

The ethnomathematics: exploration of Gayo tribe local wisdom related to mathematics education

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Abstract. Education cannot be separated by cultural value. However, in practice, learning is still far from the daily culture of students. The study aims to investigate the sort of Gayo tribe local wisdom related to ethnomathematics, and to investigate the Islamic character found in Gayo tribe local wisdom. The results of the investigation will be used to develop ideas of mathematics learning integrating the Gayo tribe local wisdom and the Islamic character. This study used a semi-structured interview that focused on four questions: *where to look, how to look, what it is, and what it means*. The data were analyzed qualitatively, followed by the concept given by Miles and Huberman. The finding shows that the local wisdom of Gayo tribe relates to mathematics. Measurement concept was found *inkal, bambu, kaleng, naleh, kunce, and padang* used to measure the dose of *zakat*. On the other hand, geometry concept was in relation *to kerawang* motives, such as *matanelo, pucuk rebung, puter tali, emun berkune, peger, emun berangkat, rante, emun beriring and cucuk pengong*. The value of Islam can be found in the motives of *kerawang* Gayo. The study implies that the Gayo tribe local wisdom and Islamic characteristics could be used for mathematics learning.

1. Introduction

Education is one of the factors that support the development of a country. Hall and Marhewas claim that training and education aspects and knowledge are useful for the progress of the nation [1]. Whereas, National Education Law number 23 of 2003 states that education is the human effort to create a learning atmosphere and process so that students are able to actively improve their self-potential to have spiritual strength, self-control, personality, intelligence, noble character, and skill needed for themselves, their society and their nation [2].

Education has a significant role in forming the intelligence, self-confidence, and commitment to promoting nation. Furthermore, the aims of education concern not only on life goals but also on helping human development to have life and survival skills. The Islamic thinkers are more oriented toward the ideal aspect and purpose, as well as spiritual thing related to God [3].

Education cannot be separated by cultural value. Education is one of the most effective ways to preserve the culture. Bishop claims that mathematics is a form of culture [4]. Drake and Reid believe that one way to address other initiatives such as environmental education, character education and the new literacies (media, critical and technological) is integrating the curriculum [5]. Learning integrating cultural value teaches core concepts and skills by connecting multiple subject areas to a unifying theme or issue. It can be implemented in mathematics learning since mathematics learning has integrated into social life. This contradicts the “conventional” insight that sees mathematics as a



subject “free of culture” and “free of value” [6]. The ethnomathematics experts state that basically, the growth of mathematics would never release from culture and social value in society.

Indonesia consists of many kinds of ethnics such as Gayonese, Acehnese, Javanese, and others. The majority are Moslems. Based on the BPS (Indonesia’s Central Department of Statistics) data in 2010, the number of Moslem in Indonesia is 207,2 million people or 87,8 percent [7]. This condition makes Islamic culture indirectly affect Indonesian culture. Ethnics have their own culture, noble value, and local wisdom. According to Wagiran, local wisdom has broad coverage: (a) idea/thought, attitude and language action, art, and literature that has a philosophy nuance (b) idea/thought, attitude and the work related to artifacts such as decoration, paintings, etc. (c) idea/thought, attitude and social behavior [8].

Gayonese is one of the ethnics who lived in Takengon, Aceh. They have some local wisdom such as dance, literature, and decoration. The Islamic Shari’ahs applied in their daily life. The Islamic sharia affects their culture. For example, it is found on the Kerawang carve in the *umah pitu ruang* (Gayo traditional house) ornaments. Kerawang carving contains the philosophy of life. The number of *pitu ruang* (seven rooms) symbolizes the Islamic faith associated with human and his God (*Allah SWT*). Culture and education are crucial as it is a unity and complete entity applied in society and education and become a fundamental need for a person.

Culture and education can be linked to cultivating characters in mathematics learning through ethnomathematics. Ethnomathematics is used to represent a field of mathematics that studies different types of mathematics arising from different cultures. Ethnomathematics includes mathematics that is practiced, used or simply incorporated in the cultural practices or activities of different groups in society [9]. Through ethnomathematics, it is expected that students can understand mathematics in culture. Thus, the teacher will easily cultivate the cultural value that is part of the nation’s character in the students [10]. Therefore, this study aims to excavate the Gayonese local wisdom related to ethnomathematics accompanied by Islamic character.

2. Method

This paper investigates the cultural wisdom of the Gayo tribe and the Islamic character related to ethnomathematics. The results of this study will then be used to develop learning materials integrating the Gayo tribe local wisdom and the Islamic character. This paper describes the investigation result on preliminary research, a phase from Plomp development model. This study used a snowball sampling technique. The result investigation on the cultural wisdom of the Gayo tribe and the Islamic character obtained is discussed through focus group discussion (FGD). The research instrument used a semi-structured interview that refers to four questions: where to look, how to look, what it is, and what it means. Those four general questions become the essence to utilize *ethnography* principle as shown in Table 1.

Table 1. The guideline of the research question.

Generic Question	Initial Answer
<i>Where to look?</i>	It is seen in the activity of Gayonese society.
<i>How to look?</i>	The investigation of the aspects related to the Gayonese activity.
<i>What is it?</i>	Alternative thinking in the prior process
<i>What does it mean?</i>	It is essential for culture and mathematics.

3. Result and discussion

Based on FGD, the information about the cultural wisdom of the Gayo tribe and the Islamic character of the Gayonese was obtained. That information relates to mathematics topics taught at school, specifically measurement and geometry. The following will describe four important findings of the investigation on the cultural wisdom of the Gayo tribe and the Islamic character on the mathematics topics.

The first finding relates to the answer to the question "where to look?", the activity of Gayonese society. Measurement topic is found in the livelihood of the Gayonese. Because of the geographical condition, the livelihood of the Gayonese society is centered in agriculture. The traditional tools they used to measure the agriculture products, such as rice and coffee is *bamboo* as seen in Figure 1.

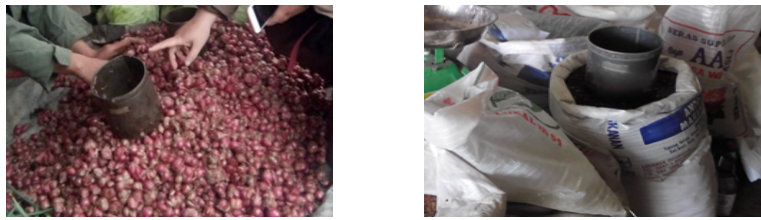


Figure 1. *Bamboo*, the traditional measuring tool used by Gayonese.

The finding shows that mathematics in an ethnic group is influenced by their cultural background because they do mathematics based on what they see and feel. This is in line with Pinxten stating that mathematics is a symbolic technology that grows on cultural skills or activities of a cultural nature [12].

On the other hand, geometry topic is found in the Gayo traditional house called *umah pitu ruang*. *Umah pitu ruang* is a big house that has seven rooms (*panaek*) with 14 connecting roofs. *Umah pitu ruang* was made by the king of Linge kingdom for his seven children. At first, there was no carve in it. Then, the king asked some thinkers to make the home more beautiful by adding some decorations such as sculpture, carvings and woven. To actualize the idea, the thinkers and diviners discussed it together. The imagination is the result of *ker* (idea from the thinker) that means a sudden feeling and *rawang* (the idea from the diviner) that means visualization. The concepts of *kerawang* Gayo basic motive *tali puter tiga* comes from *Merhum* King. *Matanelo* (the sun) and *emun berkune* is the idea from the Queen, *pucuk meluhor pucuk rebung* from the Imam (religious leader), *pagar* (fence) and *cucuk pengong* from the elders, and *embun* from the Crown Prince. At that time, the carve is made of *kertan*, *bedem*, *cike*, *benyet*, *bengkuang* and etc. which are usually called *lintem*. *Kerawang* Gayo motive can be found on *Umah Pitu Ruang's* walls, roofs, ladders and foundation in Toweren. Those motives resemble with two-dimensional figure in mathematics and every motive has a meaning and character. *Kerawang* Gayo motive can be seen in Figure 2.



Figure 2. *Kerawang* Gayo motive.

The second finding relates to the answer to the question "how to look?" This part discusses the investigation of qualitative aspects, relational, spatial on activities of Gayonese related to mathematics. Based on the observation and the interview conducted with the head of the Cultural Section of

Education and Teaching of Central Aceh Regency, traders, and farmers, it is found that the measuring tools used for those three activities have some similarities and differences. For market and coffee refining, the Gayonese use *bamboo* and *kaleng*. Meanwhile, in the rice field, the Gayonese use *sekal*, *bambu* or *are*, *kaleng* or *tem*, *naleh*, *kunce*, *padang*, *gateng*. The Gayonese is still using those traditional measuring tools until present. This is one way to preserve their local wisdom. The measurements used are $1\text{ kal} = \frac{1}{4}\text{ kg}$, $1\text{ bambu/are} = 4\text{ kal}$, $1\text{ kaleng} = 10\text{ bambu}$, $1\text{ naleh} = 16\text{ bambu}$, $1\text{ gateng} = 5\text{ kaleng}$, $1\text{ kunce} = 5\text{ kaleng} = 50\text{ bambu}$, $1\text{ padang} = 5\text{ bambu}$. Those measurements are used by the Gayonese in their daily life. According to Bishop, the broader conception of mathematical calculations illustrates that mathematics based on culture will generate mathematical knowledge to achieve community goals that are expected to solve problems and to define rules in life [13]. Mathematics is the social construction within the context of the community, where the notion is negotiated, and the conversion is approved.

Moreover, based on the interview and the observation, it is found that there are some *kerawang* gayo motives such as *matanelo*, *pucuk rebung*, *puter tali*, *emun berkune*, *peger*, *emun berangkat*, *rante*, *emun beriring*, and *cucuk pengong*. Those motives can be found on *Pitu Ruang's* wall, roof, foundation, and ladder. Those motives relate to geometry topic.

The third finding is concerning the answer to the question "what is it?" that refers to alternative thinking in the prior process. This part discusses the value of the Islamic character integrated into mathematics and Gayo culture. Based on the interview conducted with the custom figure and the head of the Cultural Section of Education and Teaching of Central Aceh Regency, it is found that the values of Islamic character are integrated into the Gayonese' everyday life through the *kerawang* Gayo motives that relate to geometry topic. The brief description of the Islamic values in the Gayo motives is presented in Table 2.

Table 2. The description of motive and character value of *kerawang* Gayo.

Motive	Meaning
<i>Matanelo</i>	The life blood of every creature and as gratitude for every favors and patient to God The vertical and horizontal relationship, either the relationship of a person to God and a person to others for the salvation of the hereafter.
<i>Pucuk rebung</i>	<i>Tut wuri handayani</i> which means following from behind and giving moral encouragement. <i>Taring merai</i> (if a person is left behind, he will be picked up), <i>pantas beruru</i> (if a person is too fast, he will be pulled back).
<i>Puter tali</i>	Support each other for every good deed
<i>Emun berkune</i>	The same thought, speech, and deed
<i>Peger</i>	Gayonese society always live under Gayo local wisdom and Islamic Sharia; otherwise they are not protected.
<i>Emun berangkat</i>	Symbolize the loyalty of Gayonese. Wherever they go, they will be together
<i>Tapak seleman</i>	Every problem should be handled wisely
<i>Rante</i>	Symbolize unity and togetherness
<i>Emun beriring</i>	Symbolize the substantial unity in the social life especially in putting ourselves wherever we are
<i>Cucuk pengong</i>	The same faith, perception, and destination.

Furthermore, in their activity, the Gayonese society uses measuring tools, e.g., *bambu* not only to measure the agriculture, forestry and selling product but also to measure the dose of *zakat*. *Zakat* is the required payment under Islamic law on certain kinds of property for charitable and religious purposes. For example, if the agriculture product, such as rice and grain, reach two *kunce*, the Gayonese must pay *zakat* because the amount of the product meets the *nisab* (the minimum amount required to pay

the *zakat*). Two *kunceis* equal to 100 *kaleng* or 1000 *bambu* or 2000 liters in international measurement unit.

The fourth finding relates to the answer to the question of "what does it means?". This section discusses the relationship that occurs between mathematics and culture. Based on the interview and the observation results, it is found that the size of the bamboo is the same as 2 liters in the international measurement unit. To convert the traditional measuring unit into the international measurement unit, we can use the following formula.

$$\rho = \frac{m}{v} \text{ or } m = \rho \cdot v$$

Where:

ρ = density (Kg/m^3)

v = volume (m^3)

m = mass (Kg)

Moreover, regarding *kerawang* Gayo motives, it is found that its shape is similar to two-dimensional objects. For instance, *matanelo* (sun) has a shape that resembles a circle in geometry. *Matanelo* symbolizes the lifeblood of every creature, gratitude for every favors, and patience to God. It also represents the vertical and horizontal relationship, the relationship between human and his God and the relationship between human and others humans for the salvation of the hereafter. *Pucuk rebung* (the top of the bamboo shoots) resembles the triangles in geometry. The meaning of *pucuk rebung* relates to education. That is *tut wuri handayani* that means following from behind and giving moral encouragement. *Pucuk rebung* also has a meaning of *taring merai* (if a person is left behind, he will be picked up), *pantas beruru* (if a person is too fast, he will be pulled back). *Peger* (fence) represents a rectangle. It symbolizes that the closeness of the Gayonese society with Islamic Sharia; they live under Gayo local wisdom and Islamic Sharia. They will not be protected if they break the Islamic law. *Tapak seleman* resembles the two-stacked triangles. *Tapak seleman* has a meaning that every problem has to be solved wisely. *Rante* (chain) resembles small circles arranged vertically. *Rante* represents unity and togetherness within the Gayonese community. *Cucuk pengong* resembles a large circle with small circles surrounding it. *Cucuk pengong* represents the same faith, perception, and destination. This is in line with the constructivist understanding that a person's knowledge is built through existing experience in his environment [14]. Thus, if the teacher makes a connection between mathematics and students' experience and objects in their environment, the students can understand the meaning of the lesson better.

4. Conclusion

Based on the research findings, there is some potential ethnomathematics in Gayo society that can be developed in mathematics learning. The traditional measuring tools used in activities of the Gayo community can be developed for teaching measurement topic in the second and third grade. Gayo ethnic art artifacts such as Gayo *kerawang* motives and a traditional house *Umah Pitu Ruang* can be developed for teaching geometry topics in elementary and junior high school levels, such as angle, line, plane geometry, and solid geometry.

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