Ethnomathematics in Boria dance from Penyengat Island

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Abstract

Boria dance is an art from Penyengat Island that shows the skill of marching and dancing to the rhythm of music in various song rhythms. The dance is performed by paying attention to the floor pattern, appropriateness of Movement, and appropriate rhythm. All of this is done to achieve the beauty of the dance. This research examines the ethnomathematics of the Boria dance on Penyengat Island. This research is qualitative research with an ethnographic approach. The data source for this research is arts activists at the Penyengat Heritage Cultural Studio. Data was collected by observation, interviews, and documentation with the main instrument, the researcher himself. Next, data analysis was carried out using domain, taxonomy, component, and cultural theme analysis. The research results found that there were mathematical activities, namely counting the beats made by dancers, measuring the distance between dancers before and after entering the stage, and designing the movements and floor patterns of the Boria Dance. The mathematical concepts in this research are multiplication, non-standard units of measurement, angles, and flat figures.

Keywords: ethnomathematics; boria dance; mathematical activity; mathematical concept

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I. Introduction

Dance is a form of art enjoyed visually because dance is a form of body movement whose artistic beauty can be seen in the dancer's movements (Maryati & Pratiwi, 2019). Dance movements can be created from our daily activities, and what we do in everyday life can be transformed into beautiful movements that have been arranged harmoniously (Zayyadi, 2017); these movements have meaning that we can absorb if we appreciate the dancer's movements (Sutini, 2018).

In the book entitled Directory of the Potential of Malay Arts and Culture (Malik & Febriyandi, 2013), the Boria dance originates from the South Indian community, many of whom live on the island of Pinang (Penang). Boria was very popular during the reign of the last Sultan of Riau-Lingga. Boria showed his skill in marching and dancing to the rhythm of the music in various song rhythms.

The era of globalization indirectly changes people's lifestyles to become more modern (Febrianti & Rahmawati, 2020). Even

207

traditional dance is a culture whose existence and preservation must be maintained, and this culture must be preserved in this era of globalization (Nahak, 2019).

All Indonesian people have the same role in preserving culture (Santika & Izzati, 2023). Preserving culture can also be done through education; through the Independent Curriculum, learning has directed local wisdom, and efforts have been made to ensure that culture is preserved and studied by students through elements of local wisdom (Nuryasana & Desiningrum, 2020).

Local wisdom results from a particular community's life in the form of life experiences not necessarily experienced by other communities, where these results are passed down from generation to generation (Fajarini, 2014). Local wisdom has potential because it has mathematical elements if brought into the mathematics learning process. A search known as ethnomathematics is needed to find mathematical elements in local wisdom (Susanta et al., 2023).

Ethnomathematics in Indonesia is something familiar; there has been much research on ethnomathematics. The development of ethnomathematics, even for learning applications, has been widely conducted in schools. Ethnomathematics can be interpreted as the application of mathematics learning in a culture with activities of measuring, designing, calculating, and so on (Destrianti, 2019).

Ethnomathematics aims to make us aware that mathematics is not just what we read in books and numbers that we can calculate. Mathematics is closely related to our daily lives; our lives cannot be separated from mathematical activities (Taus et al., 2022). Ethnomathematics teaches us to change our perspective on mathematics. Learning mathematics by linking culture can also benefit cultural preservation (Muhammad et al., 2023).

Boria Dance is a potential research object if efforts are made to identify mathematical activities. Several studies examining ethnomathematics in dance have been carried out. Namely, research conducted by (Naja et al., 2021) regarding the concept of ethnomathematics in the traditional dance movements of the Lio tribe the results of the research showed that each style of Toja and Wanda dance movements of the Lio tribe has ethnomathematics concepts, including vertical lines, horizontal lines, intersecting lines, acute angles, right angles, obtuse angles, arbitrary triangles, isosceles triangles, equilateral triangles and right triangles. Then, research was conducted by (Sa'o et al., 2022) regarding the ethnomathematics of floor patterns in the Tea Eku dance formation in the Nagekeo area with the results of the research being that there are floor patterns that form flat shapes such as parallelograms and equilateral triangles. Research conducted by (Lestari et al., 2021) titled "Ethnomathematics of the Andun Dance in the Culture of the Serawai Tribe Community in Seluma Regency, Bengkulu Province". This research explores mathematical concepts that are applied and developed in the Traditional Dance (Andun) culture of the Serawai tribe in Seluma Regency. The results of the research show that the mathematical concepts that exist in Andun dance culture include angles and flat shapes, right angles with an angle value of 90°, obtuse angles with an angle value of 180°, acute angles with an angle value of less than 90°, while Flat shapes include squares, rectangles and circles. Next is research researched by (Fitriani, 2022) with the title "Ethnomathematics Exploration in the Bimbang Gedang Dance in the Community in Bengkulu City". This research aims to see the creation of ethnomathematics and mathematical elements in the Bimbang Gedang dance among the people of Bengkulu city. The results of this research show that the mathematical concepts that exist in the dance in Bimbang Gedang in the Bengkulu city community include basic measurements, namely, counting, measuring and identifying, which are found in the distance and Movement of the dancer's feet, lines, found in the Movement of the dancer's hands, flat shapes

found in dance aids such as plates and folded handkerchiefs and space structures found on musical instruments as accompaniment to dance.

Ethnomathematics is a science whose scope is all around us, even things that we are not aware of could contain mathematical activities if studied (Muhammad et al., 2023). The dance that we usually see as an artistic performance on stage with agile and graceful movements of the dancers contains mathematical activities.

Considering that there are still limited ethnomathematics studies in the Riau Islands, it is felt that a larger number of ethnomathematics studies are still needed (Maure & Ningsi, 2018). One of the cultures on Penyengat Island is the Boria Dance, characterized by rows in the hope that it will later become a cultural icon on Penyengat Island. In their activities, dancers perform movements created by Penyengat Island art activists who were inspired by the Dutch East Indies Army, who danced in rows. The Boria Dance is a potential ethnomathematics subject because almost all the people of Penyengat Island know the Boria Dance.

Based on the problems explained, researchers will examine the ethnomathematics of the Boria Dance on Penyengat Island. Research on ethnomathematics in Boria Dance has never been carried out by researchers before; this is proven by a preliminary study conducted by researchers. This research can inform readers about ethnomathematics in the Boria Dance.

II. Research Method

This type of research is qualitative research with an ethnographic approach. In the book entitled Qualitative Research (Harahap, 2020), qualitative research is defined as research used to examine the conditions of developing objects as they are, where the researcher is the main instrument.

Research on ethnomathematics in the Boria Dance was conducted on Penyengat Island, specifically at the Penyengat Heritage Cultural Studio. The subjects in this research are arts activists on Penyengat Island and the owner of the Penyengat Heritage Cultural Studio.

Data collection techniques were carried out using observation, interviews, and documentation. Research instruments are tools used to obtain data in research. The main instrument in this research is the researcher, who observes, asks, listens, requests, and collects research data. The research tools that researchers use are interview sheets and observation sheets.

The data collected in this research is descriptive. It was obtained from observations, interviews, and documentation of the subject studied, namely the Boria Dance on Penyengat Island. As stated (Adrian, 2018), qualitative research produces descriptive data in the form of written or spoken sentences from people and habits that can be seen and directed at settings and individuals holistically (whole).

The ethnographic approach has four analysis levels: domain, taxonomy, component, and cultural theme. The design or framework for ethnomathematics ethnographic research on the Boria Dance contains four general questions, which are then arranged in the form of the following table:

Table 1. Designs or frameworks for ethnographic thought on boria dance

Guiding Question	Initial Response	Analysis Steps	Viewpoint	Activity
Where to start observing it?	There is potential for mathematical practice in dancing activities by dancers on Penyengat Island.	Domain	Culture	Conduct observations and interviews with Boria Dancers and Boria Dance art activists.
How do we observe it?	Seeing detailed movements, floor patterns, beats, and positions by the Boria Dancers of Penyengat Island, where there is	Taxonomy	Alternative thinking	Determine what potential ideas, methods, or techniques the Dancers in the Boria Dance use related

Guiding Question	Initial Response	Analysis Steps	Viewpoint	Activity
	potential for mathematical practice in them			to mathematical practices or activities.
What is that?	Proof (Mathematical activities/concepts as a result of alternative thinking)	Componential	Mathematics and philosophy of mathematics	Recognize and differentiate the potential for certain characteristics in Boria's dance activities related to mathematics.
What does it mean?	Learned cultural values	Cultural Theme	Anthropology	Describe ethnomathematics in Boria Dance by focusing on the relationship between activities and mathematical ideas or concepts.

III. Results and Discussion

This ethnomathematics research on the Boria Dance was obtained from observations, interviews, and documentation at the Penyengat Heritage Cultural Studio. After conducting research, researchers discovered that there were mathematical activities in the Boria Dance on Penyengat Island:

Counting activity

The counting activity in the Boria Dance is based on dance beats, which are used to match the Movement and the music. Tapping is usually used during dance practice, whereas in the initial stages of practice, you still use counting. The beat is quite simple: counting 1,2,3,4,5,6,7,8, or what is usually called a 1×8 count, will repeat itself to number one when it reaches number eight.

Dancers do simple counting by saying numbers ranging from one to eight, then back to number one. Each round of the Movement is done four repetitions in a count, or what is usually called a 4×8 count, and after four repetitions of the count, the Movement will move to the next Movement. This count will continue to repeat until the dance is finished.

Figure 1. Dancers practice by counting

In the counting activity in the Boria Dance, a form of multiplication with a count of 4×8 is found. Explanation of calculations for variation movements:

Table 2. Variation movement

Movement	Count
	On the first eight counts, the dancer performs a walking movement in place with the right hand raised parallel to the shoulder, followed by the left hand stretching out on both sides.

Movement	Count
	The next eight counts are when the dancer raises both hands, which were previously spread out on both sides to be raised upwards; then the hands are lowered down beside the waist.
	On the next eight counts, the dancer repeats the walking Movement in place with the right hand raised parallel to the shoulder, followed by the left hand stretching out on both sides.
	Then, for the last eight counts, the dancer raises both hands, which were previously spread out on both sides, to be raised upwards, and then the hands are lowered down beside the waist to prepare for the next Movement.

Movement	Count

Based on this explanation, it can be concluded that there are activities that are counting using a count of 1,2,3,4,5,6,7,8, commonly known as 1×8 where each Movement is repeated four times in a counting cycle, namely 4×8. This count contains the mathematical concept of repetition of the count four times or multiplication, which the dancer does in the counting process to match the movements and music.

Measuring activity

The measuring activity in Boria Dance is found in the distance or position between dancers. Determining the distance between dancers is important to make the dance movements appropriate and achieve their beauty. The distance between the dancers is done so that the movements carried out by the dancers can be maximized and do not overlap with each other. Measuring the distance between dancers is found before and after entering the stage.

Figure 2. Measuring activities before entering the stage

This picture proves measuring activity when the dancer enters the stage. This is done so that dancers do not squeeze each other when entering the stage because before entering the stage, dancers also do simple movements such as walking in place and swaying. Measuring the distance between dancers is done, namely, the dancer only raises their right hand

Until it approaches the shoulder of the dancer in front, the unit used to measure the distance between dancers is a non-standard unit of measurement, namely the front leg or half a fathom. Next is the distance between dancers after entering the stage:
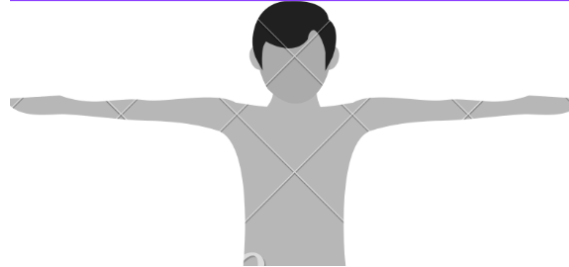
Figure 3. Measuring activities after entering the stage

This picture also provides evidence that there are measuring activities carried out by dancers after entering the stage. The movements when the dancer enters the stage will be more varied and require more space than before entering the stage. The Movement made by the dancer to determine the right distance is simply by stretching out both arms. If the tip of a dancer's hand touches the tip of another dancer's hand, the dancer must move so that the hand does not touch the other dancer. The unit used to measure the distance between dancers after entering the stage is a non-standard unit of measurement, namely by extending both hands or a fathom.

Based on this explanation, it can be concluded that measuring activities using non-standard measuring units are carried out by dancers in the process of determining the distance between dancers.

Design activity

Boria Dance is an art that was long lost and then reappeared, so there have been many changes in Boria Dance. Many movements and floor patterns have been redesigned due to the loss of speakers.

The movements in the Boria Dance include walking in place, bowing, swaying, and variation movements. Meanwhile, the Boria Dance floor pattern is trapezoidal. Each Movement and pattern has a combination of angles and shapes.

1. Walking Movement in Place
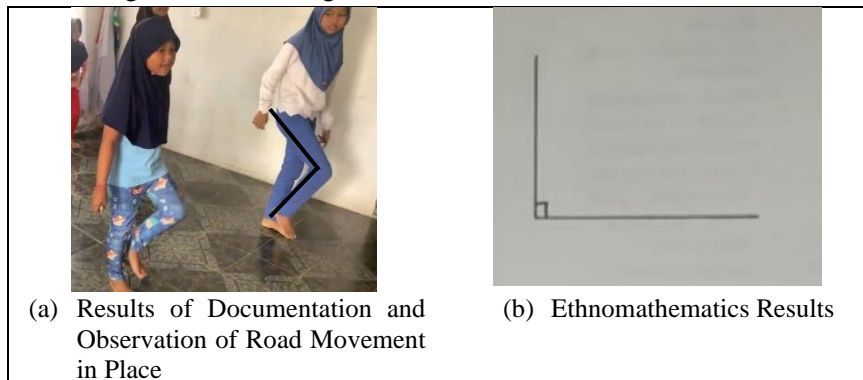
(a) Results of Documentation and Observation of Road Movement in Place

(b) Ethnomathematics Results

Figure 4. Ethnomathematics results on walking movements in place

Based on the picture, from the movements of the walking legs in place, there is a design activity in the position of the dancer's feet. So the ethnomathematics results were found to be a geometric concept, namely right angles.

2. Respectful Gesture

(a) Documentation and Observation Results of the Respect Movement
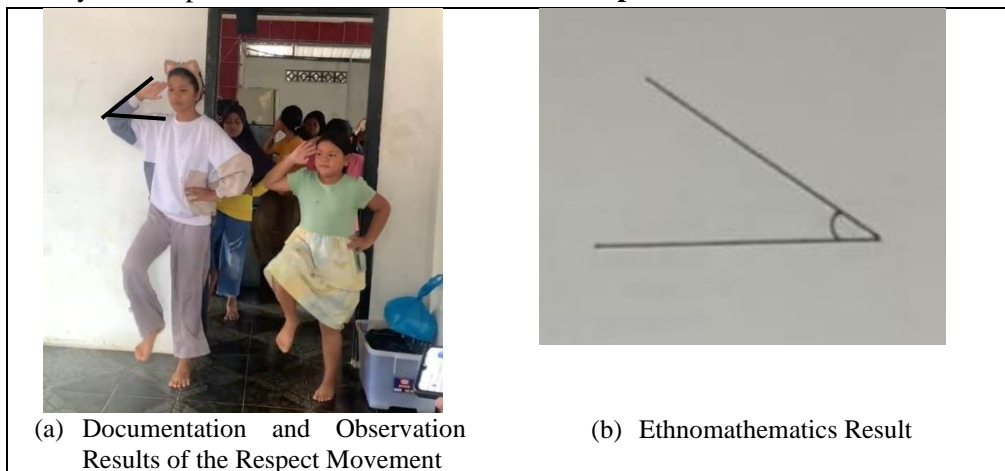
(b) Ethnomathematics Result

Figure 5. Ethnomathematics results on walking movements in place

Based on the picture from the respectful Movement, a design activity is contained in the position of the dancer's hands. So the ethnomathematics results were found to be a geometric concept, namely acute angles.

3. Swaying Movement

(a) Results of Documentation and Observation of Swaying Movements
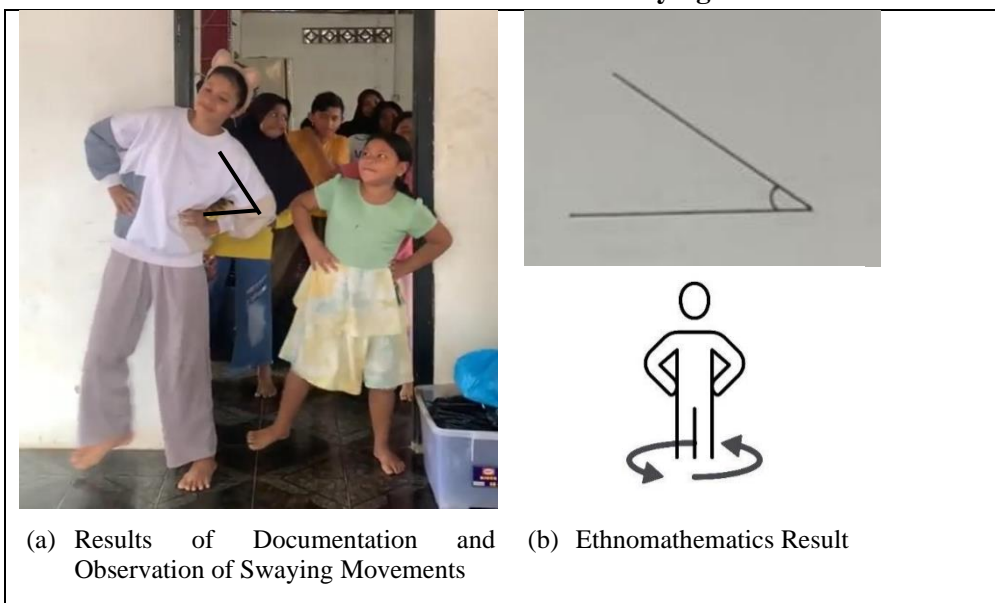
(b) Ethnomathematics Result

Figure 6. Ethnomathematics results on swaying movements

Based on the picture from the swaying Movement, a design activity is found in the position of the dancer's hands, which are at the waist. So, the ethnomathematics results were found to be a geometric concept, namely acute angles. In this Movement, too, the dancer makes a swaying movement by rotating in place one full rotation. With this, the geometric concept is found, namely the angle of one complete rotation in the dancer's rotational Movement.

4. Variation Movement

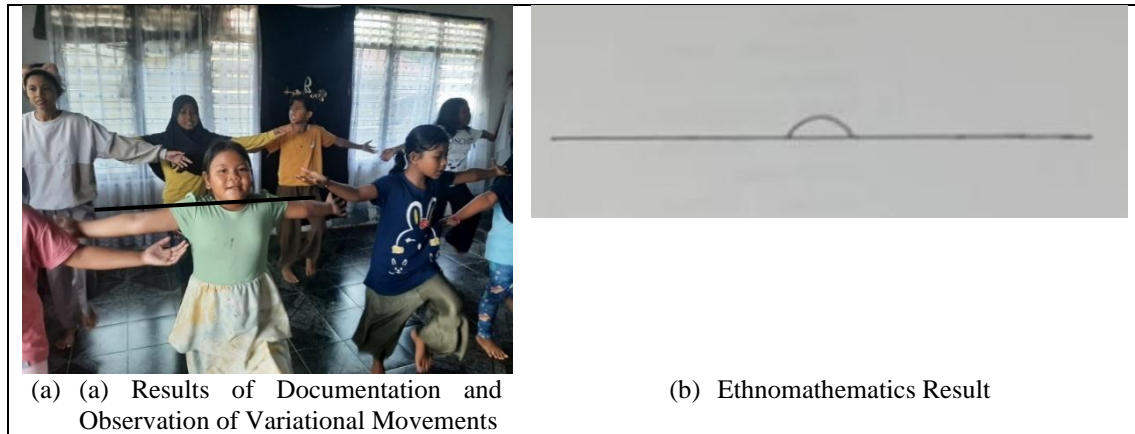| (a) (a) Results of Documentation and Observation of Variational Movements | (b) Ethnomathematics Result |

Figure 7. Ethnomathematics results on variational movements

Based on the picture, from the variation movements, a design activity is found in the position of the dancer's hands, which are spread out on both sides. So the results of ethnomathematics are obtained in geometric concepts, namely angles.

5. Trapezoid Pattern

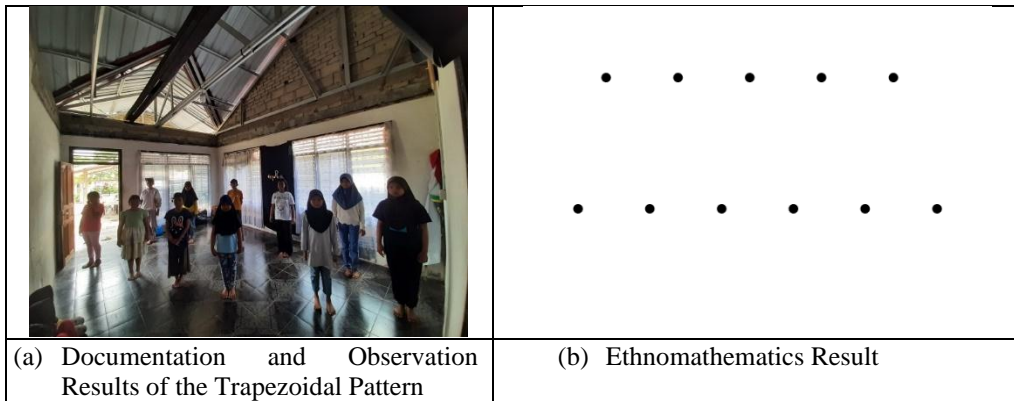| (a) Documentation and Observation Results of the Trapezoidal Pattern | (b) Ethnomathematics Result |

Figure 8. Ethnomathematics Results on Trapezoidal Patterns

Based on the picture, from the parallelogram pattern, design activities are contained in the pattern arrangement. The pattern is arranged to form a trapezoid. So the results of ethnomathematics are obtained in geometric concepts, namely flat shapes. There are activities designed in nature, where in the design, there are mathematical concepts of angles and flat shapes carried out by dancers in movements and floor patterns.

Recapitulation of data analysis results in:

Table 3. Recapitulation of data analysis results in

Domain Analysis	Taxonomic Analysis	Componential Analysis	Analysis of Cultural Themes
Count	Counting activities are found in beats or dance counts; dancers count by saying the numbers 1,2,3,4,5,6,7,8, the numbers start with the number one and end with the number eight. Then, return to number one, and so on, until the dance is finished.	There is harmony of Movement; the dancers make movements simultaneously and follow the beat of the music appropriately	There is a mathematical concept in the form of multiplication

215

Domain Analysis	Taxonomic Analysis	Componential Analysis	Analysis of Cultural Themes
Measure	Measuring activity is found in the position or distance between dancers before and after entering the stage. The dancer must make movements such as a front lengang or half a fathom and stretch out both arms or a fathom	There are differences in the distance or position of the dancers before and after entering the stage.	There is a mathematical concept in the form of non-standard units of measurement
designing.	The design activity is found in the movements and floor patterns of the Boria Dance. Dancers carry out movements and floor patterns according to what has been designed by artistic activists	There are variations in Movement, with the suitability of the dancers' movements paying attention to the angles of each Movement and the floor pattern formed with six dancers at the front and five dancers at the back.	There are mathematical concepts in the form of angles and flat figures.

Table 4. Recapitulation of results

Activity	Ideas, Methods, Mathematical Techniques	Emerging Mathematical Concepts
Counting the beats of the Boria Dance	The count used by dancers to match movements to the music	multiplication
Measuring the distance between dancers	Measure the distance between dancers before entering the stage and measure the distance between dancers after entering the stage	Unit of Measure is not Standard
Designing floor movements and patterns	See every Movement that is formed and sees every floor pattern that is formed	Angles and Flat Shapes

From the research results on the Boria Dance, there are several activities at the Boria Dance on Penyengat Island. These activities are dominant in calculating, measuring, and designing activities. Based on the results of research that has been carried out, show that counting activities are activities carried out in the Boria Dance. Dancers need counting to achieve harmony in their movements, even though the counting used is quite simple and only consists of repeating numbers from the beginning to the end of the dance, it can be proven that counting in dance is very necessary. Counting is useful for matching the tempo to the movements and suitability of each dancer's movements. This is by research conducted by (Gazanofa & Wahidin, 2023) with the title "Ethnomathematics Exploration in Piring Dance". This research aims to explore the mathematical concepts contained in Tari Piring and find out mathematical concepts that can be put into practice in learning. The result of this research is that there is a counting activity on the Plate Dance beat with eight counts.

Apart from counting activities, measuring activities are also carried out in the Boria Dance. Every dance movement performed by a dancer cannot be separated from measuring activities. If the distance between the dancers is not right, then the dance will not achieve its aesthetic value, and the dancers will not be able

to move freely on stage because the distance that is not right will make the dancers close together. So it can be concluded that measuring activity is an important activity in the Boria Dance on Penyengat Island. This is by research conducted by (Maure & Ningsi, 2018) with the title "Ethnomathematics Exploration of the Caci Dance of the Manggarai Community, East Nusa Tenggara". This research explores mathematical aspects and activities in the Caci dance, a typical dance from the Manggarai region, East Nusa Tenggara. The result of this research is the activity of measuring the distance a dancer hits an opponent using estimates of when they will hit.

Next is the design activity. The results of research that has been carried out show that designing activities are the most important activities in the Boria Dance. This is because a dance is judged by the beauty of its movements and floor patterns which differentiate it from other dances. The design activity makes the Boria Dance different and has its uniqueness. This is by research conducted by (Dewi et al., 2019) titled "Ethnomathematics in Balinese Dance Seen from the Classification of Balinese Dance". The result of this research is the discovery of designs in general patterns in each dance and specific patterns in the classification of Balinese Dance.

IV. Conclusion

After going through the domain, taxonomy, component and cultural theme analysis stages, researchers found ethnomathematics in the Boria Dance on Penyengat Island in counting, measuring, and designing activities. The counting activity in the Boria Dance is found in the count of the beats in the dance; the dancer adjusts the Movement to the music based on the count made by the dancer, namely 1,2,3,4,5,6,7,8 or known as 1×8, which is then every Movement The count is repeated four times or what is usually called 4×8.

The measuring activity in the Boria Dance is found when the dancer determines the position or distance before and after entering the stage. Dancers use measuring instruments in the form of non-standard measuring instruments;

when the dancer enters the stage, the dancer uses a measuring instrument with a forward or fathom movement. Meanwhile, after entering the stage, the dancer uses a measuring instrument to stretch out both hands or fathoms. So, with this, the mathematical concept of non-standard units of measurement was discovered. The next activity found was the design activity. Design activities are found in the movements and floor patterns of the Boria Dance. The Movement is designed by forming several angles so that the mathematical concept of angles is found, and the floor pattern is designed using a trapezoidal pattern so that the concept of a flat shape is found.

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