RECOGNIZING ETHNOMATHEMATICS IN *WAU* KITE AND *CORAK-RAGI* OF *TENUNMELAYU* FROM KEPULAUAN RIAU PROVINCE AND USING ITS POTENTIALS TOWARDS LEARNING OF SCHOOL MATHEMATICS

FEBRIAN

Department of Mathematics Education
Maritime University of Raja Ali Haji
Jl Politeknik Senggarang KM 24 Tanjungpinang, e-mail: febrianfebz@gmail.com

Abstract

Ethnomathematics proposes the idea of mathematics that develops informally in cultural aspects of human's life.Mathematics is utilized through some daily activities such as grouping, counting, measuring, designing, playing, locating, etc. For specific group of people, mathematical activities can uniquely exist and develop. Hence, ethnomathematics can obviously be subject to diversity since it relies on culture of specific groups. The idea of ethnomathematics is promising to learning practice of school mathematics for at least two reasons. First, it can provide the context of learning which is undeniably familiar for learners living in specific area. Second, it enables the reinvention of relevant mathematical concepts which are already arranged formally in school curriculum. Kepulauan Riau province, one of provinces in Indonesia, has rich *melayu* culture that spreads across the entire islands. *Wau* kite and *tenun melayu*are the examples of many cultural items originating from Kepulauan Riau province. The making of *Wau* kite utilizes mathematical activity and precision to ensure the kite is fully functioning to be played and flown. *Tenun melayu* displays beautifully arranged geometrical patterns called *corak-ragi* that are created by particular technique that involves mathematics. This ethnography based qualitative study discovers the ethnomathematics behind the creating of *Wau* kiteand*corak-ragi*of*tenun melayu*. The data is obtained through interview andliterature study. Both data are triangulated to get a fuller information. The analysis is qualitatively described to deliver attention to two main analysis: etnomathematics domain analysis and ethnomathematics taxonomy analysis on *Wau* kiteand*corak-ragi* of*tenun melayu*. The study indicates that creating of *Wau* kite heavily utilizes the length measurement which is a basic topic in school mathematics. Modelling of linear function-equation are other topics that can be reinvented. The creating of*corak*of*tenun melayu* and its variety applies the technique which is familiar to relevant mathematics topic in school such as transformation geometry (reflection, translation, rotation, and dilation). Other relevant concepts are symmetry, and transformation composition.

Keywords: Ethnomathematics, corak-ragi of tenun melayu, wau kite, mathematics learning context

1. Introduction

Culture is constructed by group of society, developed, and inherited to their younger members. It includes set of rules, ideas, concepts, and values related to the way of life including beliefs, policies, economy, language, creation, social organization, and customs. Culture is various all over the world. It entails that the way people conduct the aforementioned aspects of culture is different each other. Hence, this also implies that the daily practices or activities of a society will be different to one and another. Apparently, in every aspect of culture, daily activities can explicitly and implicitly contains mathematical activities. It becomes the sources of the informal mathematics which grows and develops in society. Those activities includes counting, localizing, grouping, explaining, measuring, playing, and designing. Mathematical practice undertaken by group of people such as society is generally known as ethnomathematics. The activity categorization is apparently called ethnomathematics domain.

However, many people in society are not aware of such mathematics-related intellectuality they perceive from daily activity.In fact, in separate occasion, they define mathematics as ready-made tool gained while having formal education in school and it is taught unconnectedly to their life. Hence, mathematics is considered as difficult and meaningless subject to learn.

Knowing the potential of this ethnomathematics, new paradigm flourishes the idea that school mathematics should be taught by using everyday life context that is familiar to the students in order to obtain meaningful study. Hence, the exploration of mathematical practices in culture of group of people is continuously executed to find hidden potential daily context for school mathematics. It enables correspondence of real life mathematics with mathematical concepts that are taught at school. Also, it gives information how to teach mathematics by reinvention.

This study tries to uncover the mathematical activities conducted by group of people in Kepulauan Riau province. This province has rich *melayu* culture and has bunch of cultural products to explore. Two famous attributes of this *melayu* culture concerned are: *Wau* kite and *corak-ragi* of *tenun melayu*. In this study, the analysis on ethnomathematics domain and taxonomy are conducted. These will give the information on what school mathematics concepts that can be corresponded to the one growing up in society. Hence, this information will bring the idea of how to deliver those explored concepts in mathematics teaching and learning at school.

2. Theoretical Background

a. Perspectives on Culture

The basic concept of this study is culture. Generally, people will relate culture with everyday life termsin society,like customs and traditions. However, culture is more complicated than only those two. There are many ways to define culture. It can be approached by many perspectives. For example, culture is defined as a system consisting of ideas and concepts as results of human's activity that has pattern (Koetjaraningrat, 2000). Meanwhile, Matsumoto (in Spencer-Oatey, 2012) defines culture as the set of attitudes, values, beliefs, and behaviors shared by group of people, but different for each individual, communicated from one generation to the next.In the same line of that definition but more elaborated one, Spencer-Oatey (2008) entails culture as a set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioral conventions that are shared by group of people, and that influence (but do not determine) each member's behavior and his/her interpretations of the meaning of other people's behavior (Spencer-Oatey, 2008).

From these solid aforementioned definitions, we can perceive that culture is constructed and developed within society. This is in line with the theory that classifies a culture into several defining attributes or characteristics. One of them is culture as an individual and social construct (Spencer-Oatey, 2012). This value and rule is spread within cultural society that makes them possible (not necessarily should) to affect people's way of life and how they interpret the way of others'.For instance, in some societies, parents teach their children how to conduct their life according to culture of the society they are living in. The values are inherited to the younger members of the society that make the culture last longer and survive. It implies that a culture can be inherited. It is another defining attribute of a culture.

Culture is also subject to diversity. For example, western culture, is a way much different with eastern culture. The culture of the eastern, for example, is transcendental kind of one. Zainal (in Malik, 2004) stated that Eastern culture is created as manifestation of relationship of human and God.

To identify a particular culture, one should understand the components that build up the culture itself. There are seven components of culture. They are social organization, customs and traditions, religion, language, arts and literature, form of government, and economic system. These components can be different with those in other cultures. This study more focuses on the component of arts and traditions.

b. Mathematics and Society

It is believed that every people, group of people, societies all over the world face the difficulty and confront with challenge in their live. This is when people try to maintain and to solve the problem with their thought and strategy. Mathematics is believed as something people from any culture grow and develop while such difficult situation or challenging condition coming into their aspects of life. This is undeniable that people growing mathematics means people growing knowledge. Since knowledge as Tyler (in Spencer-Oatey, 2012) defined, is part of culture of society, it can be concluded that mathematics becomes part of culture, part of society.

However, even though mathematics is considered the best practice people conduct while facing challenge in everyday case, it is not guaranteed that people really realize that what they have done is mathematics. For example, a creator of *Wau* kite in Kepulauan Riau province is not aware that what he does is mathematics while designing the measure of frame of kite in order to fly high and to be better played. At least one following theory explains this situation. Mathematics pervades our everyday lives, sometimes obviously and sometimeson a more hidden or implicit level(François & Van Kerkhove, 2010). It suggests us that implicity of mathematics in life practice can affect people's acquisition of mathematics existence in their life.

Moreover, whenever people in society hear the word mathematics, they directly correspond it to the one the students learn in school, something formal only gained by doing study in certain level of education. Somehow, school mathematics is also taught without everyday context so that it remains meaningless. In another context, mathematics is still considered as the tool to solve practical problems only in science practice, so that people ignore that mathematics is part of their everyday activity (Soedjadi, 2010).All of these findings accumulate to make one general social judgments towards Mathematics that it is difficult subject.

Hence, it is truly required that people realize that mathematics is part of their life. One idea needs to be planted in society about Mathematics. Certain effort needs to be undertaken to educate people that mathematics is a construction of human's culture (Sembiring in Parbowo, 2010), something theirs.

c. Ethnomathematics

The concept of mathematics that grows and develops in human's culture is widely known as ethnomathematics. D'Ambrosio (Rosa & Orey, 2011) defined ethnomathematics based on pieces of word that build up the term itself as follow

> The prefix *ethno* is today accepted as a very broad term that refers to the socialculturalcontext and therefore includes language, jargon, and codes of behavior, myths, and symbols. The derivation of *mathema* is difficult, but tends to mean to explain, to know to understand, and to do activities such as ciphering,measuring, classifying, inferring, and modeling. The suffix *tics* is derived from*techné*, and has the same root as technique (p. 81).

From the meaning of these words, the definition of ethnomathematics is derived by D'Ambrosio who was apparently the person that proposed the idea of ethnomathematics itself. He defined ethnomathematics as the mathematics practiced by cultural groups, such as urban and rural com-munities, groups of workers, professional classes, children in a given age group, indigenous societies, and so many other groups that are identified by the objectives and traditions common to these groups (D'Ambrosio, 2006).

The important aspect underlying ethnomathematics is the idea of mathematical practice that is conducted by group of people. In order to make mathematical practice well defined, categorization of practice should be derived. Bishop (Wedege, 2010)identified six types of mathematical practice or activity as follow

- *Counting*, the activity that includes the use of a systematics way to compare and order discrete phenomena.
- *Localizing*, the activity that includes exploring one's spatial environment, conceptualizing, and symbolizing that environment, with models, diagrams, drawings, words or other means.
- *Measuring*, the activity that includesquantifying qualities for the purposes of comparison and ordering, using objects or tokens as measuring devices with associated units or 'measure-words'.
- *Designing,* the activity that includes creating a shape or design for an object or for any part of one's spatial environment.
- *Playing*,the activity that includes devising and engaging in games and pastimes playing by rules with more or less formalized rules that all players must abide by.
- *Explaining,* the activity that includes finding ways to account for the existence of phenomena, be they religious, animistic or scientific.

Based on this explanation, several thoughts can be drawn. First, it can be concluded that theconcept of ethnomathematics signals that mathematics is not a ready-made product that is unconnected and at distant from human's life. It is indeed part of human's activity and people in society must realize it. Second, it implies that culture in several locations or areas does reflect the intellectuality of their people. This intellectuality should be well discovered. Third, ethnomathematics is promising for education, especially mathematics teaching and learning.Therefore, the exploration of mathematics that grows including its component in society through their culture becomes crucial.

d. Ethnomathematics and School Mathematics

The concept of ethnomathematics is promising to mathematics education. First, this thought is supported by National Council of Teacher of Mathematics (NCTM, 1991) which highlighted the importance of building connections between mathematics and students'personal lives and cultures. Second, it is argued that mathematics education is nested in a socio-cultural context (François & Van

Kerkhove, 2010). Ethnomathematics provides the information of mathematical practices which are undertaken by the people of the society with particular culture. Since students are the member of society and they learn mathematics at school, it is wise to think that ethnomathematics can be regarded as worthwhile contributor to the development of mathematics education, especially in teaching and learning mathematics.

Furthermore, there is a solid argument on why ethnomathematics can help the development of mathematics through the education curriculum. Ethnomathematics presents mathematical concepts of the school curriculum in a way in which these concepts are related to the students' cultural and daily experiences, thereby enhancing their abilities to elaborate meaningful connections and deepening their understanding of mathematics(Rosa & Orey, 2011).

It is believed that ethnomathematics will be able to replace the old paradigm that entails the display of learning mathematics at school which is brought formally, less connected to students' real life experiences, and less meaningful.It is supported by Gravemeijer (2010) who suggests that learning will proceed better if students are taught from informal level in which they are familiar with in their everyday life experience.

e. *Wau* Kite and *Corak* of *Tenun Melayu* as Products of Culture in Kepulauan Riau Province

Kepulauan Riau province is one the youngest province in Indonesia. The area of the province consists of mainly 96% waters and several bigger and smaller islands. It has about 8,202 km^2 territory in total. It consists of seven districts: *Kabupaten*Bintan, Tanjungpinang city, Batam city, *Kabupaten* Lingga, *Kabupaten* Karimun, *Kabupaten* Anambas, and *Kabupaten* Natuna. It is surrounded by Malaysia, Singapore, and Riau province. It has around 1.7 million people and about 40% of them are *Melayu* people. Language being used in everyday life is *melayu* language, or *melayu*-dialected Indonesia language. Those local people spread in entire seven districts on the islands.

Kepulauan Riau province has rich *melayu* culture. The people are mostly known as the art creators as well as poets and artists. Beside the famous *melayu* poetry and *Gurindam* 12 of Raja Ali Haji, there so many products of *melayu* culture such as *corak* or patternof *melayu* that can be found in *tenun*, building ornaments, and other media. Some famous *corak-ragi*of *melayu* are *itik pulang petang, pucuk rebung,* and *pucuk puteri*. Each *corak* has meaning that entails value grown and inherited within *melayu* society. Each *corak* can be used to create special extended patterns that apparently uses technique which shows up mathematical skill of local people. Another famous cultural stuff is *Wau* kite. This traditional game is frequently played in Kepulauan Riau province. There is also local competition of kite that is held annually. Talking about kite, Kabupaten Lingga stands out among others. It is the most famous house to see beautiful kite called *Wau* played and flown. Apparently, the locals use mathematics to gain precision in building up the frame of kite while creating it.

3. Method

The purpose of the study is to get information, and to identifyethnomathematics of people in Kepulauan Riau province in the making of *Wau* kiteand *corak* of *tenun melayu*. The appropriate approach to gain the purpose of this study is ethnography. Spradley (in Tandililing, 2012) entails that ethnography is used to describe, to explain, and to analyze the component of culture of particular society. This approach is one of those many that is used in broad qualitative study and consists of common several stages including determining informant(s), conducting interview, documenting, posing descriptive and structural questions, analyzing interview, constructing domain analysis, conducting taxonomy analysis, and reporting.

The objects of the study are *corak-ragi* of *tenun melayu* and *Wau* kite which originate from Kepulauan Riau province. In this study, researcher is the main instrument of the study that takes control several aspects of the study including determining the informants or subject of the study, undertaking the data collection, triangulating the data, and interpreting the result based on the purpose of the study. Since the study is addressed to get information of ethnomathematics on the objects of the research, then the purposive approach bases the subject determination or informant.

Kabupaten Lingga, one of the seven districts of Kepulauan Riau province, located in one of the Islands that spreads around 211,772 km^2, is one of the house of the famous handmade *Wau* kite. One of local people in Kabupaten Lingga is chosen as the main informant, locally called *Andak Sadat*. He is the person who masters the making of local *Wau* kite as well as playing it in local competition. In 2014, he won the annual kite competition in Kabupaten Lingga. He is pure *melayu* person that speaks heavy *melayu* dialect. Hence, one translator, which is also coming from Lingga, is hired to help the researcher understand the language being used while the informant is interviewed. The information obtained is not only about the making of *Wau* kite, but also about*corak-ragi* of*melayu*, those which are also found in *tenun melayu*, since those patterns are apparently found to be drawn on the body of the kite. Another instrument used while interviewing the informant was field notes. In addition, during the session, the informant made notes and drew picture on the paper while explaining *Wau* kite making. This note is used as another written data to analyze.

While interview is the main data collection method, literature study is undertaken to obtaininformation that mainly focuses on *corak-ragi* of *tenun melayu*and *Wau* kitein Kepulauan Riau province. This written data is triangulated with those obtained through interview to get deeper and fuller information for the purpose of the study. The data obtained in this study is analyzed and qualitatively described to display the ethnomathematics on the making of *Wau* kite and *corak-ragi*of *tenun melayu*.

The main result of the analysis is led and is centered on two important aspects: ethnomathematics domain analysis and ethnomachematics taxonomy analysis (Ubayanti, 2016). Ethnomathematics domain analysis aims to get broad description from research objects followed by categorization of data and domain determination including activity of: counting, measuring, designing, localising, playing, and explaining. Meanwhile, ethnomathematics taxonomy analysis is undertaken by elaborating the domains previously determined and chosen into specific details based on mathematical concepts within the making of *Wau* kite and *corak-ragi* of *tenun melayu*. Those mathematical concepts will be corresponded to those included in school mathematics curriculum that are recently applied in Indonesia, namely 2013 curriculum.

4. Result and Discussion

a. Ethnomathematics on the Making of *Wau* Kite and Its Connection to School Mathematics Concepts

The basic component used to make *Wau* kite is bamboo for kite's frame, paper, and thread. The framing is the most important part of all process. There are five bamboo sticks used in framing (see figure 1, left part). The pair of parallel bamboo sticks that have same length are called *kepak*or sticks to create wings (upper and lower both later curved). Stick in the middle perpendicular to *kepak* is called *tiang* or pole. The forth stick is called *ekor* or tail.

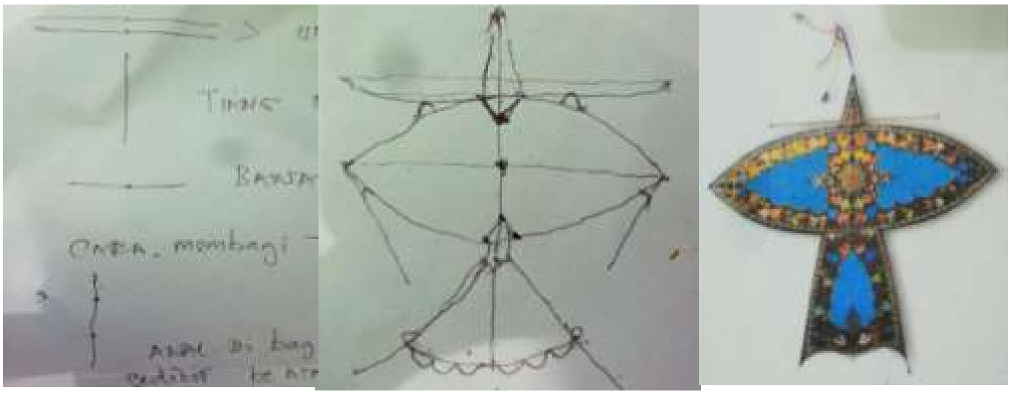

Figure 1. *Andak Sadat's* initial written strategy to measure frames (left) and Wau sketch (middle), one of the picture of ready-played kite (right)

Based on *Andak Sadat's* estimation, pole stick is divided into three equal parts resulting two points (suppose upper and lower point respectively to the picture) in between. Suppose 1 m pole, after divided three equal parts, the upper wing is bonded with thread to pole perpendicularly at exactly two fingers above the upper point. On the other hand, the lower wing is bonded with thread to pole perpendicularly at exactly one finger below the lower point. The tips of both wings are joined so that both wings make elliptical figure (see figure 1). The upper segment of pole is shortened by cutting it exactly 1 inch. This upper segment is called head.This practice entails three main mathematics topics/concepts: number (see table 2, T1), length measurement and its measure, both standardized and non-standardized like finger, inch (see table 2, T2-T7).

Tail stick is exactly half of the length of wing stick.It is bonded around the tip of the lower segment of pole and perpendicular to it. Meanwhile around the head near the upper wing another stick is bonded perpendicular to pole as the holder of *pakau*. *Pakau* is made equal with pole on length to make it produce high pitched and better sound while flown. It entails the relationship of the length between wings (W) and tail (T), *pakau* (Pa) and pole (Po). This kind of relationship can be modelled into formal mathematics expression $T = \frac{1}{2}W$ and $Pa = Po$. This equation in school is known as linear function (see table 2, T9, T10).This precision on length measurement ensures the *Wau* kite can be flown better. Besides, the precision also causes balance to the kite. Another reason for this balance is the symmetrical form within the frame of the kite's body (see table 4, T1).

Beside *Andak Sadat's* way of framing, it is also found that other Lingga people use more complicated framing to obtain precision in length measurement (see figure 2). From that delicate way of framing, it can be obviously seen that every two sticks (or pair) has "length" relationship. It is similar to that used by *Andak Sadat*. This connection supports mathematical modelling which is linear function (see table 2, T9, T10).

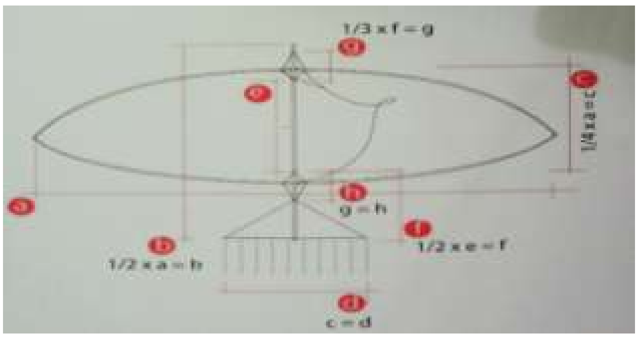

Figure 2. Another strategy for the measure of Kite's frame (source: Batam Pos 2016)

From this linear function idea, it can be derived the idea of two variable linear equation. For example $\frac{1}{2}a = b$ can be expressed into$\frac{1}{2}a - b = 0$. Consider this possible strategy within framing (if other case) "difference between wing and tail is 30 cm", then it can simply implies $W - T = 30$. Later, in the advanced case, this two variable linear equation can bring the idea of value ofvariables within linear equation (see table 2, T10).

Ethnomathematics domain analysis and ethnomathematics taxonomy analysis for the making of *Wau* kite are presented in the following tables

Table 1. Ethnomathematics domain analysis in the making of *Wau* kite

Domain	Related to	Mathematics idea/activity in the making of *Wau* kite
Counting	-how many (components) -how longer (ordering)	- Determining the number of bamboo stick used to make kite's frame. - Determining the number of segment of a stick - Determining the length relationship between each stick, for example, wing's length is twice of tail's
Localizing	Not explored	Not explored
Measuring	- **how long (quantifying and ordering)**	- **Determining the length of sticks and its segments both in standardized and non-standardized measure**
Designing	- **how to (technique)**	- **Desiging the kite's frame/basic shape** - **Precision obtained from symmetrical form of kite**
Playing	Not explored	Not explored
Explaining	Not explored	Not explored

Table 2. Ethnomathematics taxonomy analysis in the making of *Wau* kite

Code	Mathematical Activity	Associated Topics and Concepts	Kompetensi Inti (Core Competency)	Kompetensi Dasar (Basic Competence)	Education Level
1	- Determining the number of bamboo stick used to make kite's frame. - Determining the number of segment of a stick - Determining the length relationship between each stick, for example, wing's length is twice of tail's	Number - Natural Number	*Memahami pengetahuan faktual dengan cara mengamati [mendengar, melihat, membaca] dan menanya berdasarkan rasa ingin tahu tentang dirinya, makhluk ciptaan Tuhan dan kegiatannya, dan benda-benda yang dijumpainya di rumah dan di sekolah*	*Mengenal bilangan asli sampai 99 dengan menggunakan benda-benda yang ada di sekitar rumah, sekolah, atau tempat bermain*	**Elementary (first grade)**
2	Determining the length of sticks and its segments both in standardized and non-standardized measure	Geometry and Measurement - Comparing the length	*Memahami pengetahuan faktual dengan cara mengamati [mendengar, melihat, membaca] dan menanya berdasarkan rasa ingin tahu tentang dirinya, makhluk ciptaan Tuhan dan kegiatannya, dan benda-benda yang dijumpainya di rumah dan di sekolah*	*Membandingkan dengan memperkirakan panjang suatu benda menggunakan istilah sehari-hari (lebih panjang, lebih pendek)*	**Elementary (first grade)**
3	Determining the length of sticks and its segments both in standardized and non-standardized measure	Geometry and Measurement - Understanding the length through comparison		*Mengenal panjang, luas, massa, kapasitas, waktu, dan suhu*	
4	Determining the length of sticks and its segments both in standardized and non-standardized measure	Geometry and Measurement - Knowing the length by standardized and non-standardized measure	*Memahami pengetahuan faktual dengan cara mengamati [mendengar, melihat, membaca] dan menanya berdasarkan rasa ingin tahu tentang dirinya, makhluk ciptaan Tuhan dan kegiatannya, dan benda-benda yang dijumpainya di rumah dan di sekolah*	*Mengetahui ukuran panjang dan berat benda, jarak suatu tempat di kehidupan sehari-hari di rumah, sekolah dan tempat bermain mengunakan satuan tidak baku dan satuan baku*	**Elementary (second grade)**
5	Determining the length of sticks and its segments both in standardized	Geometry and Measurement - Conversing the length measure	*Memahami pengetahuan faktual dengan cara mengamati [mendengar, melihat, membaca] dan menanya berdasarkan*	*Mengenal hubungan antar satuan waktu, antar satuan panjang, dan antar satuan berat yang*	**Elementary (third grade)**

	and non-standardized measure	within standardized and non-standardized measure	*rasa ingin tahu tentang dirinya, makhluk ciptaan Tuhan dan kegiatannya, dan benda-benda yang dijumpainya di rumah dan di sekolah*	*biasa digunakan dalam kehidupan sehari-hari*	
6	Determining the length of sticks and its segments both in standardized and non-standardized measure	Geometry and Measurement - Estimating the length with standardized measure	*Menyajikan pengetahuan faktual dalam bahasa yang jelas, sistematis dan logis, dalam karya yang estetis, dalam gerakan yang mencerminkan anak sehat, dan dalam tindakan yang mencerminkan perilaku anak beriman dan berakhlak mulia*	*Menaksir panjang, luas, dan berat suatu benda dan memilih satuan baku yang sesuai*	
7	Determining the length of sticks and its segments both in standardized and non-standardized measure	Geometry and Measurement - Measuring the length with standardized and non-standardized measure		*Memperkirakan dan mengukur panjang, keliling, luas, kapasitas, massa, waktu, dan suhu menggunakan satuan baku dan tidak baku*	
8	Determining the length relationship between each stick, for example, wing's length is twice of tail's	Algebra - Two variable linear equation - Variable and its value	*Memahami dan menerapkan pengetahuan (faktual, konseptual, dan prosedural) berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya terkait fenomena dan kejadian tampak mata*	*Menentukan nilai variabel persamaan linear dua variabel dalam konteks nyata*	**Junior High School (eight grade)**
9	Determining the length relationship between each stick, for example, wing's length is twice of tail's	Algebra - Relation - Function and Its formula		*Menyajikan fungsi dalam berbagai bentuk relasi, pasangan berurut, rumus fungsi, tabel, grafik, dan diagram*	
10	Determining the length relationship between each stick, for example, wing's length is twice of tail's	Algebra - Definition of model - Solution of equation	*Mengolah, menyaji, dan menalar dalam ranah konkret (menggunakan, mengurai, merangkai, memodifikasi, dan membuat) dan ranah abstrak (menulis, membaca, menghitung, menggambar, dan mengarang) sesuai dengan yang dipelajari di sekolah dan sumber lain yang sama dalam sudut pandang/teori*	*Membuat dan menyelesaikan model matematika dari masalah nyata yang berkaitan dengan persamaan linear dua variabel*	

b. Ethnomathematics within *Corak-Ragi* of *Tenun Melayu*and Its Connection to School Mathematics Concepts

There are two local terms for patterns attached to several object like *tenun* (*melayu*traditional cloth), building ornaments, etc: *corak* and *ragi*. *Corak* refers to basic pattern or unit/single pattern. If *corak* is expanded on the surface of *tenun*, with particular technique, repeating for example, there will be new pattern or design. This design is locally called *ragi*. Many *corak* and *ragi* can be established to meet the various functionality of wear.

Figure 3. Corak of *itik pulang petang* with reflection technique (left), extended pattern from *corak* of *pucuk rebung* with translation and reflection technique (middle), and extended pattern from *corak* of *pucuk puteri* with rotation, translation, and reflection technique (right)

Several famous *corak* of *tenun melayu* are: *itik pulang petang, pucuk rebung*, and *pucuk puteri* (see figure 3). All *corak* and *ragi* have special value and meaning on several aspect of *melayu* society life such as religion, customs, tradition, social, etc. *Itik pulang petang* is one example of *corak* included in animal group. It implies the value of love, affection, and kindness. *Pucuk rebung* is an example of plant *corak*. The picture in the middle is *ragi*, called *pucuk rebung kaluk paku,* consisting of several identical *corak* of *pucuk rebung.* It entails the value of being kind, being helpful to others who are in difficult situation. *Pucuk puteri* is another plant *corak.* On the right side of the picture is the *ragi* called *kuntum bersusun*. The value implied is the significant of belief in life, life in harmony and peace.

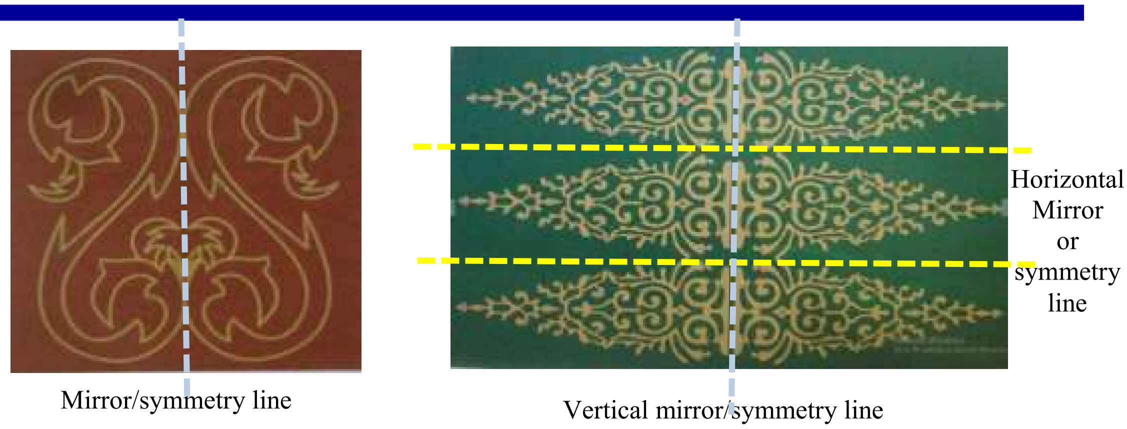

Figure 4. Reflection technique found in *corak* and *ragi*

Apparently, reflection technique is applied not only when creating *corak* but also when constructing *ragi*. *Itik pulang petang* is *corak* constructed by reflection. *Pucuk rebung kaluk paku* is design created by reflecting *pucuk rebung corak* as many as creator wants. The reflection can be done vertically or horizontally. The creator also use technique to derive precision of design. Something similar to mirror or symmetry line. Therefore, it can be concluded that creating *corak* and *ragi* applies technique that includes mathematics, especially related to topics: number (see table 2, T1), reflection, and line symmetry in school (see table 4, T1).

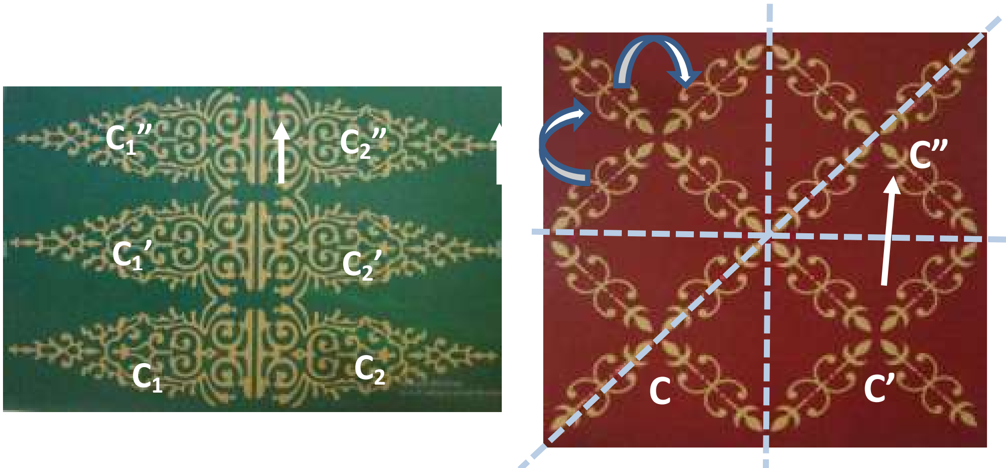

Figure 5. Translation of *pucuk rebungcorak* to derive *ragi* (left), many ways of doing transformations to derive *ragi* (right)

Ragi of *pucuk rebung kaluk paku*(figure 5, left) is apparently constructed by sliding basic *corak* of *pucuk rebung* in particular direction as many as creator wants. This sliding technique is known mathematically as translation. Meanwhile*, kuntum bersusun* (figure 5, right) can be constructed with more than one geometrical technique: rotating *pucuk puteri corak* at exactly 90 degrees either clockwise or counterclockwise. Then, reflection and translation can be undertaken to expand the design. The process can also be approached by other order of transformations. Therefore, it can be concluded that creating *pucuk rebung kaluk paku* and *kuntum bersusun*includes mathematics, especially related to topics: transformation and transformation composition (see table 4, T2-T5).

Ethnomathematics domain analysis and ethnomathematics taxonomy analysis for the making of *corak-ragi of tenun melayu*are presented in the following tables

Table 3. Ethnomathematics domain analysis in the making of *corak-ragi* of *tenun melayu*

Domain	Related to	Mathematics idea/activity in the making of Wau kite
Counting	- how many (repetition of *corak*)	- Determining the number of *corak* within pattern - Determining the number of part contained in *corak*
Localizing	Not explored	Not explored
Measuring	- **how much expanded**	- **Determining the area on tenun to be attached with *corak* and *ragi***
Designing	- **how to (technique)**	- **Designing *corak* with specific geometrical technique (transformation, symmetry)** - **Infinite exploration on *ragi* based on creativity by applying geometrical technique (transformation, symmetry)**
Playing	Not explored	Not explored
Explaining	Not explored	Not explored

Table 2. Ethnomathematics taxonomy analysis in the making of *corak-tenun*of *tenun melayu*

Code	Mathematical Activity	Associated Topics and Concepts	*Kompetensi Inti* (Core Competency)	*Kompetensi Dasar* (Basic Competence)	Education Level
1	Designing *corak* with specific geometrical technique (transformation, symmetry)	Geometry - The notion of ymmetry - Rotation - Reflection	*Memahami pengetahuan faktual dengan cara mengamati [mendengar, melihat, membaca] dan menanya berdasarkan rasa ingin tahu tentang dirinya, makhluk ciptaan Tuhan dan kegiatannya, dan benda-benda yang dijumpainya di rumah dan di sekolah*	*Menemukan sifat simetri bangun datar (melalui kegiatan menggunting dan melipat atau cara lainnya), simetri putar dan pencerminan menggunakan benda-benda konkrit*	Elementary (third grade)
2	Infinite exploration on *ragi* based on creativity by applying geometrical technique (transformation, symmetry)	Geometry - Finding the image of reflection and rotation	*Menyajikan pengetahuan faktual dalam bahasa yang jelas, sistematis dan logis, dalam karya yang estetis, dalam gerakan yang mencerminkan anak sehat, dan dalam tindakan yang mencerminkan perilaku anak beriman dan berakhlak mulia*	*Menunjukkan hasil rotasi dan pencerminan suatu bangun datar dengan menggunakan gambar*	
3	Infinite exploration on *ragi* based on creativity by applying geometrical technique (transformation, symmetry)	Geometry - Transformation of geomterical objects	*Memahami pengetahuan (faktual, konseptual, dan prosedural) berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya terkait fenomena dan kejadian tampak mata*	*Memahami konsep transformasi (dilatasi, translasi, pencerminan, rotasi) menggunakan objek-objek geometri*	Junior High School (seventh grade)
4	Infinite exploration on *ragi* based on creativity by applying geometrical technique (transformation, symmetry)	Geometry -Solving transformation problem by using transformation principles	*Mencoba, mengolah, dan menyaji dalam ranah konkret (menggunakan, mengurai, merangkai, memodifikasi, dan membuat) dan ranah abstrak (menulis, membaca, menghitung, menggambar, dan mengarang) sesuai dengan yang dipelajari di sekolah dan sumber lain yang sama dalam sudut pandang/teori*	*Menerapkan prinsip-prinsip transformasi (dilatasi, translasi, pencerminan, rotasi) dalam memecahkan permasalahan nyata*	
5	Infinite exploration on*ragi* based on creativity by applying	Geometry -Analysing and solving transformati	*Mengolah, menalar, dan menyaji dalam ranah konkret dan ranah abstrak terkait dengan pengembangan dari yang*	*Menyajikan objek kontekstual, menganalisis informasi terkait sifat-sifat objek dan menerapkan aturan*	Senior High School (eleventh

	geometrical technique (transformation, symmetry)	on daily problem -Transformation composition	*dipelajarinya di sekolah secara mandiri, bertindak secara efektif dan kreatif, serta mampu menggunakan metoda sesuai kaidah keilmuan.*	*transformasi geometri (refleksi, translasi, dilatasi, dan rotasi) dalam memecahkan masalah.*	grade)

c. Utilizing Ethnomathematics of *Wau* Kite and *Cora*k of *Tenun Melayu* in Mathematics Teaching and Learning

Based on this exploration, it can be suggested that *Wau* kite and *corak-ragi* of *tenun melayu* can be brought into mathematical classroom teaching and learning since both of them contain mathematical concepts. Hence, both of them can be regarded as the contexts of learning. The use of *Wau* kite can deliver students to daily concept of length measurement including measuring by local or standardized measure; building up understanding of length relationship between two or more components;and constructing mathematical model of linear function and two variable linear equation. Meanwhile, the investigation of pattern of *tenun melayu* can bring the idea of geometrical concepts: symmetry, transformation, and transformation composition. The use of both contexts is believed to support students' understanding of those focused concepts. These contexts can also be delivered as the problem to be solved, namely contextual problem. Treffers (in Cici, 2014) explained that the contextual problem is used to give meaning to the mathematical learning and become the milestone for students to build the mathematical concepts. Additionally, getting to know mathematics does involve much concrete experience and grounding in its central (Bentley and Malven in Mashingaidze, 2012).

Moreover, those contexts can bring the idea of guided reinvention through sequence of learning process or learning trajectory. Gravemeijer and Doorman (1999) explained that the idea of guided reinvention is to allow learners to come to regard the knowledge that they acquire as their own private knowledge, knowledge for which they themselves are responsible. In *Wau* kite case, students can reinvent the idea of function through mathematical modelling process. Consider the following problem they might find during the process, "the length of tail is half of the length of wing". The statement can be translated into equation at first, $tail = \frac{1}{2} wing.$ By translating those terms into variables, then student might obtain $t = \frac{1}{2}w$. Hence, this last expression can be understood as function, as relation.

In *tenun melayu* case, students might reinvent the idea of transformation through the understanding of geometrical movement of object on plane. They might develop the idea of reference point, reference line (symmetry line), angle, and direction. This exploration on *corak-ragi* of *tenun melayu* can bring the idea of coordinate of points in Cartesian system on plane and its image under certain transformation applied. The discussion can slightly shift from visual to algebraic way. Later, students might develop formal transformation as the function which maps every points on a plane, notated as $f: R^2 \to R^2$. Moreover, they might reinvent the idea of isometry which implies transformation that results the same shape and size of object being transformed. Formally, an isometry is defined to be function $f: R^2 \to R^2$ that preserves distance; that is $|f(P_1)f(P_2)| = |P_1P_2|$ for any point $P_1, P_2 \in R^2$(Stillwell, 2005).

5. Conclusion and Remarks

Through the result of the study, it is considerable that ethnomathematics can be found in *Wau* kite and *corak-ragi* of *tenun melayu* in Kepulauan Riau province. Mathematical activities or strategies are executed while people creating those two *melayu* cultural stuffs. The main clear domains explored are: counting, measuring, and designing. Of those three domains, some mathematical concepts that can be associated with those taught in school are: number, length measurement, modelling problem into linear function and two variable linear equation system (*Wau* kite), and symmetry, transformation, and transformation composition (*corak-ragi* of *tenun melayu*). This finding implies the intellectuality of local *melayu* people in Kepulauan Riau province.

Consequently, this finding can be contribution to the development of mathematics education especially for school mathematics teaching and learning. *Wau* kite and *corak-ragi* of *tenun melayu* can be rich sources for learning mathematics concepts. Hence, they can be regarded as meaningful contexts. In addition, reinventing those mathematical concepts can be possible to derive. From this moment, there is a chance for enhancing the practice of mathematics teaching and learning especially on the topics of length measurement and geometry.

Lastly, it is considerably wise to think about further ideas that can be included in the ethnomathematics of *Wau* kite and *corak-ragi* of *tenun melayu*. It is strongly recommended that other domains (localizing, playing, and explaining) should be explored further to meet the possibility of finding other mathematical practices of those two cultural stuffs. The exploration of other ethnomathematics in Kepulauan Riau is also important to undertake.

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