 0) \quad (3)$$

- Using associative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$7000 + (200 + 2000) + (50 + 300) + 0 \quad (4)$$

- Using commutative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$7000 + (2000 + 200) + (300 + 50) + 0 \quad (5)$$

- Using associative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(7000 + 2000) + (200 + 300) + (50 + 0) \quad (6)$$

- Using identity property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(7000 + 2000) + (200 + 300) + 50 \quad (7)$$

- Using addition operation order, the following result was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$9000 + 500 + 50 \quad (8)$$

- Using addition operation order, the ultimate result below was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$9550 \quad (9)$$

4.2 Subtraction

To do the subtraction, *hitung bini* has two versions of arithmetic operations. In version 1, in solving 5500 – 2700, for example, *hitung bini* used the following steps:

- 5500 was transformed into 5000 and 500
- 5000 minus 2700 equals 2300
- Then 2300 plus 500 equals 2800

Meanwhile, for version II, to solve 5500 – 2700, *hitung bini* used the following steps:

- 5500 was transformed into 5000 and 500. Then 2700 was transformed into 2000 and 700
- 5000 minus 2000 equals 3000
- 500 minus 700 equals negative 200
- Then 3000 minus 200 equals 2800

Referring to formal (formalized) math, *hitung bini* operation above can be elaborated as follows:

- Subtraction 5500 – 2300 was altered using subtraction order as additive inverse (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$5500 + (–2700) \quad (10)$$

- Referring to place value, the arithmetic problem was solved as follows (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$(5000 + 500) + (– (2000 + 700)) \quad (11)$$

- Using distributive property and order property, the following result was obtained (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(5000 + 500) + ((–2000) + (–700)) \quad (12)$$

- Using associative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$5000 + (500 + (–2000)) + (–700) \quad (13)$$

- Using commutative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$5000 + ((–2000) + 500) + (–700) \quad (14)$$

- Using associative property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(5000 + (–2000)) + (500 + (–700)) \quad (15)$$

- Using subtraction order as additive inverse, the operation was performed like this (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(5000 - 2000) + (500 - 700) \quad (16)$$

- Using operation order of subtraction, the operation was performed like this (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$3000 + (-200) \quad (17)$$

- Using subtraction order as additive inverse, the operation was performed like this (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$3000 - 200 \quad (18)$$

- Using operation order of subtraction, the ultimate result below was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$2800 \quad (19)$$

4.3 Multiplication

In solving multiplication problem such as 11000 × 12, these are the steps conducted in *hitung bini*

- 12 was transformed into 10 and 2
- 11000 multiplied by 10 equals 110000
- 11000 multiplied by 2 equals 22000
- Then 110000 plus 22000 equals 132000

Viewed from formal math, the above *hitung bini* operation can be elaborated as follows:

- Multiplication 11000 × 12 was altered referring to place value, such as follows (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$11000 \times (10 + 2) \quad (20)$$

- Using distributive property, the operation was performed as the following (Trench, 2013; Bartle & Sherbert, 2000; Royden, 1988; Rosen, 1993)

$$(11000 \times 10) + (11000 \times 2) \quad (21)$$

- Using multiplication order, the subsequent result was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$110000 + 22000 \quad (22)$$

- Using addition order, the following ultimate result was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$132000 \quad (23)$$

4.4 Division

In solving division problem such as 665000 : 2, these are the steps performed in *hitung bini*:

- 665000 was transformed into 600000, 60000 and 5000
- 600000 divided by 2 equals 300000
- 60000 divided by 2 equals 30000
- 5000 divided by 2 equals 2500
- Then 300000 plus 30000 plus 2500 equals 332500

Viewed from formal math, the steps used in *hitung bini* can be elaborated as follows:

- Division 665000 : 2 was altered into rational numbers (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$\frac{665000}{2} \quad (24)$$

- Using place value, the arithmetic operation was performed as follows (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$\frac{600000 + 60000 + 5000}{2} \quad (25)$$

- Using rational number operation, this is the result obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$\frac{600000}{2} + \frac{60000}{2} + \frac{5000}{2} \quad (26)$$

- Using the relation between division and rational number results in the following (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$(60000 : 2) + (60000 : 2) + (5000 : 2) \quad (27)$$

- Using division order led to the following result (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$300000 + 30000 + 2500 \quad (28)$$

- Using addition order, the ultimate result below was obtained (Kallai & Tzelgov, 2012; MacDonald et al., 2018; Sharma, 1993; Hamdani et. al., 2009)

$$332500 \quad (29)$$

From the arithmetic operation patterns of *hitung bini*, similarity in operation procedures are found between *hitung bini* and formal (formalized) math. This is shown in every step in *hitung bini* which always include formal mathematical arithmetic operation although some parts or formal math operations were skipped.

Since the beginning, *hitung bini* tends to use place value to finish the calculation. It conforms to formal math's basic concept that a number can be arranged according to its place value (Fajariah & Triatnawati, 2008). In addition, *hitung bini* also followed standard arithmetic operation order just like in formal math.

5 CONCLUSIONS

The results of exploration and study on literatures pointed out that *hitung bini* used by Banjarese people is part of ethno-mathematics. In solving problems, *hitung bini* indirectly use formal mathematical arithmetic operations comprising number place value and operation properties (such as associative, commutative, distributive and identity properties and inverse).

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