

Ethnomathematics: Panting music exploration

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Abstract: There are many interesting things to explore about Panting music related to mathematics. This link between culture and mathematics is known as ethnomathematics. This study aims to determine the mathematical concepts that exist in the Panting and Babun (baboon) instruments. This study uses a descriptive method with qualitative data that involved South Kalimantan cultural and Panting musicians in Banjarmasin, a lecturer in the art and culture of music subject at STKIP PGRI Banjarmasin, and students of the Dance Education study program at STKIP PGRI Banjarmasin. Data collection techniques through interviews, observations, and online questionnaires. The data obtained were reduced and presented descriptively—data triangulation using collection techniques and sources. The results of this study indicate (1) mathematical concepts on the Panting instrument are measurement, circle, multiples of 5, the position of two lines that coincide, and the position of lines that are equidistant, and (2) mathematical concepts on the Babun instrument are truncated cones, odd numbers, circle, the position of equidistant lines, isosceles triangle, rhombus, and congruence of plane figures.

Keywords: ethnomathematics; culture; Panting

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INTRODUCTION

Indonesia is rich in culture, each with its own local wisdom (Muslimahayati & Wardani, 2019; Prahmana et al., 2021), which becomes a national treasure. So, it has an opportunity to improve the mathematics education system in Indonesia through transformational efforts to bring mathematics closer to students' reality and culture (Abdullah, 2017). The findings of ethnomathematics exploration have been applied in mathematics learning in several schools in Indonesia. As a result, it has been proven that the use of culture in learning can change students' negative perceptions of mathematics, which increases student achievement and interest in mathematics (Pathuddin et al., 2021). Moreover, with this situation, the teaching and learning process are two concepts that might not be separated from one to another (Suriawati & Mundilarto, 2019).

One of them, South Kalimantan, is a province in Indonesia that holds a lot of regional cultures. Of course, the regional culture in question is a habit that is inherent and becomes its trademark, namely the local wisdom of South Kalimantan. There are various motifs of Sasirangan cloth, and there are various traditional houses with their uniqueness. There is also the Wasaka museum (Waja Sampai Kaputing) and local arts. One of the typical cultures of South Kalimantan, in the form of folk art, is Panting music (Anderiani, 2016), which grew from Malay music. Panting music is produced from a musical instrument called Panting. The term Panting has two meanings. First, Panting is the name of a chordophone type musical instrument derived from the Dayak lute instrument, which is influenced by Malay Gambus music (Anderiani, 2016). Second, Panting is the name of a musical ensemble, Panting instrument as the main instrument, in addition to the flute, violin, Babun (a type of drum), Kampul (a type of kempul), Agung Basar (a type of gong), Marawis or in Banjarese language is Kaprak, kulimpat (a kind of gong), Ketipung, and Kicik (similar to a tambourine) (Anderiani, 2016). As time goes by,

Panting's music has transformed according to the audience's characteristics from children to adults and contemporary tastes so that it still exists and is timeless.

Some people activities are very important in developing mathematical ideas. Activities include counting, locating, measuring, playing games, designing, and explaining. The activity classification helps design learning to introduce students to mathematical knowledge contained in a culture (Septianawati et al., 2017). Panting musical instruments are closely related to the manufacturing process and the intricacies or requirements to be called panting musical instruments. There are elements of learning and learning in it, including the rules and mathematical concepts that exist in Panting's music. While learning mathematics, at the same time introducing music is important to school children. So that students know the culture of the region and can understand the use of mathematics in their daily lives.

One alternative for learning mathematics is to use the surrounding environment to strengthen understanding of a mathematical material (Agustina, 2016). Because learning mathematics should require suitable methods, models, or learning strategies and learning resources or facilities (Hartono & Irvandi, 2021), the learning environment in question can be in the form of cultural elements (Putri, 2017). In Panting music, there is a mathematical activity, aka ethnomathematics (Muslimahayati & Wardani, 2019), which is the science used to understand how mathematics is adapted from a local culture (Marsigit et al., 2018). In fact, a mathematician as a pioneer of ethnomathematics, (D'Ambrosio, 1985), stated his belief that when children learn mathematics, it means they will be influenced by life, experience, and culture that has grown in them previously from the family environment and local community. A child will be influenced by the values that develop in the social environment of his community (Kusaeri & Pardi, 2019), including in learning mathematics.

In essence, mathematics and culture are closely related. Mathematics is an inseparable part of the culture and its embodiment (Atsnan et al., 2020; Hartoyo, 2012; Lauren et al., 2019; Suharta et al., 2017), including the many mathematical concepts contained in the Panting musical instrument. In fact, many ethnomathematical findings have been developed and integrated into mathematics learning as a form of learning innovation. Among them are guessing games like mangosteen fruit (Hariastuti, 2017), geometric concepts such as rectangles behind Balinese woven crafts (Puspawati & Putra, 2014), South Kalimantan Sasirangan fabric motifs (Ekawati et al., 2019), arithmetic sequence and geometric concepts on Gordang Sambilan musical instrument (Lubis et al., 2018), to the concept of complex geometry in the woven hat motif of the Dayak community (Hartoyo, 2012), as well as the concept of numbering in the art of Rebana (Putri, 2017), and there are many similar studies.

However, unfortunately, there has been no previous research exploring any mathematical concepts in the Panting musical instrument in depth. So it is necessary to research to explore ethnomathematics on the Panting musical instrument as a form of innovation in overcoming barriers to learning mathematics (Sari et al., 2017). At the same time, dismissing the assumptions that have developed so far in society, especially children, about mathematics having nothing to do with everyday life (Karnilah, 2013; Putra et al., 2017; Risdianti & Prahmana, 2018). It is hoped that mathematics teachers can later use the results of the research as an alternative approach that can be applied to learning mathematics (Fitrianawati et al., 2020). Once again, because mathematics and culture are a unity that cannot be separated and avoided in everyday life, which in simple language, culture is a unified whole and a comprehensive guide to behavior and plays an important role (Noto et al., 2018), including in learning mathematics. This study aimed to explore the ethnomathematics of panting music, especially on the Panting and Babun instruments.

METHODS

This research is descriptive with qualitative data. Data analysis is inductive; research results are more important and do not generalize. Meaning is the actual data obtained from the data source. The research subjects were a South Kalimantan culturalist as well as a Panting musician and music player in Banjarmasin, a lecturer in the art of music culture at STKIP PGRI Banjarmasin and eight students of the Dance Education study program at STKIP PGRI Banjarmasin. The research location is in Banjarmasin.

Sources of research data are online questionnaires, interviews, and observations. The data reduction carried out is sorting out test result data and filling out questionnaires that need to be

presented. After reducing the data, the next step is to present the data. Triangulation of data in this study is the technique and source of the poles. Triangulation techniques are comparing data from online questionnaires, interviews, and observations.

Meanwhile, triangulation of sources is comparing data sourced from South Kalimantan cultural as well as Panting music craftsmen and players in Banjarmasin, lecturers in the arts and music culture course and students of the Dance Education study program at STKIP PGRI Banjarmasin. Then, the analysis was carried out on valid data. Drawing conclusions is the result of research that answers the formulation of the problem. Conclusions are presented in the form of a description.

RESULTS AND DISCUSSION



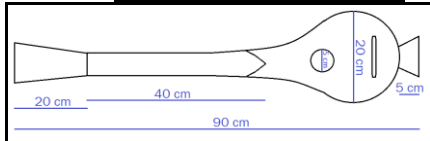
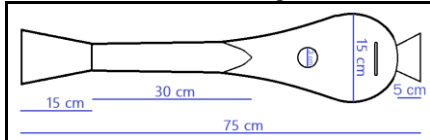
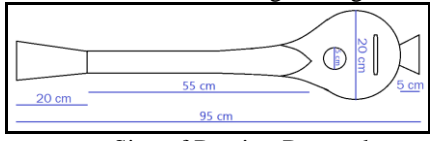


The research data were obtained through three techniques, namely online questionnaires, interviews, and observations. The data obtained from the online questionnaire are presented in Table 1.

Table 1. Online Questionnaire Results Data

Research Focus	Data
<i>How many kinds of instruments are components of Panting's musical performances?</i>	Five kinds
<i>What are the names of these tools?</i>	2 Pantings, violin, Babun, agung (gong), keyboard, tambourine, and Cymbal
<i>What is the shape of each instrument in the Panting musical performance?</i>	<ul style="list-style-type: none"> • The shape is different. • Babun, like Javanese drums, are shaped like tubes. Oval-shaped with rounded ends covered in cow or goatskin. The diameter of the hole differs from one side to the other. • The tambourine is shaped like a semi-circle. • Cymbals are circular.
<i>What is the size of each instrument in the Panting musical performance?</i>	<ul style="list-style-type: none"> • The sizes are different. • Panting is about 80 cm, the tube diameter is 15 cm, the width of the string handle is 8 cm, there are seven strings. Three scales (A, D, G) with each musical scale two strings, and one musical scale (E) 1 string. The size of the hand holder of the passage is 3 cm x 4 cm. • The length of the Babun is between 50 cm to 100 cm. • The size of the tambourine is 25 cm, and the Cymbal is 35 cm.
<i>How does each instrument function in the Panting musical performance?</i>	<ul style="list-style-type: none"> • Panting functions as a melodic musical instrument in Panting music, it also functions as a songwriter where the pattern of Panting's playing is the same as singing song lyrics. • Babun serves as percussion fillers. • Agung functions as the tempo. • The violin functions as a sound enhancer. • The tambourine functions to provide a rattling sound that combines with the sound of the Babun beat. The tambourine also functions as a regulator of the tempo of the Panting musical instrument. • Cymbals serve as markers or boundaries of each part of the song.
<i>How to play each instrument in a Panting musical performance?</i>	<ul style="list-style-type: none"> • The panting instrument is played by picking (dipanting) • Babun is beaten • Agung is hit. • The violin is swiped. • The tambourine is played by hitting it with hands or sticks, with a certain beat pattern according to the tempo and beats of the Babun on the song being played • Cymbals are played by hitting them with sticks, with a certain pattern according to the shape of the Babun wasp at each end of the song part

Furthermore, research data obtained from interviews and observations are described in Table 2.

Table 2. Interview and Observation Data

Research Focus	Interview Data	Observation Data
How many kinds of instruments are components of Panting's musical performances?	Five kinds	Five kinds
What are the names of these tools?	Panting, tambourine, Babun (gendang), violin, and agung (gong)	Panting (paningkah, pambawa, dan panggulung), tambourine, Babun, violin, and agung
What is the shape of each instrument in the Panting musical performance?	<ul style="list-style-type: none"> The main material is wood for Panting in the form of a beam. The upper chest and tail are round (circle). Babun is like tubes, but the two circular surfaces are different sizes. 	 
What is the size of each instrument in the Panting musical performance?	<ul style="list-style-type: none"> Panting Pambawa length is 90 cm, head length 20 cm, fingerboard 40 cm, <i>pambuag</i> (tail) 5 cm, upper chest midline 20 cm, and center 5 cm. Panting Paningkah length is 75 cm, head length 15 cm, fingerboard 30 cm, <i>pambuag</i> (tail) 5 cm, upper chest midline 15 cm, and center 3 cm. Panting Panggulung length is 95 cm, head length 20 cm, fingerboard 55 cm, <i>pambuag</i> (tail) 5 cm, upper chest midline 20 cm, and center 5 cm. 	 <p>Size of Panting Pambawa</p>  <p>Size of Panting Paningkah</p>  <p>Size of Panting Panggulung</p>
How does each instrument function in the Panting musical performance?	<ul style="list-style-type: none"> Panting functions to produce the sound of <i>tang</i>, <i>ting</i>, and <i>tung</i>, which are the main instruments in Panting musical performances. Baboons produce the sound of <i>tang</i>, <i>tung</i>, and <i>pak</i>. 	(videorecording)
How to play each instrument in a Panting musical performance?	<ul style="list-style-type: none"> Panting by picking. Tambourine by beating. Babun by beating. Violin by swiping. Agung by being beaten. 	 

Triangulation of techniques and sources of data based on data obtained from Table 1 and Table 2 shows that the following are valid data so that data can be analyzed: (1) there are five kinds of

Panting musical instruments; (2) the various instruments are Panting, tambourine, Babun (baboon), violin, and agung (a type of gong); (3) the shape of Babun is like a tube, but the two sides of the circle are different in size; (4) size of instrument Panting is about 80 cm long, and Babun is between 50 cm and 100 cm; and (5) how to play the instruments in panting musical performances, namely the Panting by picking, the tambourine by beating, the Babun by beating, the violin by swiping, and the agung by beating.

Panting Instrument

Additional information from the interview results that Panting music in South Kalimantan has two meanings, namely the name of an instrument that is played by picking and as the name of a musical performance in which one of the instruments uses Panting. A Panting musical performance at least consists of the Panting instrument itself, tambourine, Babun, violin, and agung. Among these instruments, Panting and Babun have special characteristics from other regional musical instruments.



Figure 1. Panting Music as a Musical Performance

Panting instruments consist of three types that produce different melodies, namely Panting Paningkah, Panting Pambawa, and Panting Panggulung. A Panting instrument can also produce three different types of sounds, which are also referred to as *paningkah*, *pambawa*, and *panggulung*. Players can use the same instrument but use different techniques to produce all three sounds. In order to achieve the perfection of the sound produced by the Panting instrument, proper calculations are needed in its manufacture, both in terms of shape and size. Craftsmen mention making a round shape is an important part of a Panting instrument to produce the desired sound. The main ingredient of the Panting instrument is made of intact jackfruit wood with a minimum length of 1 meter (m). The following are parts of the Panting instrument, namely *kepala* (head), stem, fingerboard, *senar* (strings), *pusat* (center), *dada atas* (chest up), and *pambuung* (tail). Stem serves to adjust the strings. The finger board functions as a board for strumming the strings. The center serves to emit the sound produced and is located in the upper chest. The tail serves to lock the ends of the strings. The head of the Panting instrument can be in various shapes according to the artist's soul or based on the request of the person who ordered it.

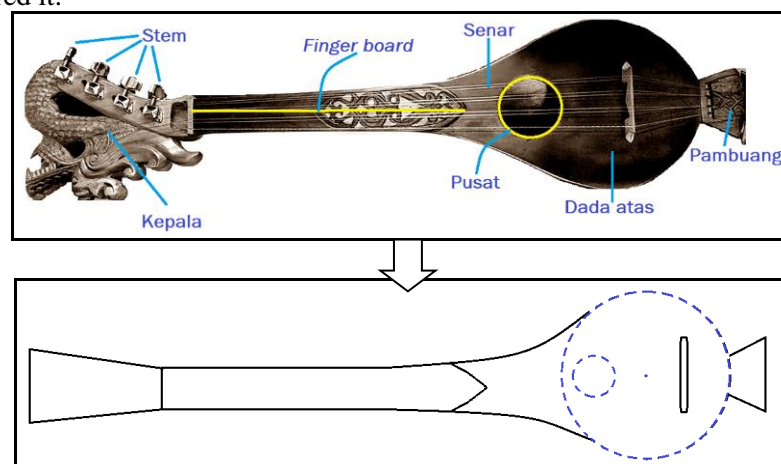


Figure 2. Panting Instrument Parts and Patterns

Each Panting instrument is crafted with precision to produce the desired sound. The manufacturer uses a long measuring tool (*meteran*) and a compass to form the round part. Panting Paningkah, Panting Pambawa, and Panting Panggulung have different sizes as described in Table 2. This difference in size will produce varying sounds. The chest of Panting is round and made using a pattern with a compass half the length of the centerline. The pattern made can be seen in the following sketch.

Panting instrument has four strings attached to two strings each, namely rope sizes 25, 35, 55, and 100 with white nylon rope, and arranged from the bottom up. In the installation of strings, each size consists of two ropes that coincide. After the strings are attached, it can be seen that the strings that coincide are equal to the position of the two lines that coincide. The position of each two strings is equidistant from the position of the other two strings. The distance between the two strings getting closer to the stem gets smaller while maintaining the same distance. So that the strings on the Panting instrument are not parallel lines.

Often craftsmen make patterns for Panting instruments using feelings with estimates because they feel they are used to and proficient in making them every day. In addition, to ensure the precision of the pattern, craftsmen also use a compass. The activity of making an upper chest pattern using a compass by placing the eye of the compass at a certain point and then turning the compass so that a pattern is formed that is equidistant from that particular point. This particular point in mathematics is referred to as the center point. Furthermore, the pattern formed by turning the compass is called a circle because the pattern is equidistant from a certain point. The centerline at the top of the chest that passes through the center is known as the circle's diameter. The same way is also done to make the Center a hole where the sound comes out in the upper chest. When viewed from the overall length of each Panting Paningkah, Panting Pambawa, and Panting Panggulung, 90 cm, 75 cm, and 95 cm are multiples of 5. Likewise for the length of the head, fingerboard, chest midline, and tail. The form of multiples of 5, in this case, can be formulated with $5n$ for n positive integers.

Babun Instrument

The Babun instrument is also one of the traditional musical instruments typical of South Kalimantan as part of the Panting musical performance. Babun in panting musical performances differs in size from the instruments used for other arts, such as *Bawayang* or Dance, *Kuda Gipang*, and *Bakuntau*. Different sizes adjust to the needs of the sound produced to accompany each performance. The following are the parts of the Babun instrument, namely *rumpiang*, *tali simpai 7* (seven hoops), *ukiran* (carving), and *baduk*.

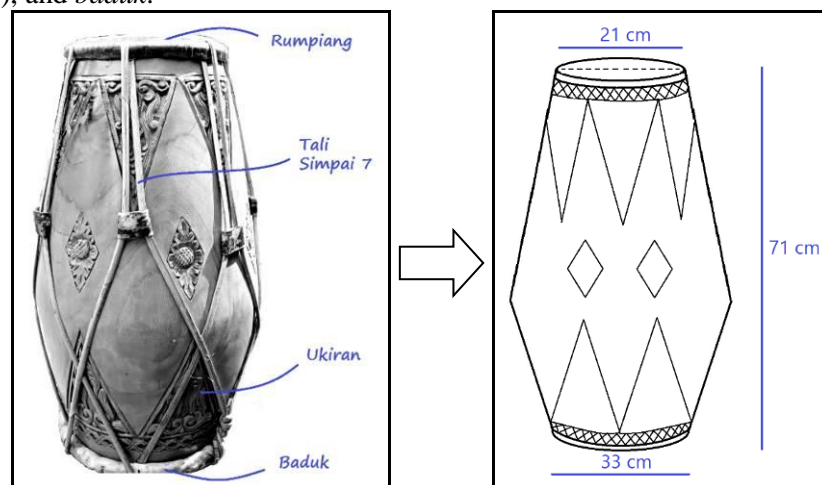


Figure 3. Babun Instrument Parts and Patterns

Babun has 2 round surfaces of different sizes. The larger surface is called Baduk, and the smaller surface is called Rumpiang. Each side of the Baduk and Rumpiang sections has seven carvings with triangular frames of the same size. In the middle of the Babun side, there is a flower carving with a rectangular frame. The following is a measure of Babun often used in Panting musical performances. The overall length is 71 cm, the length of Baduk is 33 cm, and Rumpiang is 21 cm.

Making a pattern on the upper chest and center on the Panting instrument is also done to make a round two-sided surface on Babun with a compass, namely the Rumpiang part and the Baduk part, so that it forms a circle. Rumpiang and Baduk are surrounded by seven hoops that cross from the Rumpiang section to the Baduk section, which serves to keep the surface tight when beaten. The number of the hoop is seven pieces, which is different from the Babun in other areas, which are eight pieces. The carvings under the hoop and in the middle of the Babun also number 7 pieces. The length of the diameter of Rumpiang and Baduk and the length of the whole Babun are always odd numbers. The philosophy is that the people of Banjar (South Kalimantan) consider odd numbers to be sacred numbers, so they often choose odd numbers in their daily lives. Mathematically, odd numbers, in this case, can be formulated as $2n - 1$ for $n \in \mathbb{Z}^+$.

Seven hoops are made equidistant to produce sound balance so that the distance between the carvings below is also the same distance. The carving under the hoop is in the form of an isosceles triangle because it has two equal sides and two equal angles. The seven triangles below the hoop are congruent triangles. While the carvings in the middle of the Babun are rhombus-shaped, all sides are the same length and have two pairs of equal angles. The seven rhombuses between the hoops are congruent rhombuses. Babun carving details can be seen in Figure 4.

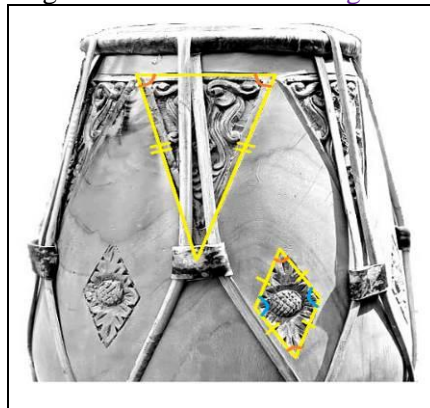


Figure 4. Babun Instrument Carving

Overall, Babun is formed by two truncated cones that coincide on the sides of the largest circle, and each part size always uses the concept of odd numbers. To find out the diameter or diameter (d) of the center of the truncated cone that coincides, it can be obtained by measuring the circumference and calculating it using the formula for the circumference of a circle (K), namely $K = \pi \times d \rightarrow d = \frac{K}{\pi}$. In Figure 5, the dotted line indicates the diameter.

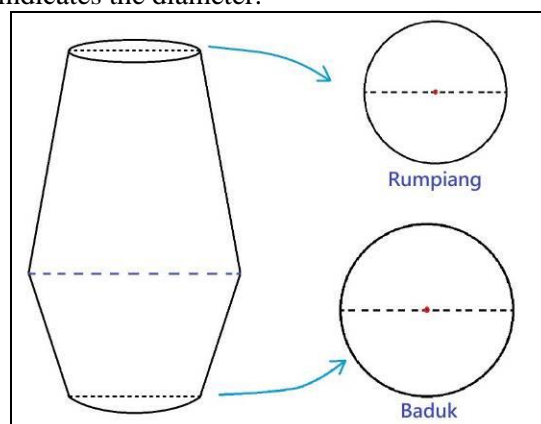


Figure 5. Circle Pattern on Babun Instrument

Panting and Babun instruments are strongly influenced by the local culture, experience and environment. Of course, they are committed to upholding the principles that are believed to be true and have been carried out since the time of their ancestors. This is in line with (D'Ambrosio, 1985) opinion, who stated his belief that when children learn mathematics, it means they will be influenced by life, experience, and culture that has grown in them previously from the family environment and

local community. A child will be influenced by the values that develop in the social environment of his community (Kusaeri & Pardi, 2019), including in learning mathematics. Therefore, a person needs to study mathematics because many things can be solved with mathematics in his daily life. Often people use a lot of math they don't even know they're doing well. The mathematics used in this case aims to get a work that gives the sense of value they want to convey through the Panting and Babun instruments. Good Panting and Babun instruments, using mathematical knowledge appropriately in their manufacture, will produce Panting musical performances that can be accepted in the hearts of the listeners.

CONCLUSION

Finally, based on the results of this study, the following conclusions can be drawn: (1) The mathematical concepts of the Panting instrument are measurement, circle, multiples of 5, the position of two lines that coincide, and the position of equidistant lines; and (2) the mathematical concepts in the Babun instrument are truncated cones, odd numbers, circles, equidistant lines, isosceles triangles, rhombuses, and congruence of plane figures. The results of this study are expected to be a consideration for teachers to develop mathematics learning by utilizing Panting's music culture and become the basis for further research.

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