ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 8 Number 2, May 2023, 589-602

ETHNOMATHEMATICS EXPLORATION OF THE *TAGANING* MUSICAL INSTRUMENT

Tasya Rahmadani[1*], Reflina Reflina[2]
[1,2]Departement of Mathematics Education, Universitas Islam Negeri Sumatera Utara, North Sumatra Province, Indonesia

*Correspondence: tasyaram2611@gmail.com

ABSTRACT

Education and culture are habits that are interconnected with human life. In education, culture can be used as a medium of learning both in schools and in culture itself. North Sumatra has various unique ethnicities, one of which is the Toba Batak which must be preserved and passed down from generation to generation. One of the Toba Batak cultures is the Taganing , a traditional musical instrument consisting of five drums with different heights and diameters that produce different tones and are played by two players. The purpose of this study is to explore what mathematical concepts exist in the Taganing musical instrument so that it can be implemented in learning mathematics.This research uses qualitative with ethnography methods with research instruments in the from of observation and documentation. The results of this study indicate that the Taganing musical instrument contains the concept of geometry and integral calculus.
Keywords: Ethnomathematics, Batak Toba, Taganing , Geometry, Integral Calculus

How to Cite: Rahmadani, T & Reflina, R. (2023). Ethnomathematics Exploration of The *Taganing* Musical Instrument. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 8*(2), 589-602. http://doi.org/10.31943/mathline.v8i2.425

PRELIMINARY

Education and culture are two things that are interrelated (Putri, 2017). Culture is a social custom that has been passed down from generation to generation which has become the identity of a region. Cultural values which form the basis of the nation's character are important things to be instilled in everyone, and need to be introduced from an early age so that everyone can better understand, interpret and live as well as realize that cultural values play a role in carrying out all important activities in life. Meanwhile, it can be seen that education is a need that as long as humans live, humans will continue to learn (long life education). Cultures that have not been touched by education will be static or unbalanced. In addition, education that does not take culture into account is difficult for society to accept. Therefore, learning must include cultural elements so that it is more easily accepted among the community (Firdaus & Hodiyanto,2019). Through education, a practice of introducing cultural values can be carried out (Fajriyah, 2018). The educational process

functions to form a creative personality that is able to balance and network the culture in which he lives.

There is an interactive relationship between education and culture, because the educational process cannot be separated from culture, and cultural balance cannot be separated from the educational process of a particular society. An education without culture is nothing, and culture without education can trigger the death of the culture itself. Education and culture have a very important role in growing and balancing the values of a nation, which has an impact on the formation of character based on noble cultural values. Tanu (2016) said that culture-based learning is a model of learning engagement that prioritizes the activities of students with a variety of cultural backgrounds they have, and is integrated into learning. Through cultural-based learning, students do not just imitate or receive information, but students create meaning, understanding, and meaning from the information they receive. Knowledge is not just a narrative summary of the knowledge that other people have, but a collection that someone has about thoughts, behaviors, relationships, predictions and feelings, the results of the transformation of the various information they receive (Fahrurrozi, 2015)

One thing that connects education and culture is ethnomathematics. Ethnomatematics was introduced by D'Ambrosio, a Brazilian mathematician in 1977. The definition of ethnomathematics according to D'Ambrosio is that linguistically "*ethno*" is defined as something very broad which refers to the socio-cultural context, including language, jargon, code of behavior, myths and symbols . The word "*mathema*" means explaining, knowing, understanding, and carrying out activities such as coding, measuring, classifying, concluding, and modeling. And the word "*tics*" comes from *techne* and has the same meaning as technique (Rosa & Orey, 2011). D'Ambrosio also said that mathematics is practiced among cultural groups identifiable as national tribal societies, labor groups, children of certain age groups and professional classes (D'Ambrosio, 1985). In fact, the results of Fujiati's research show that teaching based on ethnomathematics can improve students' mathematical abilities (Fujiati & Mastur, 2014).

Ethnomathematics is a relationship between mathematics and culture which means ethnomathematics uses broadly mathematical concepts the study of material related to culture. The study of ethnomathematics in the teaching of mathematics covers all fields, such as architecture, weaving, sewing, agriculture, kinship relations, ornaments, and spiritual and religious practices in harmony with patterns that occur in nature or ordered systems of abstract ideas (Wahyuni et al., 2013). Ethnomatematics can also be described as

a program aimed at understanding, compiling, processing, and finally applying mathematical ideas, concepts and practices that can solve problems related to daily activities (Barton, 1996). Through ethnomathematics identification, the way of thinking of society that produces mathematics can be understood so as to bridge the gap between the mathematical elements that exist in culture and school mathematics concepts (Dosinaeng et al., 2020).

Indonesia has a very wide and varied culture. Each region has its own characteristics which differ from ethnicity and race. One of the tribes and races found in North Sumatra is the Batak tribe. The Batak tribe are native settlers in the province of North Sumatra. There are dialectical differences that are used in everyday life and interaction, because the Batak people are specifically composed of six sub-subjects, namely Karo, Simalungun, Pakpak, Toba, Angkola, and Mandailing (Sugiyarto, 2017). Every Batak tribe has different cultures ranging from traditions, traditional clothing, language, traditional houses, musical instruments, and many others.

One of them is the Toba Batak tribe. The Toba Batak region is the largest region in North Sumatra which includes the shores of Lake Toba, Samosir Island, the Toba highlands, the Asahan Silindung area, the area between Barus and Sibolga. *Since 1979 with the implementation of UUD No.5 of 1979* The territory of the Toba Batak people is in the North Tapanuli regency, the Deli Serdang regency, and the Asahan regency. This paper will discuss traditional musical instruments found in the Batak Toba tribe. Toba Batak musical instruments consist of *Serume Bolon, Pangora, Garatung, Taganing , Hapetan, Gondang, Ihutan, Sarune Bulu, and Sulim* (Sitanggang, 2021).

The musical ensemble in the Toba Batak community is very important. It can be said that there is no traditional ceremonial form, both in customary activities and in religious ritual activities. The ensemble music is unique in terms of musical instruments. Such musical ensembles are collaborated (combined) with Toba Batak musical instruments (Silitonga et al., 2017). There are two musical ensembles in the Toba community, namely the *gondang hasapi* ensemble and the *sabangunan gondang* ensemble. One of the instruments in the *Sabangunan* ensemble is *Taganing* (Kuliah & Nusantara, n.d.).

Figure 1. *Taganing* Musical Instrument

Taganing is a Toba Batak musical instruments consisting of drums containing one (single-headed braced drum) which belongs to the classification of membranophone musical instruments and is played by being beaten using a stick. *Taganing* consists of five drums that are hung and arranged on a pole/rack from the smallest to the largest. However, a larger bass drum was added called a gordang (Tinambunan, 2022). Each *Taganing* drum has its own name, namely *Tingting, Paiduia Tingting, Painonga, Paiduia Odap, and Odap-odap* (Purba, 2002). *Taganing* musical instruments have different sizes, from the height to the diameter of the drum and base. Therefore, this study aims to explore what mathematical concepts in the *Taganing* musical instrument.

Many researchers have conducted ethnomathematics research. One of them is research from Lubis et al. (2018) on the exploration of ethnomathematics on the Gordang Sambilan musical instrument. The results of the exploration of mathematical concepts on the *Gordang Sambilan* musical instrument in the form of physical forms, namely the basic concepts of geometry in the form of circles, tubes, cones and cones and the concept of arithmetic rows. Through the mathematical concepts on the *Gordang Sambilan* musical instrument can introduce mathematics through local culture. There is also research that explains that ethnomathematics can be used as a learning resource in learning mathematics, namely Pertiwi & Budiarto, n.d.(2020) on the exploration of ethnomathematics in *Mlaten Pottery*. This study presents the results of exploring the form of ethnomathematics in *Mlaten Pottery* in the form of the concept of circle, the concept of geometric transformation, the concept of flat buildings, the concept of curved side space, the concept of function, and the concept of volume of rotating objects. Novitasari et al., (2022) on the exploration of ethnomathematics in the Sasak *tribe's Beleq drum* instrument. The results of the exploration of mathematical concepts in the Sasak *tribe's Beleq drum* instrument are two-dimensional geometry, three-dimensional geometry, transformation geometry, and the concept of arithmetic sequence. This research is expected to provide information to

practitioners and people who are active in the field of mathematics, especially in developing learning tools using the context of ethnomathematics on Lombok Island.

Ethnomathematics research on the Toba Batak tribe has also been carried out previously including exploration of traditional Toba Batak cakes on the concept of geometry (Naibaho et al., 2022), exploration of ethnomathematics on Ulos Hela cloth of the Toba Batak tribe on the concept of flat shapes (Saragih, 2022), ethnomathematics: exploration of geometry concepts in Toba Batak Bolon house ornaments (Sihombing & Tambunan., 2021), and ethnomathematics: exploration of traditional musical instruments typical of the Toba Batak (Sitanggang, 2021). However, research related to ethnomathematics that focuses on one of the Toba Batak musical instruments, especially *Taganing*, is still very rare. Owing to that, the research carried out beirtuijuian uintuik meingeiksplorasikan konseip mateimatika apa ada pada alat muisik *Taganing*.

METHODS

This study uses qualitative research, where the direct data source is field research or the natural environment. Field research finds the facts of the socio-cultural life of the community. The aim of the qualitative approach is to describe a complex reality (Sugiyono, 2014). This qualitative research uses an ethnography approach. Ethnography is an activity that describes ethnic groups closely related to their culture (Manan, 2021).

This research was conducted in order to find information about the relationship between mathematics and culture in *Taganing* traditional musical instruments by identifying the concepts of mathematics in *Taganing*. The location of this research was carried out at UPT. North Sumatra Cultural Park which is located at the North Sumatra Fair. This location was chosen as the research location because there are a number of traditional musical instruments such as the Toba Batak, Pak-pak, and Mandailing musical instruments which are simultaneously used in performing dance performances at Pekan Raya Sumatera Utara. This research was conducted on January 20, 2023. The subject of this research is 5 Taganing drums. The research instrument used is a human instrument, namely the research conducts research directly and plays a role in collecting data form of observation and documentation. The data analysis technique used in this research is data reduction, data presentation and conclusion drawing from the observations that have been made.

RESULT AND DISCUSSION

Based on the results of direct exploration, it is known that *Taganing* is a musical instrument originating from the Batak Toba. *Taganing* is used in the performance of Gondang Sabangunan together with other musical instruments such as *Sarune Bolon, Odap, Ogung (gong), Gordang (Gendang Besar) and Hesek. Taganing* functions as a leader or conductor in the performance of *Gondang Sabangunan* where every rhythmic signal must be obeyed by all members of the ensemble and give enthusiasm to the other players. *Taganing* can be played with two people.

Taganing is made from jackfruit wood which is old and has a yellow color because it has minimal water content so it does not become easily weathered. The sound output of *Taganing* is also produced from the cowhide which has been drizzled and measured based on the musical diameter of each drum. *Taganing* consists of 5 drums and with the addition of 1 gordang, each of which has a different size. After the exploration of *Taganing* was carried out, the results were obtained as follows:

Table 1. *Taganing* Size

Taganing	**The Height of *Taganing* (cm)**	**Top Diameter (cm)**	**Diameter of the Top Radius (cm)**	**Diameter of the Lower Part (cm)**	**The Lower Radius (cm)**
1	49 cm	19 cm	9,5 cm	17 cm	8,5 cm
2	48 cm	18,5 cm	9,25 cm	16 cm	8 cm
3	48 cm	18,5 cm	9,25 cm	15,5 cm	7,75 cm
4	48 cm	18 cm	9 cm	14,5 cm	7,25 cm
5	47 cm	17 cm	8,5 cm	14 cm	7 cm

Frustum of A Cone *Taganing*

The results of the exploration of ethnomathematics on the *Taganing* musical instrument show that it creates a geometrical concept, i.e. a curved curve because the base and top part have different shapes. The following picture shows the illustration of Cone on *Taganing* .

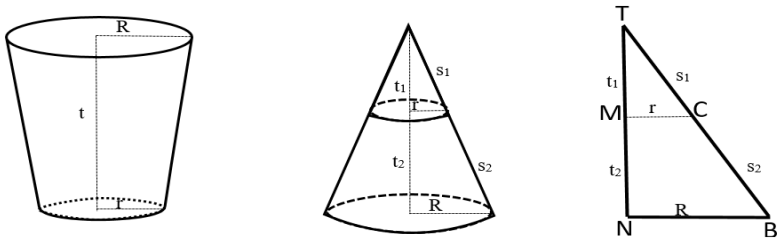

Figure 2. The Frustum Of A Cone in *Taganing*

Look at the triangular image above taken from a flat cross-section from Cone. Based on the NTB triangle and the MTC triangle, it is known that the height of the NTB triangle is $t_1 + t_2 = T$ and MTC is t_1. The length of BT side is $s_1 + s_2$ and CT is s_1, meanwhile the lengths R and r are the circle of the cone. Since the two triangles are congruent, a congruence comparison is obtained between their sides. The formula for the comparison of congruence from the sides is as follows:

$$\frac{s_1}{s_1 + s_2} = \frac{t_1}{t_1 + t_2} = \frac{r}{R}$$

Based on the above, to get the value of $t_1, s_1 \text{dan } s_2$, the following formula can be used:

$$t_1 = \frac{t_2 r}{R - r}$$

$$s_2 = \sqrt{{t_2}^2 + R^2}$$

$$s_1 = \frac{s_2 r}{R - r}$$

If R and r are the radii of the cone, we can find the surface area and the volume of the Frustum of a cone as follows (Roharjo & Widyaiswara, 2009)

$$L = \pi s_2 (R + r)$$

and

$$V = \frac{1}{3}\, \pi t_2\, (R^2 + rR + r^2)$$

Furthermore, it is possible to calculate the surface area and the volume of the Frustum of a cone on the *Taganing* musical instrument. The following is one of the calculations of the surface area and the volume of the Frustum of a cone as:

For $R = 9{,}5\ cm, r = 8{,}5\ cm, t_2 = 49\ cm$ (*Taganing* Drum 1)

After that, to find the value of $t_1, s_1 \text{dan } s_2$

$$t_1 = \frac{t_2 r}{R - r} = \frac{49\ cm\ x\ 8{,}5 cm}{9{,}5\ cm - 8{,}5\ cm} = 416{,}5\ cm$$

$$s_2 = \sqrt{{t_2}^2 + R^2} = \sqrt{49^2 + 9{,}5^2} = 49{,}9\ cm$$

$$s_1 = \frac{s_2 r}{R - r} = \frac{49{,}9\ cm\ x\ 8{,}5\ cm}{9{,}5 - 8{,}5} = 424{,}15\ cm$$

After calculating the value of t_1, s_1 dan s_2 then the next step is to determine the surface area and the volume of the Frustum of a cone Taganing.

$$L = \pi s_2 (R + r) = 3{,}14\ x\ 49{,}91\ (9{,}5 + 8{,}5)$$

$$L = 2820{,}9\ cm^2$$

and

$$V = \frac{1}{3}\ \pi t_2 (R^2 + rR + r^2) = \frac{1}{3}\ x\ 3{,}14\ x\ 49\ (9{,}5^2 + (9{,}5\ x\ 8{,}5) + 8{,}5^2)$$

$$V = \frac{1}{3}\ x\ 3{,}14\ x\ 49\ (243{,}25)$$

$$V = 12475{,}48\ cm^3$$

Integral Calculus

Based on the exploration results on the *Taganing* musical instrument, there is another alternative in determining the volume of the *Taganing* musical instrument, namely by determining the volume of the rotating object (integral calculus). The following figure shows an illustration of the volume of the *Taganing* rotating object

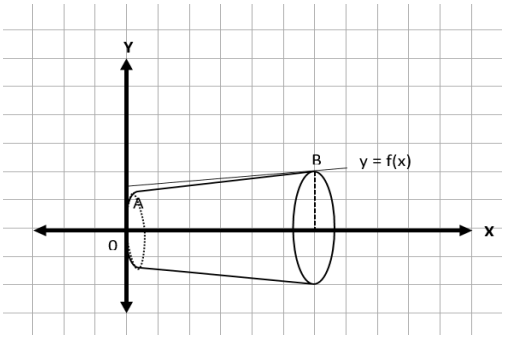

Figure 3. Volume of Objects Rotated Against the x Axis

To determine the volume of a rotating object, first determine which point A and point B are as follows:

$$\boldsymbol{Point\ A} = (\boldsymbol{x_1}, \boldsymbol{y_1})$$

$$\boldsymbol{Point\ B} = (\boldsymbol{x_2}, \boldsymbol{y_2})$$

Then determine the gradient of line AB using the formula as follows

$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

If the gradient of line AB is known and passes through point A, the equation for line AB can be determined through: (Aisyah, et al, 2021)

$$y - y_1 = m(x - x_1)$$

In determining the volume of rotating objects can be done in 2 ways,

the volume of rotating objects about the axis s*x*

$$V = \pi \int_a^b y^2 dx \ \ atau \ V = \pi \int_a^b f(x)^2 dx$$

And the volume of objects rotated about the y axis (Lumbantoruan, 2019)

$$V = \pi \int_a^b x^2 dx \ \ atau \ V = \pi \int_a^b f(y)^2 dx$$

Furthermore, it is possible to calculate the volume of the rotating object on the *Taganing* musical instrument:

It can be seen that, $\text{Point A} = (0, 85\ ), \text{Point B} = (49, 9{,}5)$ (*Taganing* drum 1)

With the gradient of line AB

$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)} = \frac{9{,}5 - 8{,}5}{49 - 0} = \frac{1}{49}$$

Then, calculate the equation of line AB

$$y - y_1 = m(x - x_1)$$

$$y - 8{,}5 = \frac{1}{49}(x - 0)$$

$$y = \frac{1}{49}x + 8{,}5$$

Because the volume of an object rotates about the x axis, the following formula is used:

$$V = \pi \int_a^b x^2 dx = 3{,}14 \int_0^{49} \left(\frac{1}{49}x + 8{,}5\right)^2 dx$$

$$V = 3{,}14 \int_0^{49} \left(\frac{1}{49}x + \frac{17}{2}\right)^2 dx = 3{,}14 \int_0^{49} \left(\frac{1}{2401}x^2 + \frac{17}{49}x + \frac{289}{4}\right) dx$$

$$V = \frac{1}{7203}x^3 + \frac{17}{98}x^2 + \frac{289}{4}\Big|_0^{49} x\ 3{,}14$$

$$V = 12475{,}48\ cm^3$$

Furthermore, it can be recalculated the surface area and the volume of the Frustum of a cone and the volume of the object rotating about the *x*-axis on the other *Taganing* drums. The following summarizes the results of calculating the surface area and the

volume of the Frustum of a cone, and the volume of the rotating object about the *x*-axis shown in table 2

Table 2. Calculation Results of Surface Area and The Volume of The Frustum of A Cone, Volume of The Disc Object of The *Taganing* Musical Instrument

Taganing	Frustum Of A Cone Surface Area (cm^2)	Frustum Of A Cone Volume (cm^3)	Disc Volume (cm^3)
1	2820,9 cm^2	12475,48 cm^3	12475,48 cm^3
2	2643,2 cm^2	11231,78 cm^3	11231,78 cm^3
3	2604,9 cm^2	10917,78 cm^3	10917,78 cm^3
4	2490,0 cm^2	9988,34 cm^3	9988,34 cm^3
5	2321,5 cm^2	8891,69 cm^3	8891,69 cm^3

Based on table 2, the results of the surface area and volume frustume of a cone, and the volume of the object rotating. It can be seen that the results of both the volume frustume of a cone and the volume of the object rotating are the same. So finding the volume value of the *Taganing* musical instrument can use 2 ways.

Discussion

Based on the results of the research that has been carried out, the musical instrument of *Taganing* as one of the Toba Batak culture can be applied in the teaching of mathematics by looking at the form of *Taganing* in which there is an ethnomathematics theory. There are mathematical concepts in *Taganing* 's musical instruments, namely the concepts of geometry and integral calculus. The results of this study are in line with the theory proposed by D'Ambrosio (D'Ambrosio, 1985) that in culture there are mathematical elements.

This can be used as an intuitive tool to introduce mathematical concepts such as geometric concepts so that in understanding abstract mathematical concepts students can easily understand them. The results of the exploration that has been carried out on the *Taganing* musical instrument show the concept of spatial geometry and integral calculus, namely the intuitive form of tapered keiruicuit and circular motion. In addition, exploration of roof diameter (midline), base diameter, roof radius, base radius, surface area and volume frustum of a cone and circular disc volume (integral calculus) can also be carried out.

The results of this study are in line with several studies which have found that there is a relationship between culture and mathematics, especially in the concept of geometry,

and (Ditasona, 2018)(Pramudita & Rosnawati, 2019)(Sihombing & Tambunan, 2021.) (Naibaho et al., 2022) one of frustum of a cone and volume of the object rotating (Lubis et al., 2018)(Pertiwi & Budiarto,2020)(Novitasari et al., 2022). It can be concluded that ethnomathematics is a combination of culture and mathematical concepts.

By exploring culture as a medium in learning, it is hoped that students can more easily understand the learning, as well as being able to develop an attitude of love for culture as well as preserving culture through learning at school.

Figure 4. Group Photo With One of The Administrators At UPT. North Sumatra Cultural Park

The following is photo documentation with one of the administrators UPT. North Sumatera Cultural Park who is in charge of musical instruments at UPT. North Sumatra Cultural Park which is located at the North Sumatra Fair.

CONCLUSION

The results of the exploration of mathematical concepts on the *Taganing* musical instrument were found to be in the form of a physical form, namely the basic concept of geometry in the form of a truncated cone and integral calculus in the form of a rotary object. Through the frustum of a cone one can find the results of the *Taganing* surface area and the *Taganing* volume. Another alternative in determining the volume of *Taganing* is using integral calculus, namely determining the volume of a rotating object. Mathematical concepts contained in the *Taganing* musical instrument can be used to introduce mathematics through local culture so that learning mathematics in class will be more meaningful.

Thus, an exploration of the mathematical concept of how to play *Taganing* can be carried out. In addition, research needs to be developed in making mathematics learning tools based on Toba Batak culture, especially *Taganing* .

ACKNOWLEDGMENT

In this research, I would like to express my gratitude to the supervisor of my final journal article because they have guided me in completing my final assignment. I also want to thank Mr. Agus Pribadi who is in charge of musical instruments at UPT. North Sumatra Cultural Park which is located at the North Sumatra Fair in that he has granted permission and assisted me in producing data about the *Taganing* musical instrument, and people that I cannot name one by one, thank you.

REFERENCES

Aisyah, Putra, R. W. Y., & Ambarwati, R. (2021). *Ringkasn Materi, Soal dan Pembahasan Gradien dan Persamaan Garis Lurus Berbasis HOTS.* Arjasa Pratama.

Barton, B. (1996). Making Sense of Ethnomathematics: Ethnomathematics is Making Sense. *Educational Studies in Mathematics*, 31(1–2), 201-233. https://doi.org/10.1007/BF00143932

D'Ambrosio, U. (1985). Ethnomathematics and Its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics*, 5(1), 44-48. https://www.jstor.org/stable/40247876

Ditasona, C. (2018). Ethnomathematics Exploration of the Toba Community: Elements of Geometry Transformation Contained in Gorga (Ornament on Bataks House). *IOP Conference Series: Materials Science and Engineering*, 335(1), 1-6. https://doi.org/10.1088/1757-899X/335/1/012042

Dosinaeng, W. B. N ., Lakapu, M., Jagom, I. V. U., Leton, S.I., & Djong, K.D. (2020). Etnomatematika Untuk Siswa Sekolah Menengah:Eksplorasi Konsep-Konsep Geometri Pada Budaya Suku Boti. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 9(3), 739-752. https://doi.org/10.24127/ajpm.v9i3.2900

Fahrurrozi, M. (2015). Pembelajaran Berbasis Budaya: Model Inovasi Pembelajaran dan Implementasi Kurikulum Berbasis Kompetensi. *Prosiding Seminar Nasional & Call For Papers Pendidikan Karakter Dalam Pemebelajaran Bisnis dan Manajemen,* 1-11. https://www.researchgate.net/publication/324258503

Fajriyah, E. (2018). Peran Etnomatematika Terkait Konsep Matematika dalam Mendukung Literasi. *Prisma Prosiding Seminar Nasional Matematika* (*1),* 114-119. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19589

Fujiati, I. ;, & Mastur, Z. (2014). Keefektifan Model Pogil Berbantuan Alat Peraga Berbasis Etnomatematika Terhadap Kemampuan Komunikasi Matematis. *Unnes Journal of Mathematics Education*, 3(3), 175-180. https://doi.org/10.15294/ujme.v3i3.4482

Undang-Undang Republik Indonesia No. 5 Tahun 1979 Tentang Pemerintah Desa, (Indonesia). Diakses tanggal (17 April 2023) https://peraturan.bpk.go.id/Home/Details/47151/uu-no-5-tahun-1979

Lubis, S. I., Mujib, A., & Siregar, H. (2018). Eksplorasi Etnomatematika pada Alat Musik Gordang Sambilan. *Edumatika : Jurnal Riset Pendidikan Matematika*, 1(2), 1-10. https://doi.org/10.32939/ejrpm.v1i2.246

Lumbantoruan, J. H. (2019). *Integral Tentu Jilid 2, Edisi 1*. Universitas Kristen Indonesia.

Manan, A. (2021). *Metode Penelitian Etnografi*. AcehPo Publishing.

Marzam & Wimbrayadi. (2012). *Buku Ajar Musik Nusantara Musik Etnik Dalam Kebudayaan Nusantara*. Universitas Negeri Padang.

Naibaho, T., Sinaga, S. J., Simangunsong, V. H., & Sihombing, S. (2022). Eksplorasi Kue Tradisional Batak Toba Terhadap Konsep Geometri. *Jurnal Pendidikan Matematika (JUDIKA EDUCATION)*, 5(1), 42–48. https://doi.org/10.31539/judika.v5i1.3652

Novitasari, D., Sridana, N., & Yulis Tyaningsih, R. (2022). Eksplorasi Etnomatematika dalam Alat Musik Gendang Beleq Suku Sasak. *Indiktika : Jurnal Inovasi Pendidikan Matematika*, 5(1), 16–27. https://doi.org/10.31851/indiktika.v5i1.7970

Pertiwi, I. J., & Budiarto, M. T. (2020). Eksplorasi Etnomatematika Pada Gerabah Mlaten. *Cendekia : Jurnal Pendidikan Matematika*, 4(2), 438-453. https://doi.org/10.31004/cendekia.v4i2.257

Pramudita, K., & Rosnawati, R. (2019). Exploration of Javanese Culture Ethnomathematics Based on Geometry Perspective. *Journal of Physics: Conference Series*, *1200*(1), 1-8. https://doi.org/10.1088/1742-6596/1200/1/012002

Purba, M. (2002). Gondang Sabangunan Ensemble Music of The Batak Toba People: Musical Instruments, Structure, and Terminology. *Journal of Musicological Research*, 21(1-2), 21-72. https://doi.org/10.1080/01411890208574797

Putri, L. (2017). Eksplorasi Etnomatematika Kesenian Rebana Sebagai Sumber Belajar Matematika Pada Jenjang MI. *Jurnal Ilmiah Pendidikan Dasar UNISSULA*, 4(1), 21-31. http://dx.doi.org/10.30659/pendas.4.1.%25p

Raharjo, M, & Widyaiswara, M. (2009). *Geometri Ruang*. Departemen Pendidikan Nasional. www.p3gmatyo.go.id.

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: the cultural aspects of Mathematics Etnomatemática: os Aspectos Culturais da Matemática. *Revista Latinoamericana de Etnomatematica*, 4 (2), 32-54. http://www.redalyc.org/articulo.oa?id=274019437002

Saragih, J. D. G. (2022). Eksplorasi Etnomatetika Pada Kain Ulos Hela Suku Batak Toba Terhadap Konsep Bangun Datar. *Inovasi Sekolah Dasar: Jurnal Kajian Pengembangan Pendidikan*, 9(2), 107-112. https://doi.org/10.36706/jisd.v9i2.19091

Sihombing, S., & Tambunan, H. (2021). Etnomatematika : Eksplorasi Konsep Geometri Pada Ornamen Rumah Bolon Batak Toba.*Jurnal Pendidikan Matematika Indonesia*, 6 (2). 100-104. http://dx.doi.org/10.26737/jpmi.v6i2.2552

Silitonga, P. H. D., Sendratasik, J., Bahasa, F., & Seni, D. (2017). Ansambel Musik Batak Toba Sebagai Pengiring dalam Peribadata Umat Kristen Etnis Batak Toba di Medan. *Jurnal Seni dan Budaya*, 1(2), 70-77. https://doi.org/10.24114/gondang.v1i2.8565

Sitanggang, N. (2021). Etnomatematika: Eksplorasi Alat Musik Tradisional Khas Batak Toba. *Jurnal Peka*, 4(2), 57-62. https://doi.org/10.37150/jp.v4i2.851

Sugiyarto, S. (2017). Menyimak (Kembali) Integrasi Budaya di Tanah Batak Toba. *Endogami: Jurnal Ilmiah Kajian Antropologi*, 1(1), 34-41. https://doi.org/10.14710/endogami.1.1.34-41

Sugiyono. (2014). *Memahami penelitian kualitatif*. Alfabeta.

Tanu, K. (2016). Pembelajaran Berbasis Budaya Dalam Meningkatkan Mutu Pendidikan Di Sekolah. *Jurnal Penjaminan Mutu*, 2(1), 34-43. https://doi.org/10.25078/jpm.v2i1.59

Tinambunan, E. R. L. (2022). Gondang Batak Toba: Makna Religi dan Implikasinya pada Keagamaan dan Adat. *Jurnal SMART (Studi Masyarakat, Religi, Dan Tradisi)*, 8(2), 261–273. https://doi.org/10.18784/smart.v8i2.1775

Wahyuni, A., Aji, A., Tias, W., & Sani, B. (2013). Peran Etnomatematika dalam Membangun Karakter Bangsa.*Prosiding Seminar Nasional Matematika dan Pendidikan Matematika*, 1(1), 114-118. http://eprints.uny.ac.id/id/eprint/10738