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DIVERSED ETHNOMATHEMATICS EXPLORATIONS OF BATAK CULTURES IN NORTH SUMATERA

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Abstract: The Batak ethnic group has cultural diversity and is rich in the values of each culture, both in the products and processes, and cultural philosophies. The Batak ethnicity is divided into several sub-ethnicities, including Toba Batak, Karo Batak, Mandailing Batak, and Simalungun Batak. The distinctive characteristics of each ethnicity can be used as material for research by researchers to explore the elements of that culture. In the field of mathematics, culture can also be used as an object of study. The research method used in the present study is the systematic literature review (SLR) which is aimed at identifying, studying, evaluating, and interpreting research results by the topics being studied so that it will answer the research questions that have been determined. The results can be seen that the Batak ethnic cultural components have mathematical concepts in them such as, among others, livelihood characters, traditional houses, traditional musical instruments, traditional foods, ulos cloth and ornaments. traditional dances, and traditional clothing. The mathematical concepts that are obtained from the exploration of Batak ethnic cultures include the concepts of lines, angles, congruence, spatial geometry, flat geometric shapes, spatial geometric shapes, geometric transformations, arithmetic sequences, and numbers. These diverse themes indicate that mathematics is our culture.

Keywords: Ethnomathematics, geometrical exploration, Batak culture

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INTRODUCTION

The Batak ethnic group is the dominant ethnic group in North Sumatera. The group spreads throughout North Sumatera. The Batak ethnic group has cultural diversity and is rich in the values of each culture, both in the products and processes and cultural philosophies. The Batak ethnicity is divided into several sub-ethnicities, including Toba Batak, Karo Batak, Mandailing Batak, and Simalungun Batak.

The Toba Batak ethnicity covers several areas, namely Toba Samosir, North Tapanuli, Central Tapanuli, Humbang Hasundutan, Bandar Sibolga, and parts of Dairi Regency. Toba Batak has its uniqueness; this uniqueness includes clothing, in the form of *kebaya* and traditional clothing, a language that uses Toba Batak dialect alphabetic characters, and traditional arts, namely the *Sigale-gale* statue theatre, and traditional dances called *tor-tor* and *soak*. Toba Batak also has traditional *gondang* music which usually consists of a set of *onang-onang*. Toba Batak is also characterized by its diverse unique customs or rituals such as cultural festivals, weddings, and funerals. Apart from these, the Toba Batak ethnic social system is very strong with its patriarchal family structure or what is usually called a genealogy. The Toba Batak people live in a traditional house called a *bolon* house. The *bolon* house has a shape that resembles a large stage.

The Karo Batak ethnic group is a tribe that lives and inhabits North Sumatera and parts of Aceh. The traditional clothing of the Karo tribe is known as *Uis Gara* or *Uis Adat* Karo. The colors red and black are very dominant in the Karo tribe's traditional clothing with gold decoration as a complement to the clothing. The Karo traditional house, called *Siwaluh Jabu* has its characteristics. Karo traditional houses do not require connections in the construction of the house. A *Siwaluh Jabu* Karo traditional house is not only inhabited by one family; but it can be inhabited by eight to ten families. The language used by the Karo people is called the Karo language. This language is used every day by the Karo people. The Karo language is written using the Karo script which is a derivative of the Brahmin script which originates from ancient India. The artistic musical instrument of the Karo tribe is the Karo *Gendang*. This drum consists of a set of dance drums that have five elements. This artistic musical instrument is used to accompany dances, songs, and various traditional rituals. The dance of the Karo tribe is the *Landek* dance. This dance has a basic pattern of body positions, and up and down hand movements, that are adjusted to the drum tempo, and foot movements.

The Simalungun Batak ethnic group spreads and resides in Simalungun Regency and its surroundings in North Sumatera. This district borders directly with Toba Regency to the south and Karo Regency to the west. The Simalungun Batak community uses the Simalungun Batak language as their mother tongue. What is unique about the Simalungun Batak ethnic group is the typical *ulos*-like cloth called *Hiou* with its various ornaments. The men's head covering is called *Gotong*; the women's head covering is called *Bulang*; and the cloth that is worn or the side cloth is called *Suri-suri*. Simalungun traditional dance is the *Tor-Tor Mangelek* dance. This dance is usually performed at weddings. This dance uses traditional language in its accompaniment of songs and traditional clothing,

known as *Bulang*, as a women's head covering. The traditional music and songs in Simalungun, *Serma With Dan*, are Simalungun regional songs that contain rhymes of advice poems, mostly or advice pieces from parents to children.

The Mandailing Batak ethnic group spreads across Mandailing Natal Regency, South Tapanuli Regency, Padang Lawas Regency, North Padang Lawas Regency, Labuhanbatu Regency, North Labuhanbatu Regency, South Labuhanbatu Regency, Batubara Regency, Deli Serdang Regency, Medan City, Rokan Hulu Regency, Rokan Hilir Regency, Pasaman Regency, and West Pasaman Regency. The Mandailing Batak traditional clothing is almost similar to that of Toba Batak, that is, using the *ulos* cloth. The most visible differences are that, in Mandailing Batak, the ulos cloth is wrapped around the middle of the body, as well as in the headdresses for men and women. The name of the Mandailing traditional house is *Bagas Godang*; *Bagas* which means "house" while *Godang* means "many". *Gordang Sambilan* is a musical instrument that originates from the traditional culture of the Mandailing tribe. This musical instrument consists of nine drums which have different lengths and diameters so that they produce different tones. *Gordang Sambilan* is usually played by six people with the smallest drum pitches being 1 and 2 as *taba-taba*, drum 3 *tepe-tepe*, drum 4 *kudong-kudong*, drum 5 *kudong-kudong nabaik*, and drum 6 *pasilion*. Drums 7, 8, and 9 are for hides. In the Mandailing tradition, the *tor-tor* dance is usually accompanied by side-by-side *gordang* music or by *onang-onang*. The movements in the traditional Mandailing *tor-tor* dance tend to be slower and feel wiser because they are accompanied by *onang-onang* which is usually a form of poetry, advice, or prayer.

From the explanation of the characteristics of the four Batak ethnicities above, a lot of research has been carried out connecting culture with mathematical concepts. Research on culture can be divided into 3 types of themes, namely cultural products, cultural processions, and cultural philosophy. Cultural products are objects produced by a culture such as artifacts, traditional houses, musical instruments, traditional clothing, ornaments, etc., or cultural performances such as dances, songs, and so on. Cultural processions are processions of customs that are customary for that ethnic group such as weddings, annual parties, and so on. Meanwhile, cultural philosophy is related to cultural values which are reflected both in cultural products and cultural processions.

The distinctive characteristics of each ethnicity can be used as material for research for researchers to explore the elements of the culture. Many studies have been carried out by researchers in the fields of culture, religion, and other fields of science. In the field of mathematics, culture can also be used as an object of study. The object of

study that links culture with mathematics is called ethnomathematics. In ethnomathematics studies, exploration or excavation of existing cultural elements is carried out and linked to mathematical concepts.

Several studies related to the exploration of research results of studies on ethnomathematics include Fitriani & Putra (2022) who explored ethnomathematics studies on traditional foods, Hafifah & Putra (2022) who explored ethnomathematics on handicrafts, Nurfauziah & Putra (2022) who looked at elements of ethnomathematics in the tribal houses, Rencitia & Putra (2022) who exported mathematical elements in weaving crafts, and Turmuzi *et al*. (2022) who studied the elements of mathematics in the local wisdoms of the Sasak cultures. Meanwhile, research regarding ethnomathematics studies on Batak cultures has not yet been carried out. Therefore, researchers are interested in conducting research related to the ethnomathematics exploration that has been carried out on Batak ethnic cultures.

The importance of the present study is to find out how Batak culture has been associated with mathematical concepts and what mathematical concepts are obtainable from Batak cultures. This can be used as a reference for readers and prospective researchers who will conduct research related to ethnomathematics in Batak cultures. The research questions raised in this study are 1) What types of Batak ethnic cultures are explored to obtain mathematical concepts in them? and 2) What mathematical concepts can be found in the exploration of Batak ethnic cultures?

METHOD

The research method used in this study is the systematic literature review (SLR) method which is aimed at identifying, studying, evaluating, and interpreting research results by the topic being studied so that it will answer the research questions that have been determined. The stages in this research method consist in formulating research questions, searching for literature, selecting appropriate literature, presenting data, processing data, and drawing conclusions.

In this case, the researcher identified articles related to the topic "ethnomathematics exploration of Batak culture" through the Google Scholar application, limiting to articles published from 2018 to 2023. Fourteen articles were relevant to this study, including nine articles related to Toba Batak ethnic cultures, one article related to Karo Batak ethnic cultures, two articles related to Simalungun Batak ethnic cultures, and two articles related to Mandailing Batak ethnic cultures.

The part analyzed is the finding of each research project, which can consist of cultural results and any mathematical concepts obtained from the research findings.

RESULTS AND DISCUSSION

Various ethnomathematics studies, especially those examining Batak cultures in North Sumatera, have been carried out and various mathematical concepts have been obtained which are linked to cultural elements including ornaments, dances, traditional houses, scripts, musical instruments, traditional foods, and traditional processions. Ethnomathematics research has been conducted to explore mathematical concepts in Batak ethnic cultures including the Toba Batak sub-ethnicity, Karo Batak sub-ethnicity, Simalungun Batak sub-ethnicity, and Mandailing Batak sub-ethnicity.

In the Toba Batak sub-ethnicity, the studies conducted by Sihombing & Tambunan (2021) discusses mathematical concepts in the ornaments of the "*Rumah Bolon* Batak Toba" [Toba Batak *Bolon* Houses]; (Ardian & Suparni, 2023; Simanjuntak & Sihombing, 2022) examine mathematical concepts in the Batak Toba scripts; Sitanggang (2021) explores mathematical concepts in Batak Toba traditional musical instruments; (Naibaho *et al*., 2022; Syahputri & Reflina, 2023) link mathematical concepts to Batak Toba traditional cakes; Saragih *et al*. (2022) explores mathematical concepts in Batak Toba *ulos hela* cloth; Purba *et al*. (2022) study mathematical concepts in Batak Toba *ulos sadum* cloth; and Ditasona (2023) explores mathematical concepts in the "gorga" ornaments of Batak Toba tradition. In the Karo Batak sub-ethnicity, the study conducted by Dewi & Asrul (2023) examines mathematical concepts in the Karo traditional house "*Siwaluh Jabu*".

In the Simalungun Batak sub-ethnicity, the studies conducted by Situngkir (2023) explores mathematical concepts in the dance "*Tor-Tor* Simalungun *Haroan Bolon*" and Panjaitan & Ammamiarihta (2023) study mathematical concepts in "*gotong* and *bulang*" of Simalungun traditional clothing. In the Mandailing Batak sub-ethnicity, the studies by Lubis *et al*. (2018) present mathematical concepts in the "*gordang sambilan*" musical instrument, and Dewita *et al*. (2019) study mathematical concepts in the traditional house "*Bagas Godang*". The identification results of each article that has been obtained are displayed in Table 1.

Table 1. Identification of Ethnomathematical Exploration Research Articles on Batak Ethnic Cultures

No.	Researcher (Years)	Journals and Research Titles	Research Results	Sub Ethnicity
1.	Lubis *et al.* (2018)	**Edumatika Jurnal Riset Pendidikan [Education] Matematika** Eksplorasi Etnomatematika pada Alat Musik Gordang Sambilan [Ethnomathema tics Exploration on *Gordang Sambilan Musical Instruments*]	There are several types of arithmetic sequence concepts and geometric concepts.	Mandailing Batak
2.	Dewita *et al.* (2019)	**Mosharafa: Jurnal Pendidikan Matematika** Studi Etnomatematika tentang Bagas Godang sebagai Unsur Budaya Mandailing di Sumatera Utara [Ethnomathematics Study on *Bagas Godang* as Cultural Element of Mandailing Cultures in North Sumatera]	There are mathematical concepts in the forms of group concepts, geometry, and geometric transformations and compositions.	Mandailing Batak
3.	Sitanggang (2021)	**Jurnal PEKA (Pendidikan Matematika)** Etnomatematika: Eksplorasi Alat Musik Tradisional Khas Batak Toba [Ethnomathematics Exploration on the Unique Toba Batak Traditional Musical Instruments	The Toba Batak traditional musical instruments have various mathematical concepts such as that of flat shapes and space shapes.	Toba Batak
4.	Simanjuntak (2020)	**SEPREN: Journal of Mathematics Education and Applied** Eksplorasi Etnomatematika pada Aksara Batak [Exploration of Ethnomathematics on Batak Alphabet]	Mathematical concepts are found in Batak script patterns, namely one-dimensional geometry, intersecting lines, parallel lines, and acute angles. Apart from that, there is also the concept of geometric transformation, namely reflection on the x-axis and y-axis.	Toba Batak

No.	Researcher (Years)	Journals and Research Titles	Research Results	Sub Ethnicity
5.	Sihombing & Tambunan (2021)	**Jurnal Pendidikan Matematika Indonesia** Etnomatematika: Eksplorasi Konsep Geometri pada Ornamen Rumah Bolon Batak Toba [Ethnomathematics: Exploring the Geomatric Concepts in the *Bolon* Toba Batak House Ornaments]	Mathematical concepts are found in Rumah *Bolon* house ornaments, such as pentagons, circles, triangles, cones, rectangles, and squares.	Toba Batak
6.	Naibaho *et al*. (2022)	**Jurnal Pendidikan Matematika: Judika Education** Eksplorasi Kue Tradisional Batak Toba terhadap Konsep Geometri [Exploration on Toba Batak Traditional Cakes against Geomatrical Concepts]	There are elements of ethnomathematics in traditional Toba Batak cakes; the five traditional cakes have a geometric concept, namely spatial shapes including rectangular pyramids on rice sheets; balls on *gadong* cake; *rectangular prism* on the *labar*; arbitrary prism on *nitak*; and cones on *lapet pulut* and *ombus-ombus*.	Toba Batak
7.	Saragih *et al*. (2022)	**Jurnal Inovasi Sekolah Dasar [Primary School Innovation Journal]** Eksplorasi Etnomatematika Pada Kain Ulos Hela Suku Batak Toba terhadap Konsep Bangun Datar [Ethnomathematics Exploration on the *Hela Ulos* Cloth of the Toba Batak Tribe against the Concepts of Flat Shapes]	Six types of flat shapes are found in the shapes and patterns of the *hela ulos*, namely: rectangle, rhombus, right triangle, isosceles triangle, and hexagon.	Toba Batak
8.	Purba *et al*. (2022)	**Intelektiva** Inspeksi Etnomatematika Kain Ulos Sadum untuk Mengungkap Nilai Filosofi Konsep Matematika Geometri Bangun Datar [Ethnomathematics Inspection of the *Ulos Sadum* Cloth to Uncover the Philosophical Values of the Mathemtical Concepts of Flat Shapes]	The results of the research obtained mathematical concepts The Toba Batak *ulos* cloth motifs, such as used for wedding ceremonies are straight lines, curved lines, circles; polygon shapes such as triangles, quadrilaterals, star shapes, hexagons, octagons, pyramids; and parallelograms.	Toba Batak

No.	Researcher (Years)	Journals and Research Titles	Research Results	Sub Ethnicity
9.	Ditasona (2023)	**Journal of Educational Research and Evaluation** Exploring Ethnomathematics in Batak Toba Carvings for Locally-based Mathematics Teaching Material	There are seven types of symmetry obtained from all *gorga* motifs. These types of symmetry include translational symmetry, glide reflection symmetry, vertical symmetry, 180° rotational symmetry, vertical and 180° rotational symmetry, horizontal symmetry, and vertical and horizontal symmetry.	Toba Batak
10.	Syahputri & Reflina (2023)	**Euclid** Eksplorasi Etnomatematika pada Kue Tradisional Khas Si Borong-Borong [Exploring Ethnomathematics in Batak Tobaon the Unique Traditional *Si Borong-Borong* Cake]	Conclusion can be drawn that the traditional Toba Batak Ombus Ombus cake is indeed related to mathematics: The shape which resembles the shape of a rectangular pyramid, if the cake is cut in the middle, will form a cone with a circular base.	Toba Batak
11.	Ardian & Suparni (2023)	**Jurnal Pendidikan Ilmu Pengetahuan Alam [Natural Science Educational Journal]** Eksplorasi Etnomatematika pada Aksara Batak [Exploring Ethnomathematics in the Toba Batak Alphabet]	Mathematical concepts in the Toba Batak script patterns are found, namely one-dimensional geometry, intersecting lines, parallel lines, and acute angles. Apart from that, there is also the concept of geometric transformation, namely reflection on the x-axis and y-axis.	Toba Batak
12.	Dewi & Asrul (2023)	**MATHLINE** Ethnomathematics: Concepts of Mathematics in The Context of "*Siwaluh Jabu*" Karo Traditional House	Research findings reveal the concepts of flat shapes, spatial geometry, and congruence.	Karo Batak
13.	Situngkir (2023)	**INNOVATIVE: Journal of Social Science Research** Ethnomatematika "Tor-Tor Simalungun Haroan Bolon"	The *Haroa Bolon* dance movements are cooperative collaboration, working with different movements. Ethnomathematics elements include vertical and horizontal lines, intersecting lines, acute angles, obtuse angles, and circles, rectangles, and cylinders observed in every movement of the *Haroan Bolon* dance.	Simalungun Batak

No.	Researcher (Years)	Journals and Research Titles	Research Results	Sub Ethnicity
14.	Panjaitan & Ammamiariht a (2023)	**EMTEKA: Jurnal Pendidikan Matematika** Eksplorasi Etnomatematika pada Gotong dan Bulang Pakaian Adat Simalungun [Exploring Ethnomathematics in the *Gotong* and *Bulang* Simalungun Batak Traditional Clothes]	There are mathematical concepts in *Gotong* and *Bulang* clothes, namely the concept of numbers, parallelism of lines, folded symmetry, flat triangles, and transformation geometry.	Simalungun Batak

Types of Batak Ethnic Cultures Explored by Mathematical Concepts in Ethnomathematics Studies

Based on the results of the identification of articles related to ethnomathematics exploration of Batak ethnic culture, several types of Batak cultures are obtained as explored in ethnomathematics studies, including:

1. Scripts: In the Toba Batak ethnic group
2. Traditional Houses: In the Toba Batak ethnic group, Karo Batak ethnic group, and Mandailing Batak ethnic group
3. Traditional Musical Instruments: In the Toba Batak ethnic group and Mandailing Batak ethnic group
4. Traditional Cakes: In the Toba Batak ethnic group
5. Ulos cloth: In the Toba Batak ethnic group
6. Ornaments: In the Toba Batak ethnic group
7. Traditional Dances: In the Simalungun Batak ethnic group
8. Traditional Clothing: In the Simalungun Batak ethnic group

From the identification results obtained, it can be seen that the Batak ethnic group that has been researched the most regarding cultural components that have mathematical concepts in them is the Toba Batak sub-ethnicity; namely characters, traditional houses, traditional musical instruments, traditional cakes, traditional cloth, and ornaments. The Simalungun Batak sub-ethnic group is researched regarding traditional dances and traditional clothing. The Mandailing sub-ethnic group is researched in traditional houses and traditional musical instruments. Meanwhile, the Karo Batak sub-ethnic group is researched only regarding traditional houses.

There are quite a lot of research studies related to ethnomathematics in the Toba Batak sub-ethnicity, while there are still relatively few in the Karo Batak sub-ethnicity, the Simalungun Batak sub-ethnicity, and the Mandailing Batak sub-ethnicity. There are still many components of Batak ethnic cultures that can be explored and mathematical concepts can be found in them so that they can enrich the repertoire of mathematics learning resources that are applied in the mathematics learning processes in the classroom.

Mathematical Concepts Found in the Explorations of Batak Ethnic Cultures

Mathematical concepts obtained from the exploration of Batak ethnic cultures include the following:

1. Concepts of Arithmetic Sequences
2. Geometric Transformation Concepts: Translation, Reflection, and Rotation
3. Geometry Concepts: Pentagon, Circle, Triangle, Square, Rectangle, Rhombus, Hexagon, Star, Hexagon, and Octagon
4. Geometry Concepts: Cone, Quadrilateral, Sphere, Rectangular Prism, any Prism, Pyramid, and Parallelogrammotif
5. Concepts of Lines: Intersecting Lines and Parallel Lines
6. Angle Concepts: Acute Angle, Obtuse Angle
7. Symmetry Concepts: Line of Symmetry
8. Congruence Concepts
9. Spatial Geometric Shape Concepts
10. Concepts of Numbers

The mathematical concepts that are most often obtained from the explorations of Batak ethnic cultures are geometric concepts including the concepts of lines, angles, congruence, spatial geometry, flat geometric shapes, spatial geometric shapes, and geometric transformations. Meanwhile, other concepts are the concepts of arithmetic sequences and the concepts of numbers. There are still many mathematical concepts that can be extracted from Batak ethnic cultures, from the various types of cultural components that exist within them.

CONCLUSION

In ethnomathematics studies, exploration or excavation of existing cultural elements is carried out and linked to mathematical concepts. Various ethnomathematics studies, especially those examining Batak cultures in North Sumatera, have been carried

out and various mathematical concepts have been obtained that are linked to cultural elements, including ornaments, dances, traditional houses, scripts, musical instruments, traditional foods, and traditional processions. Ethnomathematics research is conducted to explore mathematical concepts in Batak sub-ethnic cultures, including the Toba Batak sub-ethnicity, Karo Batak sub-ethnicity, Simalungun Batak sub-ethnicity, and Mandailing Batak sub-ethnicity.

From the identification results obtained in the study, it can be seen that the Batak ethnic group that has been researched the most regarding cultural components that have mathematical concepts in them is the Toba Batak sub-ethnicity, namely characters, traditional houses, traditional musical instruments, traditional cakes, *ulos* cloth, and ornaments. The Simalungun Batak sub-ethnic group is researched regarding traditional dances and traditional clothing. The Mandailing sub-ethnic group is researched concerning its traditional houses and traditional musical instruments. Meanwhile, the Karo Batak sub-ethnic group is only researched regarding its traditional houses.

The mathematical concepts that are most often obtained from the exploration of Batak ethnic cultures are geometric concepts including the concepts of lines, angles, congruence, spatial geometry, flat geometric shapes, spatial geometric shapes, and geometric transformations. Meanwhile, other concepts are the concepts of arithmetic sequences and the concepts of numbers.

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