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An Ethnomathematics Exploration: The Beads Basket Craft Context for Mathematics Learning

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Abstract. Mathematics learning will be more meaningful if it uses a cultural context. Therefore an exploration of the mathematical ideas that exist in a culture is needed. The purpose of this study was to determine the fundamental ethnomathematics activities in the process of making beads basket craft and to identify mathematical concepts in beads basket craft. This research is a qualitative research with ethnographic research. The subject of this research is the bead craftsman community in Sungai Tutung, Jambi, Indonesia. The results of this study found that the activity of making bead basket crafts involved counting (e.g. determining the number of colors of each type of bead to be used), locating (e.g. placing beads to make a pattern), measuring (e.g. measuring the length of the rope), designing (e.g. designing bead basket motif), and explaining (e.g. explain the meaning of the motif on the bead basket). In addition, it was also found the concept of geometry and the concept of social arithmetic on the beads basket craft. The researchers recommend using the results of this study in learning mathematics either through direct learning or through the use of learning media.

Keywords: Beads Craft; Culture Context; Ethnomathematics Exploration; Mathematics Learning

Abstrak. Pembelajaran matematika akan lebih bermakna jika menggunakan konteks budaya. Oleh karena itu diperlukan eksplorasi terhadap ide-ide matematis yang ada dalam suatu budaya. Tujuan dari penelitian ini adalah untuk mengetahui aktivitas fundamental etnomatematika dalam proses pembuatan kerajinan keranjang manik-manik dan mengidentifikasi konsep matematika pada kerajinan keranjang manik-manik. Penelitian ini merupakan penelitian kualitatif dengan penelitian etnografi. Subyek penelitian ini adalah masyarakat pengrajin manik-manik di Sungai Tutung, Jambi, Indonesia. Hasil penelitian ini ditemukan bahwa kegiatan pembuatan kerajinan keranjang manik-manik meliputi menghitung (misalnya menentukan jumlah warna tiap jenis manik yang akan digunakan), penempatan (misalnya menempatkan manik-manik untuk membuat pola), mengukur (misalnya mengukur panjang tali), merancang (misalnya merancang motif keranjang manik-manik), dan menjelaskan (misalnya menjelaskan arti motif pada keranjang manik-manik). Selain itu, ditemukan pula konsep geometri dan konsep aritmatika sosial pada kerajinan keranjang manik-manik. Peneliti merekomendasikan penggunaan hasil penelitian ini dalam pembelajaran matematika baik melalui pembelajaran langsung maupun melalui penggunaan media pembelajaran.

Kata kunci: Eksplorasi Etnomatematika; Kerajinan Manik-Manik; Konteks Budaya; Pembelajaran Matematika

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INTRODUCTION

Both education and culture play crucial roles in people's lives. Culture encompasses a set of beliefs and values shared by a specific group of individuals within a particular environment (Riwanto, 2018). It serves as a comprehensive entity that governs social life, including education. Education, on the other hand, acts as a means for the transmission of cultural heritage from one generation to another (Wahyuni, Tias, & Sani, 2013). Essentially, education is a symbolic technology that develops based on specific cultural abilities or environmental activities. Culture influences individual behavior, including the process of learning mathematics. An individual's cultural background impacts their mathematical abilities as they respond in accordance with their feelings and observations (Tandililing, 2013).

Instilling cultural values in individuals from an early age is highly important. This enables them to gain a better understanding, appreciation, and awareness of cultural values in every aspect of life. Cultural values can be nurtured through family, education, and within specific societies. There are three perspectives commonly employed in studying culture: universal culture, which examines the relationship between universal values in science and human life with culture; national culture, which encompasses principles deeply ingrained in Indonesian society; and local culture, which manifests in the daily lives of local communities (Wahyuni, Tias, & Sani, 2013). Indonesia, being a country rich in cultural heritage, is characterized by its diverse and vibrant culture.

Cultural practices facilitate the integration of mathematical ideas and recognize that each individual develops their own unique approach to mathematical tasks, a concept known as ethnomathematics (Fajriyah, 2018). However, many people often underestimate the extent to which mathematics is utilized in their daily lives (Huda, Syazili, & Umam, 2020). Whether it's measuring, calculating, dividing, or other activities, mathematics is fundamentally involved. Unfortunately, society tends to perceive mathematics solely as a subject taught in schools, disregarding its frequent applications across various aspects of life (Abi, 2015). Ethnomathematics, a technique that incorporates local activities and culture, presents a way to enhance people's understanding of mathematics (Sarwoedi et al., 2018).

Ethnomathematics was initially developed by D'Ambrosio, a Brazilian mathematician, in 1977 (Ajmain, Herna, & Masrura, 2020). It focuses on the mathematical activities that emerge within societies (Zayyadi, 2018). These mathematical ideas can be found in historical heritage and handicrafts, such as pottery and traditional tools (Hafifah & Putra, 2021), as well as in temples and inscriptions (Puspitasari & Putra, 2022), batik and embroidery motifs (Yolanda & Putra, 2022), traditional games, settlement patterns, and community housing (Nurfauziah & Putra, 2022), among others. Ethnomathematics offers a sophisticated and dynamic framework that illustrates how cultural factors influence the application of mathematics (Hartoyo, 2012). For example, woven

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motifs exemplify the mathematical aspects found in woven crafts, which originate from various ethnomathematical conceptions (Rencitia & Putra, 2021). These ethnomathematics embedded in woven crafts can serve as effective learning tools, making the learning process more enjoyable (Isnaini, 2019).

Kerinci Regency is renowned for its rich cultural heritage, which includes a wide array of woven crafts such as bamboo, rattan, and pandanus weavings. Among the woven products in Kerinci, bamboo baskets hold a special place. These baskets serve as containers for storing grains or rice that are offered during traditional rituals like weddings, funerals, and other events involving participation or donations to extended family members. Furthermore, woven crafts also contribute to the local livelihood by fulfilling clothing and daily necessities (Puspadewi & Putra, 2014). As time progressed, craftsmen began creating baskets using beads, which serve the same purpose as the traditional woven bamboo baskets.

Weaving is a technique that involves interconnecting or assembling two or more objects or materials by crossing them over one another, ensuring they remain intertwined (Anandhita, 2017). To uncover the mathematical concepts within beading, an in-depth exploration of the beading process and its outcomes is required. This exploration, also known as field exploration, aims to expand knowledge and gain a deeper understanding (Wijaya & Putra, 2020). Exploration is perceived as a journey that seeks to discover new possibilities and broaden knowledge (Koehuan, 2016).

Through exploratory activities, one can uncover previously unknown conditions and expand their knowledge (Indari, Saguni, & Marwany, 2020). Moreover, exploratory activities foster interest in both known and unknown aspects, enabling a more comprehensive and concrete understanding of information (Angraini, 2017). Consequently, this study aims to explore the fundamental activities of ethnomathematics involved in the process of creating bead baskets and identify the mathematical concepts embedded within them.

METHOD

The study utilized a qualitative research method with an ethnographic approach. It was an exploratory research employing the ethnographic approach (Setiana in Febriana, Putri, & Hidayati, 2022). Ethnography is a qualitative analysis technique used to identify, define, and interpret the characteristics of specific cultural groups (Windiani & Rahmawati, 2016). The qualitative approach was chosen to provide a detailed description of the observation process and its outcomes through verbal and visual means, while ethnography was specifically selected to observe and describe the culture within the context of mathematics. The research design and style were selected to cater to the data collection requirements of the bead basket craft, which included verbal and visual

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descriptions. Additionally, a literature review was conducted to establish connections between the craft and mathematical concepts or theories.

The research process involved direct interviews with informants and observations of the bead craftsmen community in a rural area in Kerinci, Indonesia. The data collected consisted of interview results from research informants and observations related to various activities such as counting, measuring, locating, designing, playing, and explaining (Dapa, 2019) within the context of bead basket craft that utilized beads and mathematical concepts. These data were qualitatively analyzed.

The data were described and analyzed using a qualitative research approach in order to obtain descriptive information regarding the bead-making activities and outcomes. Following Miles and Huberman's approach, the qualitative data analysis involved data reduction, data presentation, and drawing conclusions. The researcher selected and focused on the relevant data while simplifying it to derive conclusions that address the research problem formulation.

RESULTS AND DISCUSSION

Activities of Counting, Locating, Measuring, Designing, and Explaining

According to the research findings, several ethnomathematical activities were identified within the process of making bead baskets. These activities include counting, locating, measuring, designing, and explaining.

Counting activities were observed when craftsmen counted the beads used in the basket-making process. The number of beads required depended on the desired motif or design. For example, a cuboid basket with a volume of 2,197 cubic meters would typically need 350 grams of beads. Additionally, when preparing nylon ropes, craftsmen engaged in calculating the number of strands needed to create a single bead basket. Generally, 3-4 small rolls of nylon rope were required, although this could vary depending on the size of the basket. The nylon rope was then cut into 10 strands, each measuring 3.5 meters in length. As the craftsmen completed the basket-making process, they would perform a looping process to tie knots. These knots were essential to prevent the beads from coming loose or getting stuck in the string, which would cause the basket to lose its shape. This knotting process was typically repeated two or three times. Throughout the knotting process, the rope was pinned in a circular manner until it ran out. The more rope ties made, the stronger the resulting webbing would be.

Locating activities were observed as craftsmen positioned the ropes while weaving the beads. They followed specific patterns for placing the strings, as depicted in Figure 1. This pattern was repeated until the desired design for the bead basket was achieved.

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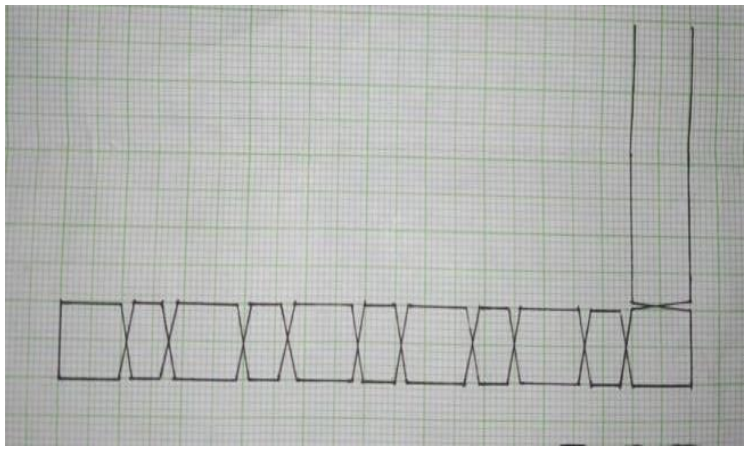

Figure 1. Placement of Nylon Rope

During the bead weaving process, craftsmen carefully consider the size of the beads they use. The size of the beads plays a role in determining the final shape of the basket. Larger beads will result in a larger basket, while smaller beads will produce a smaller one. In Figure 2, the red circle indicates the placement of long beads, while the yellow circle represents the placement of small beads.

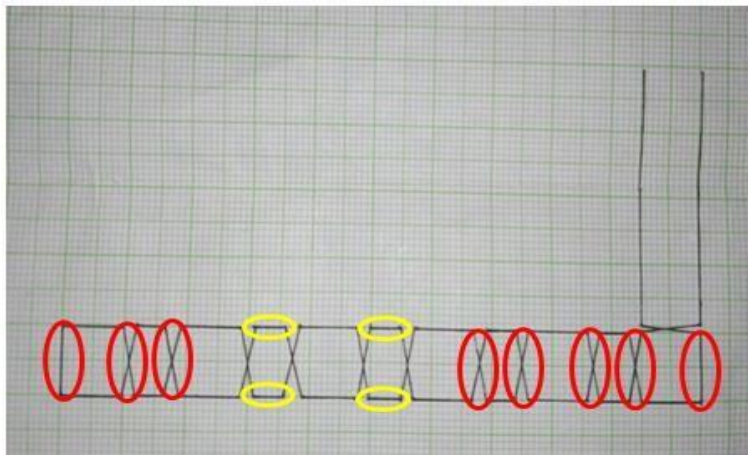

Figure 2. Placement of the Beads by Size

The activity of measuring is crucial when determining the size of the beads used. The size of the beads directly impacts the shape of the resulting basket. If larger beads are used, the basket will also be larger, and vice versa. Additionally, craftsmen also measure the length of the nylon rope. Before the weaving process begins, the rope is cut to a length of 2-3 meters or as desired, ensuring it is not too short. Typically, one small roll of nylon rope measures approximately 10 meters. To create a bead basket craft, three rolls of nylon rope are usually required. Therefore, a total of 30 meters of nylon rope is needed to make a bead basket.

The designing activity comes into play when craftsmen select the shape of the beads to be used. Beads come in various shapes, such as round, oval, square, and more. Based on observations, it was noted that round and oval beads were commonly used in making bead baskets. Craftsmen also

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design motifs for the bead baskets. There are numerous motifs available, including plaid patterns, floral motifs, star motifs, and others. Each motif incorporates beads in a unique shape or pattern.

The activity of explaining is evident in the steps involved in making a bead basket craft. To create a bead basket, craftsmen require beads and nylon string. The necessary tools are gathered before starting the crafting process. The process consists of three stages: preparation, weaving, and finishing. During the preparatory stage, ropes are made and beads are prepared. The weaving stage involves stringing the beads onto the rope following specific procedures. The finishing stage includes tying knots, cutting any excess rope, and attaching handles to shape the woven material into a basket.

Based on the observations, it is evident that the activities of counting, measuring, locating, and designing are integral to the process of creating bead baskets. These activities are present in various aspects of the basket-making process. Counting activities involve determining the quantity of beads, the number of thread strands, the length of the nylon rope, and the repetition of knot-making. Locating activities occur when positioning the rope and placing beads based on their size. Measuring activities are involved in selecting the appropriate bead size and measuring the length of the string. Designing activities take place when choosing the bead shape and designing the motif for the bead basket. However, it should be noted that playing activities are not observed in the steps of making bead baskets.

Ethnomathematical research on various types of traditional weaving has uncovered interesting findings. According to Ariani (2018), counting activities in this context are primarily focused on estimating numbers or sizes. On the other hand, Mawaddah (2018) notes that measuring activities often involve the use of traditional units, which are characterized by diverse terminologies. When it comes to design creation, craftsmen typically incorporate floral motifs and simple geometric shapes into their works (Muslim & Prabawati, 2020). The arrangement of these patterns also plays a crucial role in achieving the desired outcome. In the realm of explanation, craftsmen commonly utilize specialized terms to describe patterns, methods, and forms (Patri & Heswari, 2022). Interestingly, playing activities are not frequently observed in weaving practices. Nonetheless, several studies have explored the strategies employed by craftsmen to overcome challenges such as limited raw materials or seasonal constraints that may impede production (Ilmiyah et al., 2020).

Mathematical Concepts

Based on the research findings, it is evident that the beads basket craft incorporates several mathematical concepts. These concepts can be observed in different aspects of the basket. Firstly, the shape of the basket itself exhibits the concept of a cube. The structure of the basket closely resembles

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that of a cube, with its square sides and equal dimensions. This geometric concept of a cube is evident in the shape and construction of the basket.

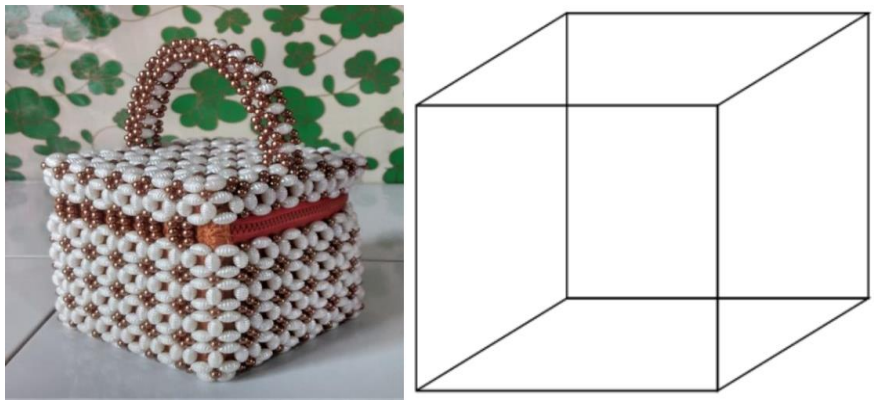

Figure 3. A Cube-Shaped Beads Basket Craft

Secondly, each part of the basket contains the concept of sets. In every section of the basket, there are sets of different beads. The beads are grouped together based on their characteristics, such as size, color, or pattern. This concept of sets is incorporated throughout the basket-making process, organizing the beads into distinct groups.

Thirdly, the base of the basket demonstrates the concept of a flat square shape and exhibits a pattern of square numbers. The base is clearly shaped like a square, meeting all the properties and elements of a square. Additionally, the arrangement of beads on the base forms a pattern of square numbers, further showcasing the mathematical concept.

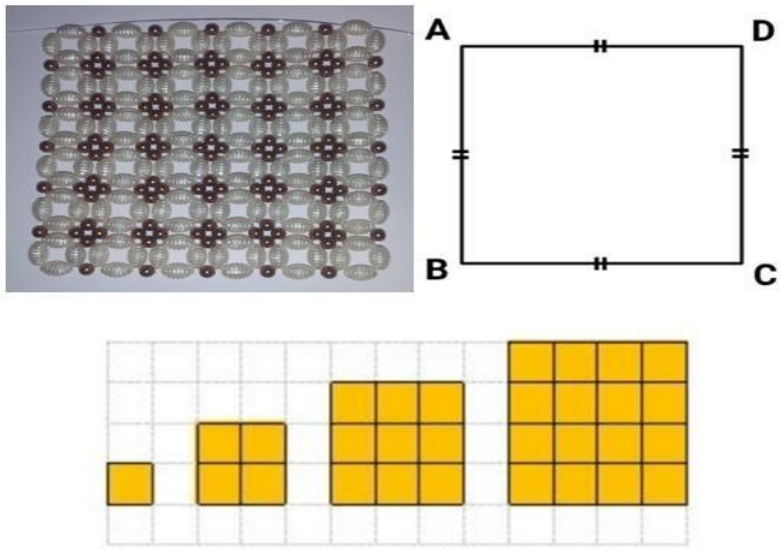

Figure 4. Shape of Beads Basket Craft Base

Fourth, the surface of the basket exhibit the concept of a rectangle. The vertical surface of the basket forms a rectangular shape, emphasizing the mathematical concept of rectangles.

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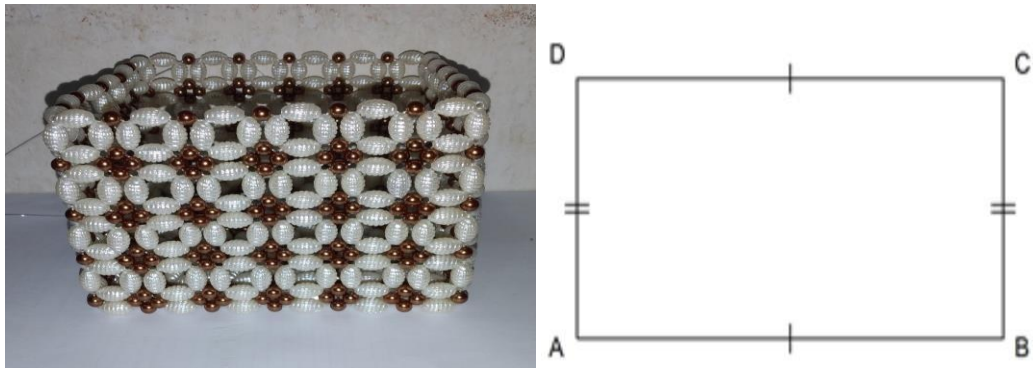

Figure 5. Vertical Surface of Beads Basket Craft

Fifth, there are two geometric concepts in the basket, namely the concept of a rectangular and a circle. The shape of the beam is found after making the basket but not yet attached to the basket lid, while the semi-circle shape is found when the basket rope has been attached to the basket lid.

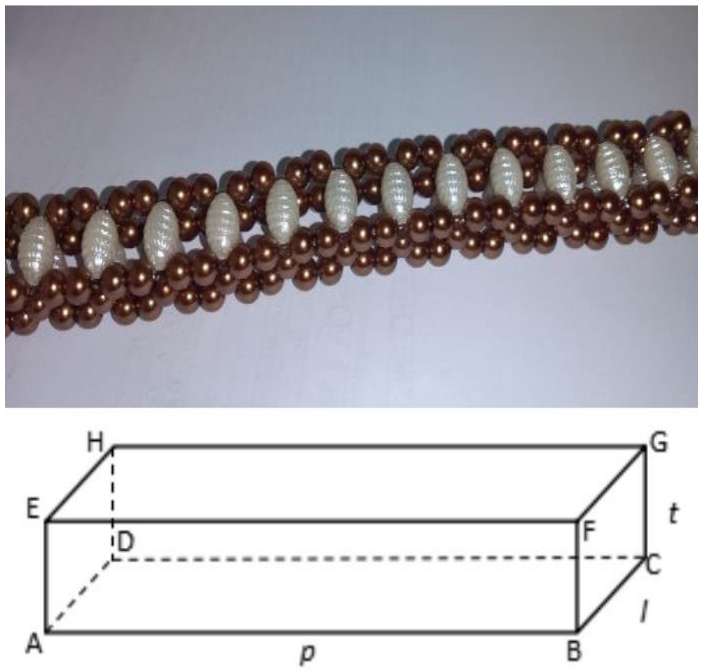

Figure 6. The Basket Stalk before Assembling with Basket Lid

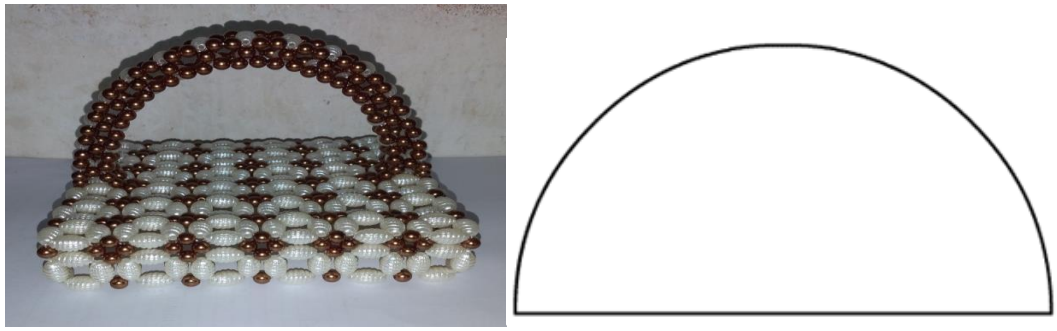

Figure 7. The Basket Stalk after Assembling with Basket Lid

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Furthermore, the process of buying and selling beads baskets involves the calculation of the selling price. The selling price is determined based on the number of beads used and the time required to create the basket. Typically, making a beads basket craft requires 350 to 400 grams of beads, which are valued at Rp. 60,000.00. The time spent making the craft usually ranges from 1 to 2 days, with a value of IDR 35,000.00 per basket. Additionally, the process of attaching the basket lid is valued at Rp. 45,000.00. Therefore, the capital required to create a beads basket craft is approximately Rp. 60,000.00 + Rp. 35,000.00 + Rp. 45,000.00 = Rp. 140,000.00. These costs are taken into account when determining the selling price, which is typically set at around Rp. 170,000.00 per basket.

Based on the research findings, several geometric concepts are evident in beads baskets, including cubes, squares, rectangles, rectangulars, and circles. These concepts manifest in different parts of the basket's structure. Furthermore, the process of calculating the selling price incorporates the concept of social arithmetic, taking into account the materials used and the labor involved in crafting the baskets. Geometry emerges as the predominant mathematical concept within the realm of ethnomathematics and its exploration of woven crafts. This prominence can be attributed to the fact that weaving, as a cultural product manifested in physical objects, lends itself to the incorporation of geometric shapes and patterns, thereby making them readily observable and identifiable (Kartikasari, Rusmana, & Indrawati, 2022).

The utilization of geometric shapes in woven designs provides a visual representation of mathematical principles and serves as a testament to the universality of geometric knowledge across diverse cultures (Unaenah et al., 2020). Geometry, being one of the oldest branches of mathematics, holds a pervasive presence in the collective understanding of various societies worldwide. Its enduring significance and wide-ranging applicability make it a natural choice for weavers to express their creativity and mathematical acumen through the intricate interplay of geometric forms within their woven pieces.

CONCLUSION

The beads basket craft using beads incorporates various mathematical concepts, such as cubes, squares, rectangles, circles, number patterns, sets, and social arithmetic. These concepts are integral to different aspects of the craft. Additionally, there are several ethnomathematical activities involved in the process. Counting plays a significant role in bead basketry, as it involves quantifying the number of beads, strands, and the length of the nylon rope. The craftsmen engage in repetitive knot-making to ensure the beads and ropes are securely fastened. Locating activities are evident in the placement of strings and beads within the basket. Craftsmen strategically position the strings and arrange the beads based on their size, creating visually appealing patterns

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and designs. Measuring activities are essential in bead basketry, as craftsmen carefully select bead sizes and measure the length of the rope. Accurate measurements are crucial to achieving desired outcomes in the craft. Designing activities are prominent in bead basket crafts. Craftsmen make deliberate choices in selecting bead shapes, designs, and motifs, allowing for creative expression and the creation of unique patterns. Furthermore, the activity of explaining occurs during the observation process. Craftsmen explain the ethnomathematical activities and mathematical concepts involved in their craft, providing insights into the mathematical aspects of bead basketry. These ethnomathematical activities and mathematical concepts contribute to the cultural significance and mathematical richness of the bead basket craft using beads.

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