Ethnomathematical Study: Creating Math to Students with Gayo Culture

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Abstract. This article is one of the writer’s efforts to help answer the question from the teacher namely what should we do to make students enjoy learning mathematics in class? This study aims to describe the local cultural wisdom of the Gayo tribe which is related to ethnomathematics. Cultural elements that can be developed and used in mathematics learning one of which is "Kerawang Gayo". This type of research is descriptive research with qualitative methods. Research subjects are communities leaders, cultural and Gayo tribal community. The instruments in this research were 1) literature study, 2) observation, 3) Interview, and 4) documentation. The data obtained were analyzed qualitatively, followed by concepts provided by Miles and Huberman. Based on the results of the analysis of the research data it was found that the motives contained in the Kerawang Gayo are emun beriring, puter tali, pucuk rebung, sarak opat and tekukur. Mathematical concepts contained in the "Kerawang Gayo" motif can be used to understand mathematics through local culture. Mathematical concepts contained in the "Kerawang Gayo" motif are curved lines, circles, concordance, triangles, angles, congruence, straight lines, parallel lines, reflection, and rotation. Besides recognizing the mathematical concepts of Kerawang Gayo, students also get knowledge about the meaning contained in each of the Kerawang Gayo motifs.

1. Introduction
Indonesia as one of the countries affected by the development of science and technology must be able to filter and adjust these conditions. As an implication, education becomes a collaborative effort that involves the participation and wisdom of the cultural value system in it.

Education is not only obtained from formal places such as schools but can also be obtained from outside the school. Thus, improving the learning process in schools, especially by increasing reasoning, problem-solving, argumentation and communicating material can be applied with culture-based learning. Culture-based learning is learning that integrates culture in the learning process, one form of which is to emphasize learning with culture. Learning with culture can make students not isolated from their local culture and can increase students' appreciation of local culture. Culture-based learning is also constructivist learning [1]. In preserving and preserving culture, the most effective transfer process is through education, one of which is in mathematics. Cultural values and national character are by following the vision contained in mathematics, namely creating students who have adequate mathematical abilities, can think and be creative, critical and careful, objective and open, can appreciate the beauty of mathematics and have a sense of curiosity and like to learn mathematics [2].

The teaching of mathematics for everyone should be adjusted to their culture. This is needed to connect mathematics outside of school with mathematics inside the school. Because students already have preliminary knowledge (initial concepts) obtained from the surrounding socio-cultural environment. Teachers only need to explore again in building and developing it during the learning process. The most important thing is the teacher must see the initial abilities of each student that are
different. However, if the teacher does not pay attention to the initial concept will result in the emergence of learning difficulties. One way that can be done to overcome student learning difficulties is to integrate mathematics and culture into the formal mathematics curriculum [3].

Culture related to mathematical concepts is usually called ethnomathematics. Ethnomathematics provides full opportunities for students to develop abilities by following their talents. This will have positive implications for their natural growth and development. In terms of ethnomathematics interpreted as: "The mathematics which is practiced among identifiable cultural groups such as national culture societies, labor groups, children of certain age brackets and professional classes" [4]. In line with the above opinion, Ethnomathematics is also defined as mathematics used by community/cultural groups, such as urban and rural communities, workers/laborers' groups, professional groups, children of a certain age, indigenous communities, and many more other groups are identified by the goals/objectives and general traditions of the group [5]. From the above definition, it can be interpreted that ethnomathematics can be practiced by all cultural groups, such as urban, rural, children and community communities.

Ethnomathematics grows and develops in Indonesia as an alternative in developing mathematics learning, which so far tends to be conventional and less contextual. Mathematics is only seen as a tool to solve practical problems in the world of science alone, thus ignoring the view of mathematics as a human activity [6]. The concept of mathematics sometimes arises naturally in certain cultural societies, through the knowledge and views of ethnic groups without going through formal education. That changes in lifestyles and culture in the era of technology and information that are rapidly now continuously have been affected by mathematical progress [7]. Because mathematics indirectly contributes to the maintenance and transmission of the cultural traditions of an area. Ethnomathematics has a wider influence in society and education, especially mathematics education. The role is very real, but the most important thing is how our efforts and hard work to display the mathematical concepts that exist in ethnomathematics into learning activities so that these concepts can be directly related to student culture and with their daily experiences. If we can do that, it will create an ethnomathematical approach to learning mathematics and is expected to be able to make mathematics in schools more relevant and meaningful for students and the quality of their education.

As a result of cultural history, mathematics can have different forms and develop according to the development of the community, one of which is the school. Expansion of the use of ethnomathematics that is in line with students' cultural diversity and with mathematical practices in their daily lives, brings mathematics closer to the student environment because ethnomathematics is implicitly a program or activity that delivers values in mathematics and mathematics education [8]. Ethnomathematics uses broad mathematical concepts related to various mathematical activities, such as grouping, counting, measuring, designing buildings or tools, playing, determining locations and others.

Cultural nuances of mathematics (ethnomathematics) will contribute greatly to the learning of mathematics. Etymologically, ethnomathematics can deepen students' understanding of mathematics. Mathematics as a form of culture has been integrated into all aspects of people's lives wherever they are. For example, in terms of counting and measuring even producing products (plaited) people are more familiar with their daily activities. Ethnomathematics is used to bridge the gap between culture and education. Mathematical learning resources can utilize culture as a medium of learning. The role of ethnomathematics should have a wider influence on society and education, especially mathematics education [9].

In Indonesia, ethnomathematics studies that aim to explore mathematical ideas in various regions have been carried out, namely the geometrical exploration study of Toraja ethnomathematics [10] and ethnomathematics study of the Dayak Kanayat'n community of West Kalimantan [11]. Based on the results of the study, it appears that integrating culture into mathematics can be done and can facilitate students in understanding mathematical concepts.

Like the Gayo tribe, which is located in Takengon City, Central Aceh, Aceh. The Gayo tribe is an ethnic group that inhabits the highlands in the province of Nanggroe Aceh Darussalam. Gayo tribe according to the area of residence and residence can be divided into three areas, namely 1) Gayo Laut or Gayo Laut Tawar, 2) Gayo deret or Gayo Linge, and 3) Gayo Lues. In general, Gayo people have
livelihoods as farmers, ranchers, and fishermen, but they are more dominant as coffee farmers. In addition to coffee, the Gayo community is also known for its crafts, namely Kerawang Gayo. These Kerawang carvings were first discovered in the Gayo Tribal traditional house ornament, namely Umah Pitu Ruang, which at this time the Kerawang carvings have been developed and applied to clothe [12].

Kerawang Gayo is a carving motif that can be seen in clothing, houses and other ornaments. The motifs contained in the openwork Gayo contain two-dimensional geometric shapes. The motifs include a) emun berangkat (clouded clouds), b) emun beriring (cloud lined), c) emun berkune, d) pucuk rebung, e) puter tali (twisted rope), f) cucuk pengong (buds), g) matanelo (sun), h) tapak seleman (footprint) the prophet Sulaiman, i) peger (fence) [13]. These Kerawang motifs are in the form of tendrils, niches, and circles that form geometric patterns. Therefore, in conveying geometry material can be related to the Kerawang Gayo motif. By linking mathematics material with culture, students are expected to be more motivated and interested in mathematics which has been considered difficult for students. Linking mathematics to culture can not only make students understand the material provided, but can also instill an attitude of respect and love for their own local culture.

The Kerawang motifs found in traditional houses and traditional clothes besides carving that resemble geometric patterns, also have meanings and meanings that are closely related to community life. The meaning is related to religion, law and community life. The motif is a reflection of the culture in the sense of values that guide the behavior patterns of the Gayo people. The meanings include a) emun berangkat (cloud cover), b) emun beriring (cloud lined). The meaning of this emun beriring is unity and unity (beluh sara loloten mowen sara tamunen). This means that unity and unity are not only limited to unity and unity but still have many meanings, including not forgetting the identity of a Gayo person, always sticking to the customary values and customary norms of the Gayo people. c) emun berkune, d) pucuk rebung, have the meaning of shoulder to shoulder in all elements, both customs, culture, education, and government, e) puter tali (twisted rope), has a united meaning we are firm divorced we collapsed (keramat mufakat behu berdedele), f) cucuk pengong (bud of the pengong), has the meaning of a single, unidirectional, senasip sepenanggungan, g) matanelo (sun), h) tapak seleman (footprint of the prophet Sulaiman), i) peger (fence) [14] [15]. These Kerawang motifs are in the form of tendrils, niches, and circles that form geometric patterns. This Kerawang motif of Gayo uses 5 (five) basic colors namely white (poteh), red (ilang), yellow, green (ijo) and black (item) [16].

Based on the explanation above, it appears that integrating culture into mathematics can be done to help teachers instill mathematical concepts as well as love and pride in culture to students. This study aims to explore ethnomathematics found in the Gayo plateau, especially in the Kerawang Gayo.

2. Research Method

This research is qualitative research with a descriptive approach. The purpose of this study is to reveal or describe the Kerawang Gayo motifs that can be applied or integrated with mathematics learning. The subjects in this study were community leaders, cultural and Gayo tribal people who were selected purposively to obtain research data. Sources of data needed in this study are grouped into primary data and secondary data. Primary data were obtained from research subjects, namely community leaders, cultural figures and the Gayo tribe community, while secondary data were obtained from various official and unofficial documents relating to research material and supporting primary data, one of which was by conducting a literature review.

In this study, the research instrument is the researcher himself who functions as the person who sets the focus of the study, selects the informant as the source of the data, collects data, evaluates the quality of the data, analyzes the data, interprets the data and makes conclusions on the research findings. Researchers used data collection techniques, namely 1) literature study, carried out to obtain preliminary data by reading and reviewing data related to the Kerawang Gayo motif, 2) observation, carried out by visiting the Gayo traditional house of Baluntara kingdom in Toweren Village, Lut Tawar District, and Gayo traditional house of the Linge Kingdom Museum in Kemili Village, Kebayakan District, 3) interviews, to strengthen the research data obtained from the observation, the researchers conducted interviews with several figures including Gayo culture, Government tourism office, Department of Education and Culture, academics, housekeepers customs and craftsmen. Interviews were conducted to obtain data that was not obtained during observation, and 4)
3. Result

Integrating mathematics with culture or ethnomathematics is a step that can be done by a teacher in instilling concepts in students so they can easily understand the concepts given. Because according to [17] learning mathematics in school and mathematics found by students in everyday life is very different, therefore it is very important to connect mathematics in school with their everyday world based on local cultural wisdom. One of them is the local cultural wisdom of the Gayo tribe.

In some research said that the Gayo tribe is one of the tribes in Indonesia with a variety of cultures, including literature, decoration, dance, singing, and others. Gayo tribe has numbers that are considered sacred as numbers 3, 4 and 7 which often appear in every activity and “perimetike” (proverb). Gayo is also famous for its traditional house, known as “Umah Pitu Ruang” which has carved “Kerawang” in every part of the house [18] [19]. The Kerawang carvings resemble geometric shapes in Mathematics.

Kerawang consists of the word ”Ker rum Rawang” which means ”Ker” is the power of thought and ”Rawang” is a prediction or bayangen [20]. Kerawang is a form of spontaneous imagination of every human individual that involves the interaction of feelings of the heart and the interaction of natural thoughts [21]. Based on observations and interviews conducted during the study obtained 5 types of Kerawang Gayo motifs, namely Emun Beriring motifs, Puter Tali, Pucuk Rebung, Sarak Opat, and Tekukur. Each of these motifs, if considered, has a form that is by following the concept of school geometry. As for the further discussion of the geometrical concepts contained in the Kerawang Gayo motif and can be used in learning geometry in schools are as follows:

1. School geometry concepts on Kerawang Gayo motifs

Based on the mapping of mathematics, it is known that mathematical concepts especially geometry are often found in Kerawang Gayo. The geometry concepts for schools contained in the Kerawang Gayo motif can be seen in Table 1.

| Geometry concepts | Motif | Figure motif | Figure geometry |
|-------------------|-------|--------------|-----------------|
| Curve             | Emun Beriring | ![Emun Beriring](image) | ![Emun Beriring](image) |
| Circle            | Puter Tali | ![Puter Tali](image) | ![Puter Tali](image) |
| Congruent         | Pucuk Rebung | ![Pucuk Rebung](image) | ![Pucuk Rebung](image) |
| Triangle          | Sarak Opat | ![Sarak Opat](image) | ![Sarak Opat](image) |
| Angle             | Tekukur | ![Tekukur](image) | ![Tekukur](image) |
| Congruence        |        |              |                 |
| Straight line     |        |              |                 |
| Parallel lines    |        |              |                 |
| Reflection        |        |              |                 |
| Rotation          |        |              |                 |
Based on Table 1, it is known that in Kerawang Gayo there are mathematical concepts, especially geometry, namely 1) the motive of emun beriring resembles the shape of a curved line on the concept of geometry, 2) puter tali motif resembles the shape of a circle on the geometry concept and contains the concept of concordance, 3) pucuk rebung resemble the shape of a triangle on the concept of geometry, and contains the concepts of angles and similarities in mathematics, 4) the motif of sarak opat resembles the shape of straight lines and parallel lines to the concept of geometry while 5) the motifs of the tekukur contain the concepts of reflection and rotation in mathematics.

This is by following the opinion of [22] who said that the motives contained in the Kerawang Gayo include: a) emun berangkat (clouded clouds). b) emun beriring (cloud lined), c) emune berkune, d) pucuk rebung, e) puter tali (twisted rope), f) cucuk pengong (buds), g) matanelo (sun), h) tapak seleman (footprint) the prophet Sulaiman), i) peger (fence), in the form of tendrils, niches, and circles resembling geometric patterns. In delivering geometry material the teacher can associate the concepts learned with the Kerawang Gayo motif. By linking mathematics material with culture, students are expected to be more motivated and interested in mathematics which has been considered difficult for students. Linking mathematics to culture can not only make students understand the material provided, but can also instill an attitude of respect and love for their own local culture.

2. The philosophical meaning of Kerawang Gayo motifs

The motif found in Kerawang Gayo is the most popular today. Usually used at weddings, traditional events, and cultural arts events. The Kerawang Gayo people symbolizes the principles of culture, religion, customs and the way they conduct social relations. Kerawang motifs are often found in the form of fabrics, bags, clothes and other trinkets. Even so, the Kerawang motif was only used as carvings in traditional houses in Central Aceh. The local craftsmen and artists who started making Kerawang motifs were not only for traditional houses. Based on interviews conducted with traditional figures and cultural figures of the Gayo tribe, it is known that the form and philosophical meaning of the main motifs of Kerawang Gayo are:

a. Emun beriring motif

Emun beriring is a shadow of the cloud when viewed in a side. The meaning is to gather together and not divorce in community life (Interview: Joni, 12 August 2018). So, together, meaningful in social life must maintain unity, mutual respect, and mutual respect.

b. Puter tali motif

Puter tali is a picture like a twisted rope used in binding an object. The philosophy of the Gayo people says "it is sacred to be conspicuous, behu to be quiet" meaning whatever is done using deliberation and gathering to produce a decision (Joni, 12 August 2018). Another meaning of the puter tali motif is unity and unity, mutual care between each other

c. Pucuk rebung motif

Pucuk rebung motif is a motif that comes from the image of bamboo shoots or new bamboo shoots that grow. The Pucuk rebung motif symbolizes the process of fostering and educating young people in Gayo in building the nation (Interview: Zainal, 12 August 2018). Besides, Pucuk rebung also have the meaning of shoulder to shoulder in all elements, both customs, culture, education, and government (interview: Joni, 12 August 2018)

d. Sarak opat motif

Sarak opat is a combination of elements of the king's office, in Gayo's philosophy stating "reje musuket sifet, imem muperlu sunet, petue musajar sasat, even people mupakat" means that the king has the nature of suket which is fair and wise, faith in carrying out sharia, petue / character has good character and smart, people gather to hold meetings (Interview: Swito, 20 June 2018)
e. Tekukur motif

Tekukur motif is a geometric motif in the form of four circles bounded by two horizontal and vertical lines. Tekukur motif is a symbol of justice in deciding the deliberation of the Gayo people.

Besides containing mathematical concepts, the motif of "Kerawang" also has character values that are expected to be absorbed and imitated by students when the teacher integrates mathematical material to be studied with the cultural elements contained in "Kerawang" Gayo. This can make students know and love their own culture. One way to do this is by giving examples of problems using motifs found in Gayo's "Kerawang". Teachers can integrate the Gayo Kerawang "motif" in their lesson plans and worksheets. As [23] has done in his research, he has developed a learning tool based on the wisdom of the local culture of the Gayo tribe for grade V students of elementary schools. The tool developed is lesson plans and student worksheets or student books that are integrated with local cultural tools that are developed to meet aspects of validity, practicality, and effectiveness.

4. Conclusions

Ethnomathematics in mathematics learning helps develop students' intellectual learning by using their cultural references. Through ethnomathematics mathematical concepts can be developed in cultural practice. The cultural element that can be developed and used in mathematics learning is the Kerawang Gayo. The mathematical concepts contained in the Kerawang Gayo motifs can be used to understand mathematics through local culture. Mathematical concepts contained in the Kerawang Gayo motifs are curved lines, circles, concordance, triangles, angles, congruence, straight lines, parallel lines, reflection, and rotation. Besides, students can also better understand the meaning of the Kerawang Gayo which has been the philosophy of the Gayo people first. It is very important that young people love the customs and culture that has been created by their ancestors. The meanings of the motifs in Kerawang Gayo include: (1) Emun Beriring: respecting and maintaining unity; (2) Puter Tali: maintain unity and integrity, and care for others; (3) Pucuk Rebung: foster young generation; (4) Sarak opat: being a just and wise leader; and (5) Tekukur: fair in making decisions when discussing.

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