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Research Article

An ethnography study on mathematical terminologies within two indigenous *Makian* languages in North Maluku

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ABSTRACT

The two indigenous Makian languages, Western Makian (*Makian* Luar) and Eastern Makian (*Makian* Dalam/Taba), stem from two different language families in North Maluku. The indigenous *Makian* people are typically ignorant of the riches of values and knowledge reserved in their language and culture, including mathematical content. Therefore, through an ethnography ap-proach, this study identifies mathematical terminologies *(natural numbers, fractions, number operations, indefinite quantifiers and adverbs of time)* that exist in indigenous Makian languages. Data Collecting was conducted through indepth interviews with indigenous community leaders and some primary literature reviews, then analyzed qualitatively. The mathematical language that has been identified along with the context of its use can be a good entry point and a meaningful material in integrating indigenous languages and cultures in mathematics learning.

Keywords: Ethnography Study; Mathematical Terminologies; *Makian* Languages; North Maluku

1. INTRODUCTION

Mathematics is a product of human culture like other disciplines such as science, social humanities, and language since Mathematics is not a culture-free discipline (Zaslavsky, 1998). All knowledge related to human experience in social life is always through a cultural system that contains norms, values and conventions (Nasir et al., 2008). Symbols, operational processes, and representations of arts and crafts are historically the roots of mathematics (Barton et al., 2006) which is continuously rehearsed even by indigenous communities to ensure their survival (Meaney et al., 2011). A range of activities such as counting, measurement, design, and game are illustrations of mathematizing activities found in most major cultural phenomena (Bishop, 1988).

The existence of a close relationship between mathematics and culture is a sign of the importance of bringing mathematics learning closer to culture itself. Historically, mathematics and its teaching learning process have been an inseparable part of cultural reproduction from generation to generation and have even become a fundamental teaching approach (Acharya et al., 2021; Machaba & Dhlamini, 2021). However, nowadays, mathematics standards that tend to be Eurocentric alienate students from their own culture (Alangui, 2017). Hence, some recommendations for creating culturally relevant mathematics learning experiences have long been voiced with the aim that students can reflect on and appreciate their own culture (Acharya et al., 2021; Aronson & Laughter, 2016; Civil, 2002; D'Ambrosio, 1985; d'Entremont, 2015; NCTM, 1989). Thus, the experience can enable students to implement mathematical operations in their cultural environment (Acharya, 2020).

One of the first actions to simplify the process of providing mathematical experience to students is internalising the formal language of mathematics into the local language. Many studies carried out in the context of broader language revitalisation were conducted on indigenous peoples trying to decipher their native language for teaching and learning mathematics (Kirmura, 2009). The study stimulated the emergence of a paradigm of recognising the linguistic rights of traditional tribal groups who elaborated their language to teach mathematics (Barwell, 2012). However, at the same time, the hierarchical matrix formed since colonial periods tends to encourage resistance to these activities by limiting the use of native languages to only a few domains *(excluding mathematics)* which will cumulatively lead to extinction (Grosfoguel, 2011; Simons & Lewis, 2011).

Studies on the exploration of language and mathematical concepts in the traditional culture of the tribes in Indonesia have been widely carried out in the last ten years. These reports can be grouped into two groups. The first group specifically examines the mathematical content used by traditional societies, while the second integrates traditional mathematical

concepts in school mathematics learning. The study of the mathematical language of indigenous societies is an illustration of research that explores mathematical content in the languages of ethnic groups in Indonesia, such as the mathematical language of the Yogyakarta people (Prahmana, 2020), the Sundanese (Muhtadi et al., 2021), the Yapen people of Pa-pua (Aritonang, 2017) and other ethnic groups in eastern Indonesia such as Maluku and East Nusa Tenggara (Winarti, 2017).

Other mathematical content such as geometry is also one of the cultural mathematical studies such as the concept of geometry in Rumah Kaki Seribu of the Arfak Tribe in Papua (Haryanto et al., 2016), the concept of geometric transformation in Batik (Masrukha & Budiarto,Maki 2021) and the use of mathematical concepts in calculations of Agricultural products (Umbara et al., 2019). In addition, the assimilation of traditional mathematics into contemporary mathematics learning models is also widely studied, especially in geometry learning (Hartinah et al., 2019; Lubis et al., 2021; Sudirman et al., 2020). Although ethnomathematical research continues to experience a positive trend in Indonesia, literature studies show the lack of ethnomathematical studies based on ethnic cultures in eastern Indonesia, especially North Maluku, settled by more than 10 indigenous tribes. Interestingly, the languages of these tribes come from two different roots, namely the North Hal-mahera family (Ternate, Tidore, Sahu, Tobaru, Loloda, Galela, Tobelo, Modole, Pagu, and Western *Makian*/*Makian* Luar) and the South Halmahera family (Weda, Sawai, Patani, Maba, Buli and *Makian* Timur/*Makian* Dalam/Taba) (Bowden, 1997; Taha, 2019; Voorhoeve C.L., 1982).

There are two fundamental reasons why this research examines the mathematical language of the *Makian* tribe. The reasons are related to the uniqueness and the threat of extinction. *Makian* Island is inhabited by one tribe with two different languages: Western *Makian* and Eastern *Makian*, with various dialects (Bowden, 1997; Voorhoeve C.L., 1982). However, on the other hand, the extinction of indigenous languages in North Maluku has become a real threat (Imelda, 2017). Therefore, a serious study of local languages and their rela-tionship with other aspects, including mathematics, can be considered essential for language preservation.

This study explicitly explores the two *Makian* tribal languages to find mathematical content and language that can be utilised as an entry point in integrating traditional mathematics into formal mathematics learning in schools. Mathematical content that will be discussed includes numbers, mathematical operations, areas, volumes and units of time. In addition, the comparison of the two *Makian* language variants will also be discussed in this paper.

2. RESEARCH METHOD

This study is ethnomathematical research which is part of an ethnographic approach. Ethnographic research aims to describe, analyze and interpret behavioral patterns, beliefs, and language of cultural groups, including language, rituals, economic and political structures, life stages, interactions, and communication styles that develop over time (Creswell, 2015). This definition is relevant to the research objective to explore the context of mathematics in the indigenous *Makian* language. Fraenkel & Wallen (2009) clarify that the emphasis in eth-nographic research is on documenting or describing the daily experiences of individuals by observing and interviewing them and other relevant people. Therefore, researchers conducted in-depth interviews and observations of participants contin-uously and continuously. For example, interviews were con-ducted with three traditional figures of the western *Makian* tribe from three regions: Waikyon, Waigitang, and Soma. In addition, interviews were also carried out with three traditional Makian leaders from Sabalé and Tafasoho. All of these sources are *Makian* natives who grasp the indigenous *Makian* language.

Observations were made in several places where the indigenous *Makian* tribe performed daily activities, such as in coconut groves, markets, and ritual events. In addition, literature studies are also carried out, such as regional language dictionaries and research reports. In general, the series of ethnographic data analysis processes begins with reading the data as a whole to build an in-depth understanding. The next stage is data reduction, describing the data and drawing conclusions and verification. Data reduction is carried out if data is found that does not correspond to some sources and some literature. Furthermore, detailed descriptions and interpretations are made to establish the context of the mathematical language used by the *Makian* people.

3. RESULTS AND DISCUSSION

3.1 Results

The following describes mathematical terminology: natural numbers and fractions, number operations, indefinite quantities, and units measuring length, area, volume, and time. The language base used in the mention is Western *Makian* (WM) and Eastern *Makian* (EM).

3.1.1 The Mention of Natural Numbers 1-9

Based on **Table 1**, there are significant differences in the root pronunciation of natural numbers 1-9 between the Western *Makian* and Eastern *Makian* languages. However, these two words are often prefixed according to the object of the conversation or the noun that follows, for example: *me minyé* (WM)= one person, *oma dimaedé* (WM)=two children *pso*(EM) = one/a piece of fruit, *sis wal* (EM)= eight (animals).

In Western *Makian*, Nouns fall into two broad classes: Animate and Inanimate. In addition, they are divided into two smaller classes which are labeled Animate High (AH), Ani-mate Low (AL), Inanimate High (IH), and Inanimate Low (IL). Animate nouns denote people and animals, while Inanimate nouns denote plants, trees, and objects. Therefore, there are four sets of numbers in the West *Makian* language, namely: (1) numbers used to count Inanimate Low nouns, (2) numbers used to count Animate Low nouns, (3) numbers used to count objects Animate High and Inanimate High, and (4) the set of

roots of numbers. This grouping ultimately leads to using different affixes placed before the mention of the number.

The classifier of nouns in the Eastern *Makian* language is divided into two: fruit and animal. This classification specifies the affixes used, namely *p-* for fruit and *i-* and *sis-* for 2-9 animals, such as *iso* = one (animal), *silhim/sislim* = five (animals).

Table 1. Names of Natural numbers 1-9

Numbers	WM	EM
1	*-minyé*	*-so*
2	*-edéng*	*-lu*
3	*-ungé*	*-tol*
4	*-faté*	*-hot*
5	*-foy*	*-lim*
6	*-dam*	*-wonam*
7	*-tepedingi*	*-hit*
8	*-tukbange*	*-wal*
9	*-siwe*	*-sio*

3.1.2 The Mention of Natural Numbers 11-19

In the mention of the numbers 11-19, both in the western *Makian* language and the eastern *Makian* represent it in the addition of 10 with the unit numbers 1-9. The pronunciation of the number 10 in Western *Makian* is *Ainyé*, while it is called *Yo ha so* in Eastern *Makian*. In addition, a numeral connector is also used in the designation pattern, namely, *lo*, which means *and* or *plus*. That applies not only to the numbers 11-19 but also to larger integers. The numeral connector "lo" is operated in Western and Eastern *Makian*. An example of mentioning the numbers 11-19 can be seen in **Table 2**.

Table 2. Names of Natural numbers 11-19

Numbers	WM	EM
11	*Ainyé lo minyé*	*Yo ha so lo -so*
12	*Ainyé lo medeng*	*Yo ha so lo -lu*
13	*Ainyé lo ungé*	*Yo ha so lo -tol*
14	*Ainyé lo faté*	*Yo ha so lo -hot*
15	*Ainyé lo mafoy*	*Yo ha so lo -lim*
16	*Ainyé lo dami*	*Yo ha so lo -wonam*
17	*Ainyélo tepedengi*	*Yo ha so lo -hit*
18	*Ainyé lo tukbange*	*Yo ha so lo -wal*
19	*Ainyé lo siwe*	*Yo ha so lo -sio*

3.1.3 The Mention of Tens

Based on the mentioning tens numbers in Table 3, it can be seen that three elements make up words: the tens number class, times or measurement intervals, and numbers. The tens class in Western *Makian* is *-Awe*, and the measurement interval is *-i*. An illustration of the Western *Makian* language of forty (40) is *Awe i fate*, where *Awe* (tens), *i* (times), and *fate* (four). So in the structure of the Indonesian language, it can be interpreted as "ten times four".

Meanwhile, in the Eastern *Makian* language, there are two types of mentions of the tenth grade: *Beit*, which is employed for animals, *Yo* for fruit, followed by *Ha*, which means times. For example, *Beit lu* = twenty (animals) where *beit* shows a multiple of 10, while *Yo hatol* means ten times three (30 pieces of fruits).

Table 3. List of Tens Mention

Numbers	WM	EM
10	*Ainyé*	*(Beit/ Yo ha) -so*
20	*Awedéng*	*(Beit/ Yo ha) lu*
30	*Awe i ungé*	*(Beit/ Yo ha) -tol*
40	*Awe i faté*	*(Beit/ Yo ha) -hot*
50	*Awe i mafoy*	*(Beit/ Yo ha) -lim*
60	*Awe i dami*	*(Beit/ Yo ha) -wonam*
70	*Awe i tepedengi*	*(Beit/ Yo ha)-hit*
80	*Awe i tukbange*	*(Beit/ Yo ha) -wal*
90	*Awe i siwe*	*(Beit/ Yo ha) -sio*

3.1.4 The Mention of Hundreds

The hundredth class in Western *Makian* is named *Atus*. This mention is similar to the mention in Bahasa. Meanwhile, in the Eastern *Makian* language, the hundredth grade is called *Utin*. One of the distinctions between "hundreds formation" and "tens formation" is that the number name directly follows the hundredth class (*Utin*) without including the *ha-* like the tenth class *yo*. Nonetheless, there are exceptions to units of measurement, such as meters. Therefore 400 meters in the Eastern *Makian* language is called "*meter ha utin hot"*. The list of mentions of other hundreds of numbers can be seen in **Table 4**.

Table 4. The Mention of Hundreds

Numbers	WM	EM
100	*Atus minyé*	*Utin co*
200	*Atus medéng*	*Utin lu*
300	*Atus ungé*	*Utin tol*
400	*Atus fati*	*Utin hot*
500	*Atus mafoy*	*Utin lim*
600	*Atus i dam*	*Utin wonam*
700	*Atus tepedengi*	*Utin hit*
800	*Atus tukbange*	*Utin wal*
900	*Atus siwe*	*Utin sio*

3.1.5 The Mention of Thousands

The thousandth class in both Western *Makian* and Eastern *Makian* is *Calan*. Nonetheless, there is a slight difference in the West *Makian* language, namely the class *au* (times/product) affixing. Some instances of mentioning a thousand numbers are provided in **Table 5**.

Table 5. The Mention of Thousandths

Numbers	WM	EM
1000	*Calan nye*	*Calan co*
2000	*Calan audeng*	*Calan lu*
3000	*Calan anyunge*	*Calan tol*
4000	*Calan au fati*	*Calan hot*
5000	*Calan au mafoy*	*Calan lim*
6000	*Calan au idam*	*Calan wonam*
7000	*Calan au tepedengi*	*Calan hit*
8000	*Calan au tukbange*	*Calan wal*
9000	*Calan au siwe*	*Calan sio*

Interestingly, when it involves mentioning larger numbers or quantities such as ten thousand, one hundred thousand, tens of millions, and hundred million. The pattern utilized is the largest number class at the beginning, followed by the smaller class, and ending by the numeral. For example, in the Eastern *Makian* language: six hundred thousand is called *Calan Utin Wonam*, where *Calan* is the thousandth class, *Utin* is the hundredth class, and *Wonam* is the numeral name of 6. In the Western *Makian* language, the word for "*twenty million*" is *Juta Awedéng*, where *Juta* is the millionth class, *Awe* is the tenth grade, and *medéng* reduced to *édeng* is the numeral of 2.

3.1.6 Complex Number

Complex numbers referred to in this study are number formations consisting of unit numbers, multiples of ten, and multiples of a thousand and so on.

Table 6. Illustrations of expressing complex numbers in Western *Makian*

Numbers	WM
21	*Awedéng lo Minyé*
315	*Atus ungé lo Ainyé lo mafoy*
450	*Atus fati lo Awe i mafoy*
1500	*Calan nye lo Atus mafoy*
2650	*Calan audeng lo Atus i dam lo Awe i mafoy*

Based on **Tables 6** and **Table 7**, the mention of complex numbers in both the Western *Makian* and Eastern *Makian* languages is constructed in successive addition using a numeral connector lo and frequently starting with the largest number class and terminating with the unit number.

Table 7. Illustrations of expressing complex numbers in Eastern *Makian*

Numbers	EM
32	*Yo ha tol lo -lu*
415	*Utin -hot lo Yo ha so lo -lim*
550	*Utin lim lo Yo ha lim*
2500	*Calan lu lo Utin lim*
3650	*Calan tol lo Utin wonam lo Yo ha lim*

3.1.7 Zero, Fraction and Indefinite Numbers

Indigenous people often recognize Zero as empty/nothing. For example, the Western *Makian* people call empty with *momua*, and the Eastern *Makian* people call it *molo/nol*. The only known mention of the fraction is half, which in Western *Makian* is called *eta*, and *Palo* in Eastern *Makian*. Subsequently, it is known to say indefinite quantities such as many, few, and some, as in **Table 8**.

Table 8. An example of Mention of some Indefinite Quantities

Indefinite quantities	WM	EM
Few	*otu*	*moto*
Many	*folo*	*lloci*
Some	*eta*	*Lomo/pálo*
All	*Famasi/feberesí*	*hasále*

3.1.8 Mention of Mathematical Operations

Makian natives have a special designation in mathematical operations, although their usage is not in formal mathematics, which is the context of daily life. The list of mentions of mathematical operations can be found in **Table 9**.

Table 9. The Mention of some Mathematics Operation

Math Operations	WM	EM
Addition	*dogo*	*dogo*
Substruction	*notupe*	*mosak*
Division	*nafapula*	*haluat/mlawat*
Equal to	*dadi*	*indadi*

Based on **Table 9**, it can be seen that the two *Makian l*anguages have similarities in the mention of addition and equal. Nevertheless, unfortunately, they do not have a specific term for the multiplication.

3.1.9 Length, Area, and Volume

The indigenous people of the West *Makian* and the Eastern *Makian* use a unique mathematical language to measure units of length, area, and volume of objects.

Western *Makian*

1. *Kama Minye* is used to describe the length measured with one index finger, which is usually operated to measure relatively short objects.
2. *Mlongan,* this term is used to express the height of an object.
3. *Tanet,* this term is used to express the size of a very long object.
4. *Rof* is used to express the length measurement described by extending both hands, and the position of both is straight with the shoulders, usually used to measure objects that are not too long.
5. *Lamo* means the term for the mention of objects with a broad area.
6. *Sinaó* means the term for the mention of objects with a narrow area.
7. *Magol* is a term for objects with large volume sizes, such as stones.
8. *Alus* is the term for the mention of objects with a small volume size.
9. *Ilui guma* means the term for the mention of objects which is relatively high.
10. *Katoba* is the term for mentioning objects with relatively short length.

Eastern *Makian*

1. *Sang* is used to mentioning the length measured by one index finger, usually used to measure relatively short objects.
2. *Mlongan,* this term is used to express the height of an object
3. *Lof* is used to describe the length measured by extending both hands and their position being straight with the shoulders, usually used to measure objects that are not too long.
4. *Tonate*, is used to express the size of a very long object.
5. *Odoso* is used to measure the length of an object with segments, such as bamboo or sugar cane.
6. *Kil,* or arm span. This term describes the length of one meter, around nine to ten spans.
7. *Mlongan,* this term is used to express the height of an object.
8. *8. Mnopa,* this term is used to express the width of an object.
9. *Myao* is used to describe the length measured with one finger.
10. *Sagal* describes the measure of length described by one step, usually used to measure the distance of an object that is not too far away.
11. *Soan,* which is a bamboo measuring 2-3 m, has a sharp tip and is used to pry the soil when planting rice in the fields
12. *Tak Tek,* this term is used to express the volume of a liquid measured using a water pitcher.

13. *Sopo* is used to express the volume of a liquid such as herbs or coconut sap. In addition, sopo is also used to express objects in the form of grains such as rice or grains measured by half a coconut shell.
14. *Gugum*, this term is used to express the volume of a solid object that is the size of a human fist.
15. *Tugai* is used to express the volume of a liquid that is measured using a measuring device.

3.1.9 Some Time-Terminology

The *Makian* community uses a particular mathematical language to indicate the adverb of time. Natural signs such as sunlight are often used to indicate time, especially for people who are occupied outdoors, such as farmers in coconut cultivation or fisherman. They know the time by recognizing these natural signs. The terminology mentioned below is a time terminology that native *Makian* frequently uses.

Western *Makian*

1. *Kaman,* this term indicates the night.
2. *Kama gola* is used to indicate the time at midnight.
3. *Osufi,* this term indicates the early morning time.
4. *Win uwai*, this term is used to indicate the time of noon.
5. *Iseba ibulang,* this term indicates the time before noon.
6. *Mararing,* this term indicates the evening.

Eastern *Makian*

1. *Maddiding* is used to indicate the time of the evening before sunset.
2. *Galmumite* is used to indicate the time of night.
3. *Musama-Halaim* is used to indicate the time of midnight
4. *Gagal-mumto* is used to indicate the time of dawn.
5. *Daking-mauwa* is used to indicate the time around 3 o'clock at the early morning
6. *Galumto* is used to indicate the morning time after sunrise
7. *Ngan-halaim* is used to indicate the time of noon.
8. *Laimone* is used to indicate the time of today.

3.2 Discussion

The description of the variety of Western *Makian* and Eastern *Makian* languages that contain mathematics includes mentioning the names of natural numbers (from small to large), indefinite numbers, and terms that represent the context of the area, the volume of objects, and time are not focused on comparing the two language variants. However, it is intended to introduce and understand teachers and students who are part of the local inhabitant about the mathematical context in their everyday words. Hence, mathematics educators can explore and exploit sociolinguistic and epistemological problems that arise when the native language is elaborated and combined with formal language that is often used in learning mathematics (Parra & Trinick, 2018). Furthermore, teaching indigenous languages and incorporating indigenous cultural knowledge and modern worldviews in the mathematics curriculum makes it possible to improve the performance of indigenous students in mathematics education (Aikenhead, 2018). In addition, Riccomini(2015) also confirms that learning students' mathematical vocabulary is a crucial part of students' language development and, ultimately, mathematical abilities because vocabulary comprehension is a significant contributor to overall understanding in many content areas, including mathematics.

In the local scope of North Maluku Province, there has been no similar research related to the ethnomathematics of the *Makian* tribe, especially the implementation of *Makian* culture in school mathematics learning. However, there have been many ethnomathematical researchers who have documented their research reports on the positive impact of internalizing local culture in learning mathematics in primary and secondary schools, such as the use of cultural contexts in improving mathematical literacy (Zaenuri et al., 2020), exploration of art as a source of learning mathematics (Budiarto et al., 2020; Sugianto et al., 2019), internalization of ethnomathematics into mathematical activities such as estimation, measurement, and finding patterns (Muhtadi et al., 2017) and even mathematics learning design using traditional games (Roza et al., 2020).

4. CONCLUSION

The indigenous languages of the Western *Makian* and Eastern *Makian* are rich in knowledge and values, including mathematical content such as natural numbers, indefinite quantities, measurement, and time display. The involvement of native languages in learning mathematics is a step toward bringing students from indigenous communities closer to formal mathematics. This integration can be done through learning designs containing activities such as traditional games, works of art, and native languages. Furthermore, this research can be a good entry point for mathematics teachers in North Maluku Province to bring mathematics learning closer to their native language and culture as a bridge to foster student understanding.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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