



## Ethnomathematics of *Kluwung* Weaving as Learning Material for Mathematics Elements of Geometry and Measurement

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### Abstract

Ethnomathematics is a branch of mathematics that bridges the abstraction of mathematical concepts with their contextualization in culture or everyday life. This study aims to reveal ethnomathematics in the making of the *kluwung* motif woven fabric in Banyuwangi as a mathematics learning material, especially in the elements of geometry and measurement. The study was conducted in a qualitative framework with an ethnographic approach, in Jambesari village, Banyuwangi, which is the residence of the only woven fabric maker in Banyuwangi. This confirms that the informant in this study is only one, so data collection was carried out through observation, interviews, and documentation, which were validated in the form of time triangulation. Data analysis was conducted qualitatively using the Miles & Huberman method. The research results show that there is ethnomathematics in the *kluwung* woven fabric motif, namely two-dimensional shapes, three-dimensional shapes, and measurement (length and time). These results support the contextualization of mathematics learning in the elements of geometry and measurement, especially in phases A and B. Furthermore, combinatorics and arithmetic concepts were also discovered. The results can be further developed as materials and media in mathematics learning according to the intended learning outcomes.

### Keywords:

Contextual Mathematics

Elements of Geometry and Measurement

Ethnomathematics

*Kluwung* Motif Woven Fabric

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## INTRODUCTION

Indonesia boasts cultural diversity in languages, house construction, food, clothing, traditional ceremonies and rituals, as well as in the arts, including music, dance, weaving, carving, traditional textiles, and more. This diversity demonstrates that differences do not divide, but rather enrich the nation through its diverse cultures. Culture is a way of life or habit that develops, is owned by a certain group of people, and is passed down from generation to generation (Herlince et al., 2021), and becomes a difference and habit in every place that is continuously preserved from generation to generation (Manik et al., 2022). As technology advances, Indonesian cultures are fading, and people's lives are changing, with the current generation tending to neglect their own. One way to prevent the decline of Indonesia's cultural diversity is to integrate culture into learning, such as in mathematics.

Mathematics used in culture is known as ethnomathematics. D'Ambrosio introduced ethnomathematics as a program that studies aspects of mathematics in culture (Rosa & Shirley, 2016), recognizing the various ways in which academic mathematical knowledge is used in the practical lives

of culturally diverse societies. However, ethnomathematics concepts themselves need to be identified before they can be used in learning programs. This is emphasized by Rosa and Gavarrete (2017), who explain that a process of investigation is needed into mathematical ideas, procedures, and practices contained in various cultural groups before they are used in learning programs. Investigation is necessary to recognize the existence of various mathematical ideas, procedures, and practices in cultures and to determine their suitability for the mathematics learning process.

Ethnomathematics needs to be explored to help build meta-awareness about the role of mathematical concepts in society and culture (Rosa & Gavarrete, 2017). Understanding the role of mathematics in society and culture can be integrated into learning. This will make mathematics seem more human and easier to understand for anyone who learns it. D'Ambrosio (2016) emphasized that ethnomathematics can be brought into schools to: (1) eliminate elements that make the myth of mathematics as something that can only be understood or learned by certain people; and (2) illustrate the achievements of various civilizations, cultures, societies, professions, and genders. Furthermore, the results of the ethnomathematics exploration can be used as material for contextual mathematics learning (Herlince et al., 2021). These opinions emphasize the need to identify ethnomathematics before integrating it into mathematics learning.

One of Indonesia's cultural traditions that incorporates ethnomathematics is woven fabric. Indonesia is known for producing woven fabrics that vary in materials, colors, motifs, and manufacturing processes. Woven fabric is a piece of fabric made from threads tied together to form a pattern and then woven (Herlince et al., 2021). Panggabean (in Manik et al., 2022) explains that woven fabric is the result of a crossing process between cross-directional threads called *lungsi* (warp) and combined with wide-directional threads called *pakan* (weft) based on a certain weaving pattern. Hamidi (in Khoiriyah et al., 2020) explains that woven fabrics possess a diversity of motifs, representing the basic forms of human thought and embodying the decorative motifs of all forms of God's creation, such as humans, animals, plants, mountains, rocks, clouds, and other natural phenomena, as well as the products of human creativity. Therefore, motifs in woven fabrics can be understood as arrangements of patterns that contain specific decorative motifs on the fabric's surface, resulting in beautiful shapes.

Woven fabrics are highly valued in their production process, embodying philosophical and symbolic meaning. Woven fabrics are commonly worn as regional or traditional clothing, and are used for activities such as weddings, the inauguration of traditional leaders, traditional ceremonies, funerals, and other events (Manik et al., 2022). One of the ethnic groups in Indonesia that still preserves the culture of woven fabrics is the *Using* people of Banyuwangi. The uniqueness of Banyuwangi woven fabric lies in its patterns and motifs, which differ from those of other regions. Consequently, Banyuwangi woven fabrics are very expensive due to the complex process, the different materials used, and the distinctive motifs that characterize Banyuwangi (Khoiriyah et al., 2020).

Unfortunately, not many people are engaged in weaving in Banyuwangi. Currently, only one weaver remains in Banyuwangi, Mrs. Siyami. She learned weaving from her mother, also a traditional weaver, in the 1960s. Her woven fabrics are made in the form of *gendongan* (slings) consisting of five motifs: *kluwung*, *solok*, *boto*, *lumut*, and *gedokan*. However, she currently only produces *kluwung* and *solok* motifs.

Previous research on the *solok* motif has shown the presence of geometric plane elements (points, lines, and polygons) and transformations (translation, reflection, rotation, and dilatation) in it (Khoiriyah et al., 2020). The results indicate the presence of ethnomathematics in woven fabrics from Banyuwangi. Furthermore, no exploration has been conducted on the *kluwung* motif. This research focuses on the *kluwung* motif woven fabric, which is still frequently made by Mrs. Siyami. This research is important as an exploration of woven fabrics, particularly in Banyuwangi, while also expanding the diversity of contextual mathematical concepts based on the culture of the *kluwung* woven fabric.

Each piece of woven *kluwung motif fabric* is made by Mrs. Siyami using a traditional, simple tool in the form of a wooden *pangku* weaver, as shown in Figure 1(a), and sold for Rp. 4 million per piece. The woven fabric measures 300 cm × 60 cm and is usually used for births, weddings, and

traditional ceremonies. The woven fabric is made from silk thread, with the work process being entirely manual. The time required to make one piece of woven fabric is approximately one month or more.



**Figure 1.** (a) The Process of Making *Kluwung* Woven Fabric with a *Pangku* Weaver; (b) *Kluwung* Motif Woven Fabric (Author's Documentation)

Figure 1 (b) shows a woven fabric with the *kluwung* motif. *Kluwung*, also known as *kuwung*, means rainbow in Javanese. *Kluwung* woven fabric has four basic colors that resemble the stripes of a rainbow: white, maroon, gray, and pink.

Each piece of *kluwung* woven fabric is rectangular, divided into four regions based on the colors within it. Each region is also a congruent rectangle. This condition forms the basis for ethnomathematics exploration, as it is believed that other mathematical concepts, particularly geometry and measurement, are embedded in the process of making *kluwung* woven fabric.

## METHOD

This research was conducted within a qualitative framework with an ethnographic approach. The researcher served as the primary instrument, assisted by interview guidelines and observation guides as supporting instruments. Data validation techniques were conducted using time triangulation. Data were analyzed qualitatively and the results were used to understand the uniqueness and construct ethnomathematical phenomena in the production of *kluwung* woven fabric. The ethnographic approach was used to examine the cultural process of making *kluwung* woven fabric.

This research was conducted to explore the production of *kluwung* woven fabric in Jambesari Village, Giri District, Banyuwangi, and then identify its ethnomathematics. The research area was determined purposively because it is the residence of Mrs. Siyami, the only *kluwung* woven fabric maker in Banyuwangi. Furthermore, Jambesari Village is the center of the *Using* community and has been designated by the government as a cultural heritage site for the *Using* tribe in Banyuwangi, which is still preserved. Data were collected through observation, interviews, and documentation. The observations and interviews were unstructured, meaning they were not systematically prepared but simply provided with observation guidelines and questions (Sugiyono, 2023). Observations and interviews were conducted to observe the preparation, production, and formation of the motifs on the *kluwung* woven fabric. Documentation included photos, videos, audio recordings, and interview transcripts.

The data were then triangulated to ensure consistency. The triangulated data were analyzed qualitatively using the three-step model of Miles and Huberman (Sugiyono, 2023): data reduction, data presentation, and conclusion drawing. The data collected from the interviews were then transcribed, observation notes were sorted as needed, and documents including photos and videos were sorted to support the information. The data reduction results were then presented in narrative and graphic form. Conclusions were drawn based on the mathematical concepts involved in the preparation, production, and pattern formation of the *kluwung* woven fabric.

## RESULTS & DISCUSSION

### Results

The ethnomathematics exploration process on the *kluwung* woven fabric was conducted from May to June 2025. The informant (Mrs. Siyami) is a *kluwung* woven fabric maker in Jambesari Village, Giri District, Banyuwangi, who has been engaged in woven fabric making since the 1960s. Her experience of more than 65 years has enabled the informant to truly understand the process of making *kluwung* woven fabric, from preparation to completion.

After triangulation and data analysis, it was discovered that informants began preparing the woven fabric by setting up a wooden *pangku* loom with the following components: *gandokan*, *apit*, *suri*, *wliro*, *cincingan*, *usek*, *belabas*, *cacak*, *pemanen*, *pendalan*, *undar*, *jontrok*, *undar*, *gandokan*, *liringan*, *pendalan*, *sumbi*, *suri*, *ulakan*, and *teropong*. The informant also prepared silk thread as the material for making *kluwung* woven fabric, which was chosen for its suitability for weaving. The informant believes that a thicker thread yields a smoother fabric, while a thinner thread yields a rougher and thinner fabric.

Each component of the *pangku* loom has specific characteristics and dimensions. The *pangku* loom, as shown in Figure 2, is used by the weaver sitting on his lap. The loom is made of rectangular wood, measuring 60 cm long and 20 cm wide. Therefore, the *pangku* loom incorporates the concepts of plane geometry and length measurement.



**Figure 2.** Weaving Process with a *Pangku* Loom (Author's Documentation)

A *gandokan* is a tool used to support the weaver's back and to tie the rope, which helps stabilize the weaver's body position while weaving. It also maintains thread tension, ensuring a smooth weaving process and a neat fabric. It helps the weaver maintain a comfortable and stable sitting position while weaving, thus reducing fatigue. The *gandokan* is made of wood and has the shape of a rectangular block or prism with a notch in the center, as shown in Figure 3 (a). It measures 85 cm long, 3 cm wide, and 2 cm thick.



**Figure 3.** (a) *Gandokan* and (b) *Apit* (Author's Documentation)

An *apit* is a tool for rolling up finished woven fabric and also functions as a support for the *gandokan*. Figure 3(b) shows a tubular *apit* made of wood, measuring 75 cm long and 3 cm in diameter. The explanation of the *gandokan* and *apit* shows the concept of three-dimensional geometry and length measurements in both components.

A *sumbi* is a tool used to arrange or organize the threads on a loom before the weaving process. Figure 4(a) shows a rectangular *sumbi* made of wood measuring 75 cm long and 3 cm wide, with all four corners right angles.



**Figure 4.** (a) *Sumbi* and (b) *Suri* (Author's Documentation)

Figure 4 (b) shows a *suri*, a tool used to separate and tidy the upper and lower *lungsi* (threads that run along the loom) during the weaving process. The *suri* is rectangular and made of wood, measuring 50 cm long, 5 cm wide, and having four right angles. The explanation of the *sumbi* and *suri* demonstrates the concept of plane shapes and length measurements in both components.

A *wliro* is a tool used to pound and tighten the threads during the weaving process to create a denser and neater weave. It is made of wood and is shaped like a rectangular block or prism measuring 90 cm long, 5 cm wide, and 1 cm high, as shown in Figure 5 (a).



**Figure 5.** (a) *Wliro* and (b) *Cincingan* (Author's Documentation)

A *cincingan* is a tool used to hold the thread during the weaving process of the *kluwung* woven fabric. Without it, the threads could become messy or untidy. So, this tool is crucial for maintaining thread tension and regularity, ensuring the fabric's patterns and motifs are formed correctly. Figure 5 (b) shows a wooden *cincingan* shaped like a long rod with a pointed end. It measures 95 cm long and 1 cm wide at the non-pointed end. The explanation of the *wliro* and *cincingan* shows that both components incorporate the concepts of three-dimensional geometry and length measurement.

A *usek* is a tool used to straighten threads during weaving, ensuring they remain neat and orderly. It is made of bamboo filled with stones to provide weight, ensuring the thread is pulled and straightened properly. This tool prevents the thread from tangling or falling apart, resulting in a neater woven fabric. Figure 6(a) shows a wooden *usek* shaped like a tube, with a length of 100 cm and a diameter of 2 cm. This explanation demonstrates the use of concepts from three-dimensional geometry and length measurement.



**Figure 6.** (a) *Usek* and (b) *Belabas* (Author's Documentation)

A *belabas* is a tool for locking the ends of the threads on a *kluwung* loom. It maintains the tension and stability of the threads during weaving, ensuring the fabric remains neat and undamaged. Figure 6 (b) shows a *belabas* made of wood in the shape of a rectangle measuring 95 cm long and 2 cm wide, with four right-angled corners. This explanation demonstrates that the *belabas* incorporates the concepts of plane figures and length measurements.

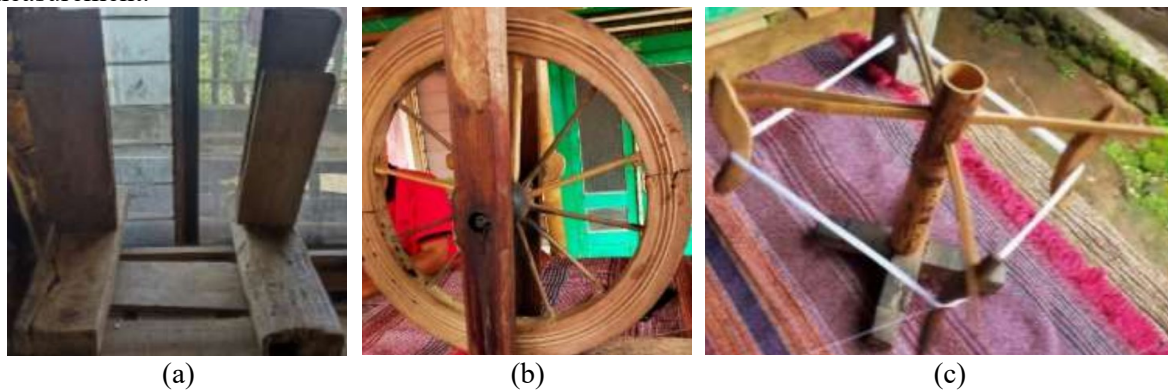
The *cacak* serves to support the loom, keeping the threads woven in an orderly, stable manner during the weaving process. It is positioned on the right and left of the loom, thus helping to maintain balance and neatness. This tool is made of wood and is shaped as a rectangular block or prism, measuring 95 cm long, 15 cm wide, and 10 cm high, as shown in Figure 7(a).



**Figure 7.** (a) *Cacak* and (b) *Pendalan* (Author's Documentation)

A *pendalan* is a tool used to wind the ends of threads during weaving. It helps keep the threads neat and organized, making it easier for the weaver to arrange the *lungs*i and *pakan*. This tool is made of wood and shaped as a rectangular block or prism, measuring 200 cm long, 10 cm wide, and 10 cm high, as shown in Figure 7(b). The explanation of the *cacak* and *pendalan* illustrates the concepts of three-dimensional geometry and length measurements in these two components.

Figure 8 (a) shows a *pemanen*, a tool used to harvest yarn or other materials used in the weaving process. This tool helps cut or collect finished materials for further use. The *pemanen* is made of wood and is shaped like interconnected blocks measuring 50 cm long, 15 cm wide, and 5 cm high. This explanation shows that the *pemanen* includes concepts of three-dimensional geometry and length measurement.



**Figure 8.** (a) *Pemanen*, (b) *Undar*, and (c) *Jontrok* (Author's Documentation)

The *undar* is a pair of *jontrok*. Both work together in the *ngeliring* process (pulling and arranging the *pakan* threads on the loom) to ensure smooth weaving and a neat arrangement of threads. Figure 8 (b) shows a circular wooden *undar* with an outer diameter of 50 cm, used to pull and rotate the *ulakan*. The inner diameter is 40 cm, and the wall thickness is 5 cm. *Undar* is supported by two upright block-shaped frames measuring 50 cm long, 5 cm wide, and 2 cm thick. The description shows the concepts of two-dimensional and three-dimensional shapes and measuring length.

*Jontrok* is paired with the *undar*. *Jontrok* is made of wood and consists of several components, with a main frame located in the center, a tube measuring 30 cm in height and 3 cm in diameter. The main frame is connected to wooden frames on all four sides, each 25 cm long, as shown in Figure 8(c). The wooden frame holds the thread as it is threaded around the *jontrok*. One spool of thread is wound around the *jontrok* 10 times until it is used up. The length of the thread connected to each corner of the *jontrok* is 25 cm. This means the *jontrok*, once threaded, has a square shape with a circumference of 100 cm. A spool of thread wrapped around a *jontrok* is used up in 10 turns, meaning each spool is 1000 cm long, or 10 meters. This description shows the concepts of two-dimensional and three-dimensional shapes and measuring length in the *jontrok*.

Figure 9(a) shows a *teropong* (telescope), a tool for viewing details of the threads being woven, so that the weaver can ensure that the weaving results match the desired pattern. This tool is made of wood and is tubular, measuring 20 cm long and 2 cm in diameter.

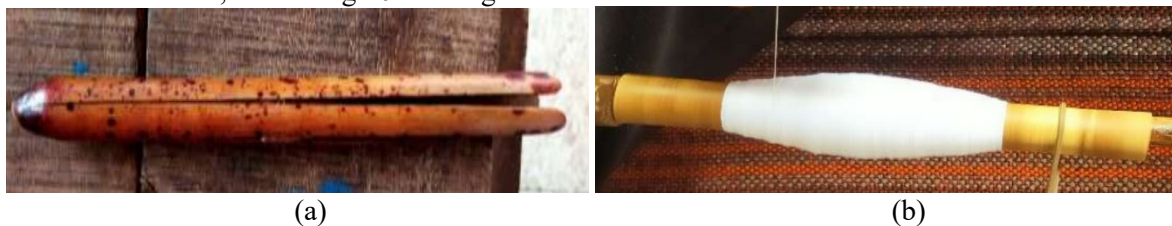


Figure 9. (a) *Teropong* and (b) *Ulakan* (Author's Documentation)

*Ulakan* is a tool for pounding or smoothing woven or rolled thread. It helps smooth and tidy the thread that will be woven. Figure 9(b) shows a wooden *ulkn* shaped as a tube, with a length of 15 cm and a diameter of 1 cm. The explanation of *teropong* and *ulakan* includes the concepts of three-dimensional shapes and length measurement.

In addition to the weaving tools, silk thread is also prepared as the material for making *kluwung* woven fabric. Three thread colors are used: maroon, white, and black. The thread requirement for making one sheet of *kluwung* woven fabric is 50 rolls. One roll of thread can be converted to 10 meters. The thread used in the weaving process is divided into two parts: the *lungsi* thread (that stretches across the loom) and the *pakan* thread (inserted crosswise into the *lungsi* thread). This description shows that woven materials involve measuring length.

The making of *kluwung* woven fabric involves five processes: *ngeliring*, *nyukiti*, *mani*, *mulung*, and weaving. *Ngeliring* is the process of making *kluwung* woven fabric, which involves arranging and laying out the *pakan* threads before weaving. It is the process of separating and grouping the *pakan* threads so that they are ready to be inserted into the loom. The *pakan* threads that have been *liring* are then rolled. The threads are then separated and grouped one by one so that the *pakan* threads are easily arranged and inserted into the loom. After being separated, the *pakan* threads are rolled, then inserted into the loom to be woven together with the *lungsi* threads. This process is very important to ensure the *pakan* threads are neatly arranged, so that the weaving process runs smoothly and produces high-quality weaving.

The *ngeliring* process begins by arranging a roll of thread into the *jontrok* until it is used up, then the thread is pulled in a rotating manner on the *ulakan* assisted by the rotation of the *undar*. This process is carried out by continuously rotating the *undar* until the thread in the *jontrok* is used up and all of it is installed on the *ulakan*, as shown in Figure 10 (a). The *undar* is circular, with an outer diameter of 50 cm, and each turn has a circumference of 314 cm. This means that each turn of the *undar* pulls the

thread on the *jontrok* by 314 cm. If the total length of the thread attached to the *jontrok* is 1000 cm, then the thread will run out on the fourth turn of the *undar*. Thus, the *ngeliring* process includes the concepts of division, circumference, and length measurement.

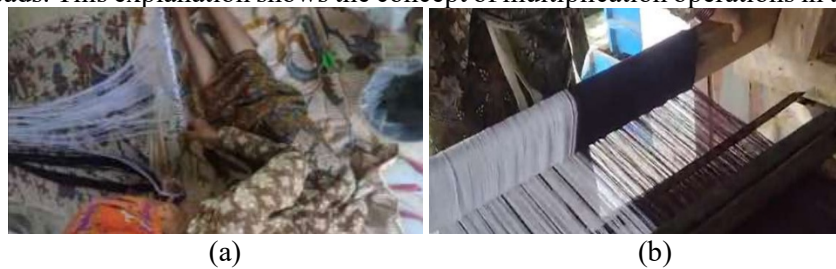


**Figure 10.** (a) The Process of *Ngeliring Pakan* Threads and (b) The Process of *Nyukiti Lungsi* Threads (Author's Documentation)

*Nyukiti* is the process of inserting the *lungsi* threads into a *suri* (comb). This process ensures the *lungsi* threads are arranged in an orderly fashion and ready for the next weaving process. Once the *lungsi* threads have been prepared and arranged on the loom, they are inserted one by one into the *suri*, which maintains proper spacing between the *lungsi* threads during weaving. Each strand of *lungsi* thread passes through a gap in the *suri*. The process also involves smoothing the threads to prevent tangles and prepare them for the next weaving. This process is a crucial part of loom preparation, ensuring the *lungsi* are aligned and ready to be combined with the *pakan* threads in the weaving process.

The *Nyukiti* process begins by winding the thread onto the *usek*. The thread is then pulled and attached to the *suri*, as shown in Figure 10 (b). The thread is pulled through the gaps in the *suri*, *pinched as many as 700 times*, and tied on both sides, back and forth, to ensure it is firmly attached to the *suri*. This process is repeated until the gaps in the *suri* are filled with thread. This explanation shows that the *nyukiti* process includes multiplication operations.

Figure 11(a) shows the *mani* process, the process of spinning the ends of the threads on a *cincingan*. *Mani* is done on a skewered thread. One skewer contains 10 knotted threads, which are then inserted into the *cincingan*. *Mintal* resembles tying a slip knot that can later be easily untied. The number of knots on the *cincingan* is estimated at 70, because there are 700 *cukitan* of thread, where each *pintal* contains 10 threads. This explanation shows the concept of multiplication operations in the *mani* process.



**Figure 11.** (a) *Mani* Process and (b) *Mulung* Process (Author's Documentation)

*Mulung* is the process of lifting and separating the *lungsi* threads to insert the *pakan* threads. This process is essential for forming the fabric's pattern and weave. *Mulung* is part of the weaving process that ensures the *lungsi* threads are properly separated, keeping the weave neat. *Mulung* begins by pulling the thread on the *cincingan* and winding it around the *pendalan*, as shown in Figure 11 (b). The *Pendalan*, which has been threaded, is rotated forward until the thread is pulled taut. *Pendalan* has a width of 10 cm and a height of 10 cm, so its circumference is 40 cm. This means that each round of the *pendalan* rolls 40 cm of thread. The *pendalan* rolls the thread and leaves the length of the loom (about 60 cm). This means that if the attached thread is 300 cm long, it will rotate 6 times: the length of

the loom is 60 cm, the thread in the pendalan in one round is 40 cm, and the remaining thread that extends is 240 cm. This shows that the *mulung* process includes concepts such as division, subtraction, perimeter of a rectangle, and length measurement.

The weaving process begins by neatly arranging the *lungsi* threads. The distance between the dividers is made the same, so that the width of the woven product is even on the right and left, as shown in Figure 12. The thread connection forward from the end of the weave is approximately 2-3 cm. The process of tightening the weave with the *suri* must be the same, so that the density of the weave is also even. The weave is made according to the planned motif and size of the *kluwung* woven fabric. Once the *lungsi* threads are tightly spaced, the weave is rolled to the desired size. It takes one month to complete one piece of woven fabric. This shows that the concept of measuring length and time is in the weaving process.



**Figure 12.** *Kluwung* Motif Fabric Weaving Process (Author's Documentation)

Each weaving process produces only one piece of Banyuwangi *kluwung* woven fabric. The name "kluwung" translates to "rainbow," as the fabric contains four colors arranged in a rainbow-like pattern. This motif is a cultural heritage of the *Using* people of Banyuwangi, characterized by bright, colorful patterns and straight, elongated lines in various colors, making it easily recognizable. *Kluwung* woven fabric not only has aesthetic value but also high cultural significance, as it is often used in various traditional ceremonies, such as weddings and welcoming the birth of a baby. A small piece of *kluwung* woven fabric is 150 cm long and 30 cm wide, while a large piece is 300 cm long and 60 cm wide.

Figure 13 shows a rectangular motif in *kluwung* woven fabric that is congruent according to its color distribution. In one fabric, three thread colors are combined: maroon, white, and black. This combination produces four colors: maroon, pink (a combination of maroon and white), white, and gray (a combination of black and white). This shows that the *kluwung* motif embodies the concepts of rectangles, length measurement, and combinatorics (combinations).



**Figure 13.** *Kluwung* Motif Fabric Woven (Author's Documentation)

## Discussion

This research explores the process of making *kluwung* woven fabric, from preparation to completion. This exploration revealed the need for tools and materials for making *kluwung* woven fabric. The primary tool used is a *pangku* loom with various supporting components. Each component has its own function and cannot be substituted for the others. The *pangku* loom is a traditional tool used with the weaver sitting on the floor. Traditional looms are still widely used in various regions of Indonesia. Generally, it is called *gedogan* (Nuraini & Falah, 2022), and they take months to produce a single piece of beautiful woven fabric. This is why *kluwung* woven fabric is quite expensive.

The main materials used to make *kluwung* woven fabric are maroon, white, and black silk threads. Silk thread is used specifically in the weaving process in several areas, such as Wajo, Sulawesi (Firdaus, 2021; Ja'faruddin et al., 2025) and Garut (Maylindah et al., 2023). Silk thread is generally used as a material for certain woven fabrics used specifically for traditional/cultural activities.

The tools and materials used in making *kluwung* woven fabric include concepts of two- and three-dimensional geometry and length measurement (standard and non-standard units). The concept of two-dimensional geometry is presented in rectangles on *sumbi*, *suri*, and *belabas*, and circles on *undar*. The three-dimensional geometry concept is presented in blocks on *gandokan*, *wliro*, *cacak*, *pemanen*, and *pendalan*, and as tubes on *apit*, *usek*, *jontrok*, *teropong*, and *ulakan*. Length measurements in centimeters were obtained on the *pangku*, *gandokan*, *apit*, *sumbi*, *suri*, *wliro*, *cincingan*, *usek*, *belabas*, *cacak*, *pemanen*, *pendalan*, *undar*, *jontrok*, *teropong*, and *ulakan* looms, the lengths of which have been determined. Informants understand the concept of length as a measure that must be used without making direct measurements. The concept of measuring length with non-standard units is obtained in determining the number of threads used, namely, the unit of rolls. One roll can be converted to 10 meters.

The making of *kluwung* woven fabric involves five sequential processes. The process incorporates arithmetic and measurement concepts. Arithmetic concepts are derived from the operations of addition, subtraction, multiplication, and division. These concepts are evident in the *ngeliring* (winding the thread on the *jontrok*), *nyukiti* (attaching the thread to the *suri*), *mani* (spinning the thread on the *cincingan*), and *mulung* (winding the thread on the *pendalan*). The concept of measurement is obtained in the context of length, the circumference of two-dimensional shapes, and time. Measurements in centimeters are taken during the *ngeliring* (installing thread on the *jontrok*) and *mulung* (winding thread on the *pendalan*) processes. The circumference of a circle is measured during the *ngeliring* (installing thread on the *jontrok* with the help of an *undar*) process. The circumference of a rectangle is measured during the *mulung* (winding thread on the *pendalan*) process. Time is measured during the weaving process, which takes at least one month to produce a piece of *kluwung* woven fabric.

This summary is one of the novelties in this study because no previous research has revealed the ethnomathematics of tools, materials, and the manufacture of woven fabrics. This needs to be strengthened in subsequent research to obtain more valid results. However, in general, it can be seen that the concepts of geometry and measurement are found in the process. The woven product in the form of a *kluwung* motif contains the concept of a rectangle (the shape of the fabric and the color division area), measuring length in centimeters (the length of the fabric), and combinatorics (the combination of thread colors to create a rainbow color in the *kluwung* motif).

Previous research has revealed that the *Lipa Kaet* woven fabric motif in East Nusa Tenggara contains the concepts of rectangles, rhombuses, triangles, and hexagons (Rahayu et al., 2020). Research related to *solok* woven fabric motifs in Banyuwangi also found the presence of two-dimensional shapes such as triangles, quadrilaterals, and hexagons combined in the concepts of symmetry and similarity (Khoiriyah et al., 2020). The results of Baidawi et al.'s (2023) research on ethnomathematics in the Oba Agi Oba Pete in East Nusa Tenggara revealed the presence of concepts of rhombuses, hexagons, and rectangles. Zaky and Khotimah's (2024) research also revealed the concept of quadrilaterals (squares, rectangles, rhombuses, kites, parallelograms, trapezoids), triangles, and circles in *Troso* woven fabric motifs from Jepara. These four studies, and many others, support the existence of the rectangular concept

in *kluwung* woven fabric motifs. The results of this study are less diverse than those of others due to the simplicity of the *kluwung* woven fabric motif.

In general, the results of this study support the contextualization of mathematics learning in geometry and measurement elements, even under very limited conditions. In the geometry element in phase A, students are expected to recognize various two-dimensional shapes (quadrilaterals and circles) and three-dimensional shapes (cubes and cylinders), while in the measurement element in phase B, students are expected to be able to measure the length of objects using standard units (Kemendikbudristek, 2024). The limitations of this research are that it can only introduce the concepts of rectangles, circles, cuboids, and cylinders. Measurements of object length are also limited to centimeters. Nevertheless, these limitations are expected to introduce students to their culture further and help them understand that it encompasses mathematical concepts.

## CONCLUSION

This exploration of the making of *kluwung* woven fabric is part of the cultural record. It can serve as a learning experience for students and the general public to better understand and recognize the culture of weaving in Banyuwangi, which is almost extinct. Specifically, the results of the exploration become the basis for identifying contextual mathematical concepts in the culture of making *kluwung* woven fabric. The identification results show that the process of making *kluwung* woven fabric contains mathematical concepts in geometric elements (two- and three-dimensional shapes) and measurement (length and time). In addition, the concept of arithmetic operations and combinatorics was also found, which enriches the contextualization of mathematics in Banyuwangi culture.

## REFERENCES

- Baidawi, M., Khasanah, F., & Una, A. M. W. (2023). Etnomatematika pada Kain Tenun Ikat Oba Agi Oba Pete dalam Masyarakat Nagekeo Nusa Tenggara Timur. *JRPM (Jurnal Review Pembelajaran Matematika)*, 8(2), 85–96. <https://doi.org/https://doi.org/10.15642/jrpm.2023.8.2.85-96>
- D'Ambrosio, U. (2016). Ethnomathematics and Its Pedagogical Action. *13th International Congress on Mathematical Education*, 1-1-1–8. <https://www.mathunion.org/icmi/icme/icme-introduction/icme-13-2016>
- Firdaus, F. (2021). Eksistensi Tennung Walida (Gedogan) kain sutera di Desa Rumpia Kecamatan Majauleng Kabupaten Wajo. *Equilibrium: Jurnal Pendidikan*, 9(3), 366–372. <https://doi.org/https://doi.org/10.26618/equilibrium.v9i3.6059>
- Herlince, I., Tupen, S. N., & Seto, S. B. (2021). Eksplorasi Etnomatematika pada Kain Tenun Ikat Masyarakat Sikka. *Jupika: Jurnal Pendidikan Matematika*, 4(2), 169–180. <https://doi.org/https://doi.org/10.37478/jupika.v4i2.842>
- Ja'faruddin, Khaerati, Aris, F. A., Jelita, Nurdin, N., Qalzum, U. N., Azzahra, A., & Ardiyanti, F. (2025). Ekspolarasi Konsep Fungsi Matematika dalam Pembuatan Kain Tenun Tradisional Wajo. *PROXIMAL: Jurnal Penelitian Matematika dan Pendidikan Matematika*, 8(1), 110–118. <https://doi.org/https://doi.org/10.30605/proximal.v8i1.4898>
- Kemendikbudristek. (2024). *Keputusan Kepala Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 032/H/KR/2024 tentang Capaian Pembelajaran pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Me.*
- Khoiriyah, S. W., Sunardi, S., Yudianto, E., Suharto, & Pambudi, D. S. (2020). Identifikasi Geometri Bidang pada Pola Motif Kain Tenun Solok Banyuwangi. *Saintifika*, 22(2), 50–59. <https://doi.org/https://doi.org/10.19184/saintifika.v22i2.23454>

- Manik, S. Y., Sayu, S., & Munaldus, M. (2022). Identifikasi Etnomatematika pada Kain Tenun Corak Libau Suku Dayak De'sa Kabupaten Sintang. *Jago MIPA: Jurnal Pendidikan Matematika dan IPA*, 2(2), 126–139. <https://doi.org/https://doi.org/10.53299/jagomipa.v2i2.213>
- Maylindah, S., Listya, A., & Sukarwo, W. (2023). Perancangan Buku Informasi Tenun Sutra Garut Sebagai Produk Keberagaman Budaya Tekstil Indonesia. *Cipta*, 2(1), 44–51. <https://doi.org/https://doi.org/10.30998/cipta.v2i1.2008>
- Nuraini, S., & Falah, A. M. (2022). Eksistensi Kain Tenun di Era Modern. *ATRAT*, 10(2), 162–169. <https://doi.org/https://doi.org/10.26742/atrat.v10i2.2106>
- Rahayu, A. P., Snae, M., & Bani, S. (2020). Etnomatematika pada Kain Tenun Lipa Kaet. *MEGA: Jurnal Pendidikan Matematika*, 1(1), 16–24. <https://doi.org/https://doi.org/10.59098/mega.v1i1.178>
- Rosa, M., & Gavarrete, M. E. (2017). An Ethnomathematics Overview: An Introduction. In M. Rosa, M. E. Gavarrete, L. Shirley, & W. V. Alangui (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education*. Springer Nature. <https://doi.org/10.1007/978-3-319-59220-6>
- Rosa, M., & Shirley, L. (2016). Introduction. In G. Kaiser (Ed.), *Current and Future Perspectives of Ethnomathematics as a Program* (pp. 1–4). Springer International Publishing. <https://doi.org/10.1007/978-3-319-30120-4>
- Sugiyono. (2023). *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D, dan Penelitian Tindakan)* (A. Nuryanto (ed.); edisi 3). Alfabeta.
- Zaky, H. M., & Khotimah, R. P. (2024). Etnomatematika: Pengenalan Bangun Datar Melalui Konteks Kain Tenun Troso Jepara. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 8(1), 441–453. <https://doi.org/https://doi.org/10.31004/cendekia.v8i1.2369>