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# Ethnomathematics Study: Mathematical Concepts in Bima Weaving Motifs

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**ABSTRACT**

This study aimed to discover and investigate the mathematical concepts present in *muna Mbojo* (Bima weaving). This study was an ethnographic research, and employed a descriptive approach. This study's information was derived from observations and document reviews of Bima woven fabrics. The data was obtained using documentation by collecting the types or motifs of Bima weaving. Subsequently, in-depth observationswere conducted on the collected weaving. The data was analysed through reduction, presentation, and verification/conclusion. The results of the study found by the researchers namely: 1) *bali* motif (line motif) discovered mathematical concepts, including lines, rectangles, squares, and parallels; 2) *wunta* motif (flower motif) discovered mathematical concepts, including lines, sigsag lines/curves, angles, triangles, rhombuses, circles, alignments, symmetrical, translation/shifts, and reflections; and 3) *kakando* motif (bamboo shoots motif). Bima weaving is rich in motifs, weaving motifs that are generally produced by Bima people are bali motifs (lines), *wunta* motifs (flowers), and *kakando* motifs (bamboo shoots). In these motifs, mathematical concepts such as line, zigzag/curved line, angle, rectangle, square, triangle, rhombus, circle, alignment, symmetry, translation/shift, and mirroring are found. Teachers can use these mathematical concepts found in Bima weaving to help or facilitate elementary school students in learning and understanding mathematical concepts. Learning mathematics will be more meaningful if teachers are able to involve students' culture in constructing their knowledge in the learning process.



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## 1. INTRODUCTION

Ethno-mathematics (mathematics in culture) is a branch of mathematics that is no longer novel. Ethnomathematics is composed of the terms ethno, mathematics, and tics. Ethno refers to a community or cultural customs, mathematics can be interpreted as calculating, sorting, measuring, patterning, and classifying, and tics are defined as art/artistic behaviour (Banase et al., 2022). Ethno-mathematics can be interpreted as culture-based mathematics (Isnaniah et al., 2022). Both mathematics and culture emerge from human action (human activity). Ethnomathematics is defined as mathematics found in culture. This is because mathematics is created from the habits of community activities that occur continuously.

Culture or ethno results from human activity; thus, it is reasonable to bring primary school students closer to their culture through learning, particularly mathematics. This is intended to facilitate student comprehension of mathematical concepts by incorporating local culture or daily activities. Offering daily learning activities to students is central to the contextual learning approach (Imamuddin, Isnaniah, Putra, et al., 2019). Learning mathematics in the context of students' everyday lives can facilitate students' comprehension of mathematical concepts and motivate them to learn (Imamuddin, Isnaniah, Rusdi, et al., 2019). The use of students' daily contexts in learning mathematics can motivate and facilitate students in learning the mathematical concepts they learn.

Weaving culture becomes a part of the daily life of the students. Students of numerous ethnic groups in Indonesia weave daily. Producing knitted or woven fabrics is a community/students activity involving weaving. Weaving is a community-based, inherited practice that produces woven cloth. Due to the close relationship between weaving and culture, woven products vary from region to region (Amalia et al., 2021). The cloth is woven by joining transverse and longitudinal threads (Amalia et al. 2021). The Bima region has a culture of weaving that has been passed down from generation to generation, and Bima weaving has characteristics that set it apart from other Indonesian regions. Locals refer to Bima woven fabric as *muna Mbojo* (Bima weaving). Bima weaving themes are diverse and brimming with regional and local meanings and values (Amalia et al. 2021; Mubin 2016). Bima weaving has a variety of motifs and the motifs reflect the beauty of nature and the religiosity of the community. This makes Bima weaving one of the favoured weavings in Indonesia.

Mathematics in indigenous culture/wisdom is widely known (Prahmana & D'Ambrosio, 2020; Maryati & Prahmana, 2019; Bishop, 1988; D'Ambrosio, 1985). There are previous researchers, lecturers, and others have conducted several researches on regional craftsmanship, particularly batik and weaving. According to Sari et al. (2021) batik/weaving motifs and patterns can be incorporated into the learning of mathematics, particularly geometry. Various mathematical concepts can be applied to the study of weaving (Zayyadi 2017). There are numerical and geometric concepts in the manufacturing process and the woven cloth itself (Sutarto et al., 2021; Banase et al., 2022; Isnaniah et al., 2022; Fauzi et al., 2023). Using local culture/wisdom in visualising mathematical concepts (Bishop, 1979), facilitates student comprehension of mathematical concepts (Isnaniah & M. Imamuddin 2022; Fitriza et al. 2020; Zayyadi 2017). Sociocultural approaches to education can more effectively foster students' intellectual skills and attitudes (Rosa & Orey 2011).

Some research related to *Mbojo* (Bima) culture has been done before by Nurbaeti et al. (2019). This research examines tembe *nggoli* (sarong) woven by the people of Bima and Dompu. This study concluded that in Bima sarong there are geometry concepts that can be used as learning resources. The same thing was done by Mubin (2016) and Amalia et al. (2021). This research focused on the woven motifs of Bima City and Regency. The results of this study concluded that the Bima weaving motif has undergone many developments, but regional motifs still dominate it. Different from previous research, Sutarto et al. (2021) conducted a broader research than before. The focus of this research is on Mbojo tembe, uma jompa (jompa house), and the buying and selling of Mbojo people. The results of Sutarto et al. research concluded that in tembe Mbojo and *uma jompa* there are geometry concepts, and in the buying and selling activities of the Mbojo community, the concept of measurement is found.

Learning mathematics by involving local wisdom weaving has been proven to be able to improve students' mathematical abilities and skills as well as being able to improve students' positive attitudes, especially in appreciating and upholding local culture. This has been widely proven from the results of studies related to mathematics and culture (ethnomathematics). Using local culture in learning mathematics can make it easier for students to understand mathematical concepts. (Fitriza et al. 2020; Isnaniah & M. Imamuddin, 2022). For this reason, the use of Bima weaving in mathematics learning for local students (students in the Bima area) is very important to implement.

The difference between this research and previous research lies in the focus of the research. This research focuses on exploring mathematical concepts found in various types of bima weaving motifs. Therefore, it was necessary to reveal the mathematical concepts in Bima weaving to facilitate teachers'

mathematical education. This research is to enrich the study of ethnomathematics. In addition, it describes the mathematical features or characteristics of Bima weaving.

## 2. METHODS

This study was an ethnographic research. This study investigated the mathematical concepts discovered in *muna Mbojo* (Bima weaving). This research was conducted in early 2023 in Bima district. The subject of this research is Bima weaving with *bali* motif (line motif), wunta motif (flower motif), and *kakando* motif (bamboo shoot motif). The selection of the bali motif, wunta motif, and *kakando* motif is based on the consideration of the many people who use this motif in various social activities. Data in this study were obtained from documentation and observation.

The scholars gathered a collection of documents pertaining to Bima weaving themes. The researcher opted for weaving designs commonly employed by the majority of the Bima population throughout various communal engagements, including wedding parties, traditional gatherings, religious ceremonies, and similar occasions. The researcher proceeded to conduct thorough observations pertaining to the mathematical notions embedded inside each motif, utilising the acquired documents as a basis for analysis. The analysis involved a systematic comparison of multiple instances that were closely associated with the themes present in the woven fabric. The data collection process involved the utilisation of an observation sheet.

Furthermore, researchers conducted data analysis, The analysis was carried out with the following steps; data generated from documentation and in-depth observations, then described as is to then select the data needed according to research needs and discard data that is not needed (data reduction). The next step is to arrange and organise the data so that it can be well organised and meaningful (data presentation), which is then draw conclusions (Sugiyono, 2017). This conclusion is the result of the answer to the research question.

## 3. FINDINGS AND DISCUSSION

### *3.1 Findings*

The results of this research began with the collection of documents in the form of *Muna Mbojo* (Bima weaving). Based on the documents collected, motifs that are commonly used by the community in everyday life were selected. Furthermore, in-depth observations were made of the documents to see the mathematical concepts contained in the weaving.Based on the documents collected, several Bima weaving motifs were obtained along with the mathematical concepts contained in them. The Bima weaving motifs include the *bali* motif, *wunta* motif, and *kakando* motif.

#### 3.1.1 Bali motifs (Line motifs)

The *bali* motif is typically used on woven fabrics such as *tembe nggoli* in Bima weaving (sarong). On the woven Bima sarong, there are two types of line motifs namely *bali mpida* and *bali lomba*.

#### 3.1.1a. *Bali mpida* motif (Small line motif)

*Bali mpida* is a small striped pattern that forms a square or rectangle. This motif frequently appears on Bima sarong-weaved cloth, or what the Bima call *tembe bali mpida* (sarong with small stripe motifs).

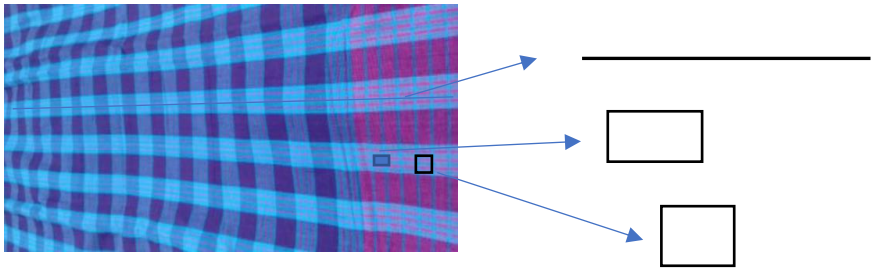

**Figure 1.** *Bali mpida* motif (small line motifs)

This motif of *bali mpida* contains three mathematical concepts. Included among the existing mathematical concepts are lines, rectangles, and squares.

### 3.1.1b. *Bali lomba* motif (Outline motif)

Similar to the *bali mpida* (small outline) motif, the *bali lomba* (outline) motif is commonly discovered on *tembe* woven fabrics or is referred to as the tembe *bali lomba* motif (sarong with outline motifs). The *bali lomba*/outlines are composed of large lines and squares.

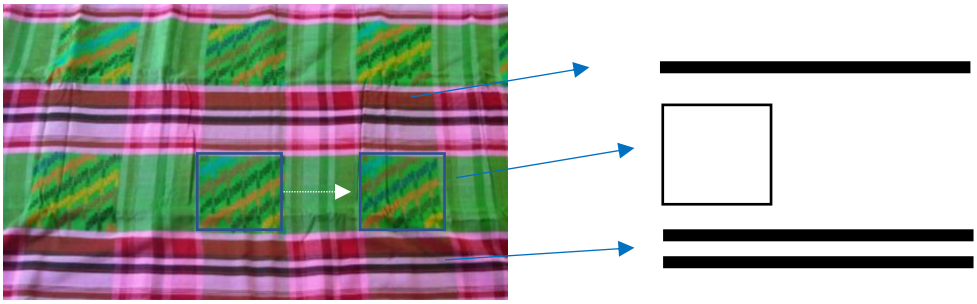

**Figure 2.** *Bali lomba* motif (Outline motif)

There are two mathematical concepts in the *bali lomba* motif. Existing mathematical concepts include parallel lines, squares, translations/shifts, and lines.

### 3.1.2 *Wunta* motif (Flower motif)

In the original Bima weaving, in addition to the line designs, *wunta* motifs (flower motifs) also exist. Bima's original weaving includes the following floral motifs and mathematical concepts namely *wunta aruna, wunta samobo, and wunta Satako.*

### 3.1.2a. *Wunta aruna* motif (Pineapple flower motif)

The *wunta aruna* motif replicates the flower discovered in the original Bima weaving, specifically the pineapple flower.

**Figure 3.** *Wunta aruna* motif (Pineapple flower motif)

In this original Bima weaving, particularly in the pineapple flower motif (*wunta aruna*), a mathematical concept is represented by isosceles triangles, sigsag lines, and parallel vertical lines.

### 3.1.2b. *Wunta samobo* motif (One flower motif)

The *wunta samobo* motif is a floral motif used in the original weaving by Bima. This *wunta samobo* design is a floral motif (a flower motif).

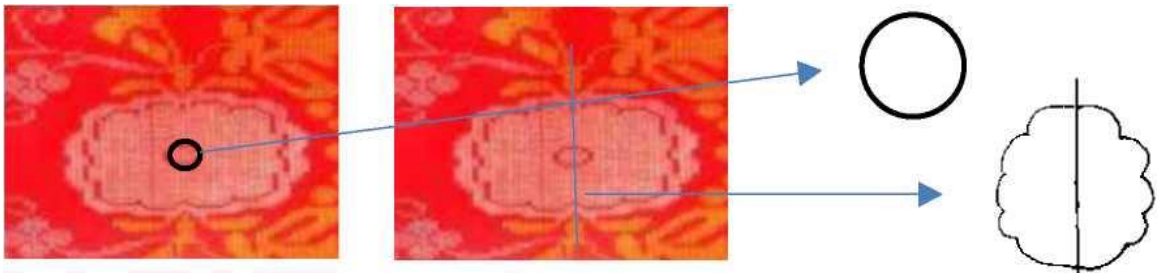

**Figure 4.** The *wunta samobo* motif (a single flower motif)

Existing mathematical concepts in this motif include the concept of the circle and the concept of symmetry.

### 3.1.2c. *Wunta Satako* Motif (Spring Flower Motif)

The *wunta satako* pattern is characteristic of Bima weaving. In Indonesian, the *wunta satako* motif signifies a single flower

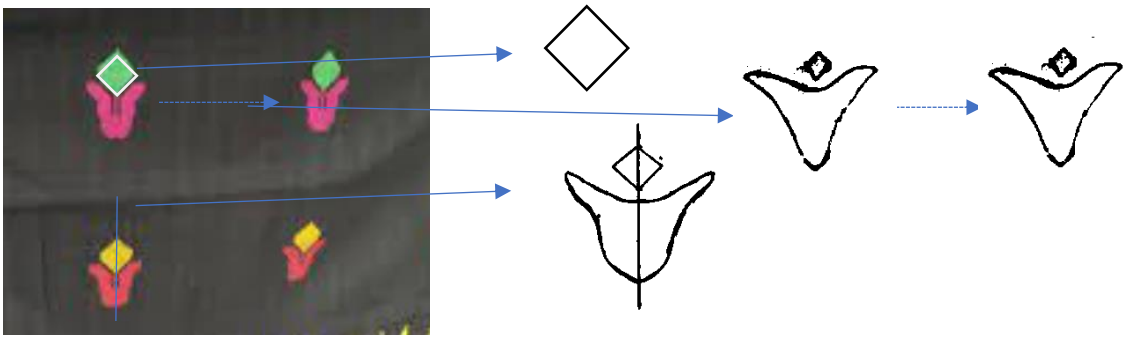

**Figure 5.** *Wunta satako* motif (Spring Flower Motif)

In the picture above, this *wunta satako* motif contains a mathematical concept, namely the rhombus concept, translation, reflection, and the concept of symmetry.

### 3.1.3 Plant Motifs

In addition to the motifs mentioned above, Bima's original weaving also features plant motifs. Existing plant motifs are *kakando* motifs (bamboo shoots motifs). The *kakando* motif is comprised of bamboo shoot replicas.

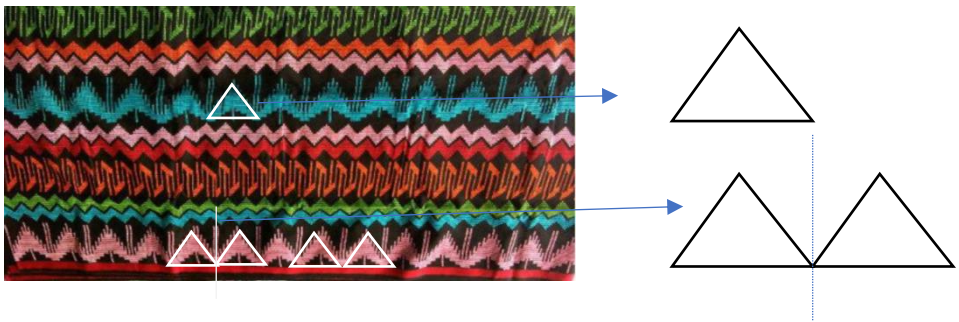

**Figure 6.** *Kakando* motif (Bamboo shoots motif)

Bima weaving with the *kakando* (bamboo shoot) motif contains several mathematical concepts. Mathematical concepts include the triangle concept, symmetry, congruence, translation, and reflection. Table 1 Summarises the mathematical concepts present in *muna mbojo* as a whole.

**Table 1.** Mathematical Concepts Discovered In *Muna Mbojo* (Bima weaving)

| No | Motif | Math Concept |
|---|---|---|
| **1** | *Bali* motif (lines motif) | Lines, rectangles, squares, parallels |
| **2** | *Wunta* motif (flower motif) | Lines, sigsag/curved lines, angles, triangles, rhombuses, circles, alignments, symmetries, translations/shifts, and reflections |
| **3** | *Kakando* motif **(**bamboo shoot motif**)** | Triangular, symmetry, congruence, translations, and reflections |

Based on Table 1 above, the mathematical concepts found in the *bali*, *wunta*, and *kakando* motifs are very diverse. These mathematical concepts include line, curved line, rectangle, square, triangle, rhombuses, circles, alignments, symmetries, translations, and reflections.

### *3.2 Discussion*

Songket weaving is the product of indigenous Indonesian community activities, and *songket* weaving is referred to as weaving. Weaving is a local tradition passed down from generation to generation (Isnaniah et al., 2022). Spinning threads, which then become and produce woven fabrics, is a technique and set of tools utilised in weaving (Guslinda & Kurniaman, 2016). The indigenous knowledge or culture of the Indonesian people is weaving. In numerous regions of Indonesia, indigenous knowledge and weaving culture are prevalent. Each location has distinct traits or characteristics of its woven items, which imparts cultural significance to the finished weaving.

*Muna mbojo* is one of the weavings in Indonesia (Bima weaving). Bima weaving has evolved, particularly in terms of its motifs. Ancient times were characterised by a prevalence of line motifs, whereas a profusion of patterns and motifs characterises modern times. The introduction of Islam to Bima was a pivotal moment in the evolution/progress of Bima weaving (Amalia et al., 2021). At that time, the Bima Islamic Palace commissioned the community to produce woven Bima motifs. In contrast, weavers in the past selected woven patterns based on Islamic norms and values (Amalia et al., 2021). Integrating local culture with Islamic laws is part of the way of Islamic da'wah, (Nomay & Jamain Warwefubun, 2021). Such as *tembe sambea kai* (prayer sarong) uses only stripe patterns. The Islamic sultanate of Bima forbade animal and human motifs, while plant motifs were permitted. This is since it is believed that the Bima community will again adhere to the ancient doctrines, especially worshipping supernatural powers and spirits (Amalia et al., 2021). The development of the Bima woven fabric accelerated after 1986. It has since citizens of the Bima Islamic Sultanate and the wider public utilise Bima weaving. This resulted in the rapid evolution of Bima weaving with several new designs. Bima weaving is now a cultural product and economic driver for the community (Suwandi & Sunarya, 2021).

Using context to learn mathematics is highly recommended. Utilising local/cultural knowledge to learn mathematics is one way to implement learning within this context. Incorporating culture into mathematics education facilitates student comprehension of mathematical topics. By exhibiting a culture of students familiar with their lives, it is possible to make learning relevant for pupils (Moh. Zayyadi, 2017).

Understanding mathematical concepts is enhanced when culture is incorporated into the learning process. They incorporate local culture/wisdom into mathematics learning within the framework of visualising mathematical concepts (Bishop, 1979), making it easier for students to comprehend mathematical concepts (Moh. Zayyadi, 2017; Fitriza et al., 2020; Isnaniah et al., 2022; Isnaniah & M. Imamuddin, 2022). According to Rosa & Orey (2011), a sociocultural approach to learning can foster students' intellectual development and positive attitudes. It was clear that learning mathematics by incorporating local knowledge and student culture, such as Bima weaving, can assist students in comprehending mathematical ideas.

Mathematical concepts are abstract notions used to categorise multiple/a group of objects (Skemp, 1987; Soedjadi, 2000). The concept's comprehension is crucial for students. The teacher may

employ media, *songket* weaving motifs (Isnaniah & Imamuddin, 2020; Moh. Zayyadi, 2017; Isnaniah et al., 2022), new learning approaches (Susanto, 2009; Imamuddin et al., 2019), and others to help pupils comprehend the subject. The use of learning media, such as weaving, can also be implemented so long as the teacher understands both the concepts contained in the weaving motifs used as media and the concepts contained in the Bima weaving motifs.

The purpose of the Bima motif's introduction to mathematical concepts was to make it easier for teachers to communicate mathematics-related content. According to the study, the Bima weaving motif contains the notions of lines, zigzag/curved lines, angles, triangles, rectangles, squares, rhombuses, circles, alignment, symmetry, translation/shift, and reflection.

According to the conclusions of this study, Bima weaving incorporates various mathematical concepts. This study's findings support and extend those of Prahmana & D'Ambrosio, (2020) and Risdiyanti & Prahmana (2018), in which the concepts of motif formation, and geometry, in addition, transformation were employed. Isnaniah et al. (2022), Sutarto et al. (2021), Nurbaeti et al. (2019), Juano & Jediut (2019), and Zayyadi (2017) discovered that mathematical (ethnomathematics) concepts were present in weaving/community culture. This Bima weaving contains mathematical concepts that can aid or facilitate students' mathematical comprehension and learning. Weaving can also be a springboard for designing mathematics learning (Isnaniah et al., 2022). Students' understanding of Bima weaving will be enhanced since weaving is familiar to them. This finding is consistent with Zayyadi (2017), who stated that learning in students' cultural context can make learning meaningful for them. Adapting learning to the cognitive/thinking development and habits of students, as well as the characteristics of the material, will make it easier to achieve the intended learning goals.

The mathematical concepts used in Bima weaving, such as geometric shapes and the concept of transformation, are primary school mathematics curricula. Thus, Bima weaving can create a contextual and enjoyable learning environment in primary schools. Students are more connected to their culture and can see and comprehend the connections between culture and mathematics (Radiusman & Dwi Juniati, 2022). Learning mathematics by providing cultural touches will have a different impact on students even though the material being studied is the same (Andari et al., 2022).

## 4 CONCLUSION

Bima weaving is a product of the local wisdom of the Bima people. Weaving has become a local community activity. Bima weaving is rich in motifs; weaving motifs that are generally produced by Bima people are bali motifs (lines), *wunta* motifs (flowers), and *kakando* motifs (bamboo shoots). In these motifs, many mathematical concepts are found, such as line, zigzag/curved line, angle, rectangle, square, triangle, rhombus, circle, alignment, symmetry, translation/shift, and mirroring. These mathematical concepts found in Bima weaving can be used by teachers to help or facilitate elementary school students in learning and understanding mathematical concepts. Learning mathematics will be more meaningful if teachers are able to involve students' culture in constructing their knowledge in the learning process. Recommendations for future researchers are the need to look at the use of Bima weaving as a learning resource in studying mathematics at school. This is none other than as a form of developing students' character in accordance with local culture and also as a form of preserving local culture.

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