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Ethnomathematics in *bungkalang* and *sarakap* crafts as mathematics learning media

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Abstract

Ethnomathematics is used to explore the presence of mathematics in cultural practices. *Bungkalang* and *sarakap* are Banjar crafts that are rarely studied and are starting to lose their existence in Banjar society. Educators also have not utilized this craft in learning mathematics. This study aims to determine the concept of mathematics in the *bungkalang* and *sarakap*, as well as the effects of these crafts as a medium for learning mathematics. The research approach is qualitative. The research was conducted in Tambak Baru Ilir involving 4 *bungkalang* and *sarakap* craftsmen, 1 Banjar culture administrator, 2 teachers, and 10 Banjar high school students. Data collection was completed using observation, interviews, documentation, and questionnaires. The data analysis was carried out using the interactive analysis model (Spradley model), and data validity was assessed using face validity and triangulation. The results showed that the mathematical concepts in the *bungkalang* and *sarakap* include counting activities and geometrical concepts (including circles and truncated cones). The use of *bungkalang* and *sarakap* as a medium for learning mathematics received good responses from teachers and students. Of the 12 informants, 11 of them were interested in trying to use the *bungkalang* and *sarakap* in learning mathematics.

Keywords: Ethnomatematics; *Bungkalang*; *Sarakap*; Mathematics Learning Media; Math Concept

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1. Introduction

According to Ruseffendi (Nur'aini, Harahap, Badruzzaman, & Darmawan, 2017), mathematics is the science of organized structure which discusses facts and relationships, along with space and form. Therefore, mathematics is a very important subject in education and must be studied at every level because it is closely related to everyday life (Ajmain, Herna, & Masrura, 2020). Based on these objectives, learning mathematics is not as simple as learning other courses that emphasize knowledge mastery. Instead, mathematics learning aims to broaden understanding, skills, and analytical abilities, which enable students to solve everyday problems related to mathematics.

Based on the results of the Program for International Student Assessment (PISA), which was carried out in 2018, Indonesia still has a low literacy rate. Tests carried out on 12,098 students from 399 educational institutions found that 70% of students' competencies were still below the minimum competency in mathematics (Balitbang Kemendikbud, 2019). Judging from their low achievement, educators, students, and the learning material delivery carry influence to realize successful learning.

During the process of mathematics material delivery, an educator certainly needs learning media. Learning media is every object that functions as a communication and interaction device for teachers and students that enhance the effectiveness and efficiency of learning (Mashuri, 2019). It can be said that learning media is used as an instrument in transferring learning material from teacher to student or vice versa. The learning media can be in the form of visuals, audio, or audio-visual.

Teachers often use the lecture method and blackboards for learning. As a result, the current mathematics learning process tends to be too dry, theoretical, less contextual, and artificial (Widiasworo, 2020). Learning is also less varied, so it affects students' interest in studying mathematics further, and they often perceive mathematics as a difficult lesson. Besides, mathematics teaching at school is too formal and different from what children encounter in everyday life. Therefore, learning mathematics needs to provide content that bridges the everyday world based on local culture and school mathematics.

The urgent need for excellent systems in mathematics education prompts a broader consideration of various influencing factors, such as context, cultural influences, and ethnicity. Ethnomathematics and multicultural education have been the main force behind progress in this direction. By engaging in traditional mathematical activities in a different cultural setting, students can learn to value mathematics and develop a tremendous respect for those who are different from themselves.

Ethnomathematics was first coined by D'Ambrosio. The definition of ethnomathematics, according to D'Ambrosio is:

"*The prefik ethno is today accepted as a very broad term that refers to the social-cultural context and therefore includes language, jargon, codes of behavior, myths, and symbols. The derivation of mathema is difficult but tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modeling. The suffix tics is derived from techne and has the same root as technique.*" (D'Ambrosio, 1985)

Ethnomathematics in the process of learning mathematics can be viewed as an approach to motivating students to learn mathematics by involving or associating the mathematical material being taught with concrete examples of mathematical models. In this learning model, examples of mathematical models are in accordance with the material being taught and everyday life, involving the existing local culture or with existing cultural practices. Bishop stated that all mathematics education is a process of cultural interaction, and every student experiences culture in this process. Thus, formal mathematics education in schools cannot be separated from the various cultural phenomena surrounding it. Freudental *described that* mathematics must be connected to reality (mathematics must be close to students and must be related to everyday life situations) (Zaenuri, Dwidayati, & Suyitno, 2018).

Previous research on ethnomathematics investigated ethnomathematics in the *dengklaq* game. This research shows that the traditional *dengklaq* game is not only entertainment for children but also contains an educational value that can shape children's character. Besides being beneficial for children, this *dengklaq* game can be used as a medium for learning mathematics because the game contains many elements of mathematics. It is proven that the *dengklaq* game consists of many mathematical elements such as mathematical logic, congruence, reflection, cube nets, and probability (Fauzi & Lu'luilmaknun, 2019).

Furthermore, Rahmi Hidayati and Ratna Restapaty reported that *problem-based learning* model based on the ethnomathematics of the *sasirangan* cloth motif is effective in helping students overcome problems in solving math word problems, especially in facing geometry material for square and rectangular sub-chapters that elevate local culture. In addition, the use of ethnomathematics in learning is effective in increasing love for local culture (Hidayati & Restapaty, 2019). Therefore, ethnomathematics can be a new solution to the delivery of mathematics in schools.

In terms of culture, South Borneo has its own culture. According to Jumiati, Fajriah, and Agni, one of the cultural and social values that develop in Banjarmasin society is Banjar culture. The central elements of Banjar culture are traditional Banjar handicrafts and tools. The examples of Banjar-style handicrafts in the form of woven are *purun baskets, purun mats*, and *purun hats,* while examples of traditional Banjar tools are *tangguk, sarakap*, *bungkalang*, and so forth (Jumiati et al., 2021).

Bungkalang handicrafts have been a trading tool for the Banjar people since ancient times. The existence of the *bungkalang* can be traced from the book of poetry "*bahalindang sakumpul sapalimbayan*" by Iberamsyah Barbary, where the *bungkalang* is mentioned as part of the Banjar tribe's living equipment system (Ramadania, 2020). *Bungkalang,* according to the Banjar language dictionary (Hapip, 2008), means a basket of bamboo with a square or round base, while the top is round and covered by a rattan or bamboo frame. *Bungkalang* was originally made of rattan which is woven to form a truncated cone. But in its development, *Bungkalang* is now made from a combination of bamboo and rattan. Based on other sources, *bungkalang* is defined as a kind of basket made of woven bamboo, commonly used by floating market traders to place their wares and as a tool for selling fruit and vegetables (Apriati, 2015). Meanwhile, based on the Banjar language dictionary (Hapip, 2008), *sarakap* is defined as a fishing tool. *Sarakap* is a large fish trap made of cylindrical bamboo slats woven with string or ties, with the bottom of the bamboo slats being sharpened (Rustam Effendi, 2022).

Bungkalang and *sarakap* crafts are Banjar cultures that can be fascinating research topics. Consequently, several studies have investigated this craft. However, research related to the crafts of *bungkalang* and *sarakap* mainly examines the economics and sociolinguistic effects. For instance, a study that examines the productivity, yield, and contribution of bamboo handicrafts (*Bambusa sp*) to income in Tambak Baru Village, Martapura District, Banjar Regency. This study analyzes the contribution of the *bungkalang* and *tampirai* crafts to the income of the village community. This study found that the average contribution of the *bungkalang* craft was 41.85%, and the average contribution of the *tampirai* craft was 49.08% (Erfani, Abidin, & Violet, 2020). Another research reported the vocabulary of fishing gear that is endangered in Karatungan Village. The results of this study found 7 fishing gear and 1 searchlight that are endangered. Those seven fishing gears include *tangkalak, tangkawing, jambih* or sarakap *, kabam, sarapang* or *sirapang, banjur,* and *alau* as well as 1 searchlight, namely *suar* (Rustam Effendi, 2022).

As a product of culture, of course, the *bungkalang* and *sarakap* crafts are expected to exist in society continuously, especially in South Borneo. However, in the field, this is not reflected. Bungkalang handicrafts, for example, are starting to be replaced with plastic baskets which are considered to be cheaper. Likewise, because of its limited use, *sarakap* is beginning to fade from young people's knowledge.

In response to this, we aim to fill the gap by investigating the culture-based mathematics media that links mathematics material and the crafts of *bungkalang* and *sarakap*, to enhance both education (mathematics) and culture. Further, this study was carried out to preserve the existing culture and enhance students' motivation to study mathematics.

Based on the aforementioned description, this research focuses on ethnomathematics in the crafts of *bungkalang* and *sarakap* as a medium for learning mathematics. To answers the research focus, several main questions were formulated, namely: 1) What are the mathematical concepts contained in the *bungkalang* craft? 2) What are the mathematical concepts contained in the *sarakap* craft? 3) What is the response if the *bungkalang* and *sarakap* crafts are used as a medium for learning mathematics?

2. Method

The research was conducted in the village of Tambak Baru Ilir, Martapura District, Banjar Regency, South Borneo Province, on 12 July- 5 August 2022. The number of informants was 17 people (3 *bungkalang* craftsmen, 1 *sarakap* craftsman, 1 Banjar culture administrator, 2 teachers, and 10 students from State Islamic High Scool 2 Banjar). This research was conducted in the village of Tambak Baru Ilir with *bungkalang* and *sarakap* craftsmen, in Taman Budaya with cultural tutors. Meanwhile, the interview with the teachers was conducted via *WhatsApp,* and the interview with the students was completed via google form.

The type of research used in this research was descriptive qualitative. According to Nazir, a descriptive method examines the current state of a group of people, an object, a set of conditions, a system of thought, or a class of events. Suharsimi Arikunto emphasizes that descriptive research is not intended to test certain hypotheses but only to describe a variable, symptom, or situation (Prastowo, 2016).

Data collection techniques used were observation, interviews, documentation, and questionnaires. The observation method was used to obtain information from data sources in the form of recorded events, places or locations, objects, and pictures. For the observation, we used passive participation methods to observe behavior among the research object. In this observation, we only visited the research location but did not act as passive observers.

According to Moleong (Moleong, 2012), an interview is a conversation with a specific purpose by two parties, namely the interviewer who asks the question and the interviewee who is being interviewed by the interviewer. Esterbeg (Sugiyono, 2013) classified interviews into three types, namely *structured interviews*, semi-*structured interviews*, and *unstructured interviews*. The type of interviews used in this study were semi-structured interviews, specifically *in-depth interviews,* which were freer in practice compared to structured interviews. The interview was conducted to find problems openly, along with thoughts and opinions from those invited for interviews.

Another method used to collect data in this study was the documentation method. The documentation method is a research data collection technique regarding matters or variables in the form of notes, transcripts, books, letters, newspapers, magazines, inscriptions, meeting minutes, score sheets, agendas, and others. Suharsimi Arikunto (2006) described the documentation method as a research method by studying data about things or variables in the form of notes, transcripts, books, newspapers, magazines, inscriptions, meeting minutes, letters, agendas, and others. Compared to other methods, documentation is not that difficult because even if there is an error, the data source remains unchanged. The documentation method is a source of data in the form of inanimate objects, so they are not easily changed or easily moved (Dimyati, 2013).

The final data collection method used was a questionnaire. The questionnaire is a data collection technique carried out by giving a set of questions or written statements to respondents to answer (Sugiyono, 2019). In the construction of education research, questionnaire items can be categorized into two types, namely questionnaires with open-ended and closed-ended questions (Sukardi, 2011). In this study, researchers used an open-item questionnaire. Questionnaires with open items were made using questions of whether, why, when, how, and who to gather teacher and student responses to *bungkalang* and *sarakap* as a medium for learning mathematics.

To facilitate research, of course, researchers need instruments. In this study, the research instrument was a *human instrument,* in which the researcher acts as an instrument that cannot be replaced by other people (Tandililing, 2015). In this study, the researcher made a data collection instrument consisting of the main instrument and the auxiliary instrument. The main instruments were interview guides, observation guides, and open questionnaires, while the auxiliary instruments were in the form of observation sheets, documentation sheets, check sheets, and field data.

The obtained data were analyzed using an interactive analysis model, namely the Spradley model. The Spradley model illustrates that the research process follows a circle, so it is better known as a cyclical research process. The data analysis steps described by Spradley in Lexy J. Moleong include domain analysis, taxonomic analysis, component analysis, and theme analysis (Moleong, 2012).

The research data were analyzed to obtain ethnomathematics descriptions of the *bungkalang* and *sarakap* crafts in the discussion of geometry as well as ethnomathematics responses to the *bungkalang* and *sarakap* crafts as mathematics learning media. During the analysis, each subject was assigned an initial code to simplify the analysis process further. The coding given based on initials can be seen in Table 1.

Table 1. List of Research Subjects

No.	Subject Name	Subject Code
1	Tini	S1
2	Armah	S2
3	Sanah	S3
4	Jamhari	S4
5	Drs. Mukhlis Maman	S5
6	Guru MAN 2 Banjar	S6
7	Siswa/i MAN 2 Banjar	S7

The validation technique that we used for the questionnaire was *face validity,* an instrument validation commonly used in qualitative research. Appearance validity does not indicate whether a measuring instrument measures what it is intended to measure but only indicates that in terms of the appearance of a measuring instrument, whether it appears to measure what is intended to be measured (Siswanto & Suyanto, 2019). Furthermore, checking the validity of the data for the interview, observation, and documentation methods in this study was carried out through data triangulation. In this stage, we used two types of approaches, namely source triangulation and method triangulation.

3. Results and Discussion

Bungkalang and *Sarakap* Craft Information

Bungkalang

Bungkalang craft consists of several parts, including *bilah*, *talampin*, and *bingkai*. *Bilah bungkalang* are divided into two, namely *bilah uma* and *bilah anak*. When assembled, *bilah bungkalang* will form a *bungkalang's* frame. *Talampin* is part of the base of the *bungkalang*. *Talampin* is made of woven bamboo to form circular and elliptical patterns. The process of making *talampin* is separated from the process of making the *bungkalang's* frame. When the *talampin* is finished, then the *talampin* is put together with the frame. Next, *bingkai* is the top of the *bungkalang,* as shown in Figure 1.

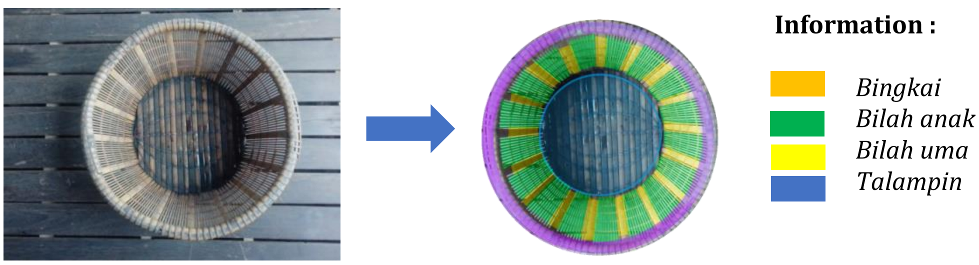


Figure 1. *Bungkalang* Section

Bungkalang crafts are generally divided into two categories, namely *bungkalang* based on the number of *jalinan* and *bungkalang* based on the width of the *talampin*. Based on the number *of jalinan* or webbing on the *bungkalang*, *bungkalang* is divided into 5, namely *jalin 1, jalin 2, jalin 3, jalin 4,* and *jalin 5* as shown in Figure 2. In the study, craftsmen in Tambak Baru

Ilir village only used to produce *jalin 1* to *jalin 4*. Therefore, researchers can only attach 4 types of *jalin.* Furthermore, based on the area of the *talampin, there* are three types of *bungkalang*, namely *lipir, kulung,* and medium as shown in Figure 3.

Jalin 1 *Jalin 2* *Jalin 3* *Jalin 4*

Figure 2. Types of *Bungkalang* Based on *Jalin*

bungkalang lipir *bungkalang medium* *bungkalang kulung*

Figure 3. Types of *Bungkalang* Based on *Talampin Area*

Sarakap

Sarakap craft has several parts, including *bilah*, *talapak cacak*, *bingkai*, *tamburak*, and *gulu alang*. *Talapak cacak* (the palm of the lizard) is a part of the *sarakap* woven. The shape of the woven *talapak cacak* is similar to the soles of the lizard's feet. Usually, on the inside of the *sarakap* using woven *talapak cacak*, there is a ±1 cm wide *bingkai*. Thus, when photographed from the side, the *bingkai sarakap* will not be seen clearly. The ideal number of *talapak cacak* is 4, depending on the number of *bingkai*.

Tamburak is one of the woven *sarakap* which is located at the bottom of the *talapak cacak*. Its shape is circular, according to the surface of the *sarakap*. Next, the *gulu alang* is located at the top of the *sarakap*. *Gulu alang* is the most complicated part of the *sarakap* because it requires a more complex type of webbing. According to the informant, the technique of making *gulu alang* is similar to how to make the edge of the *lampit* (rattan mat). For more details, the illustration of parts of the woven *sarakap* is shown in Figure 4.

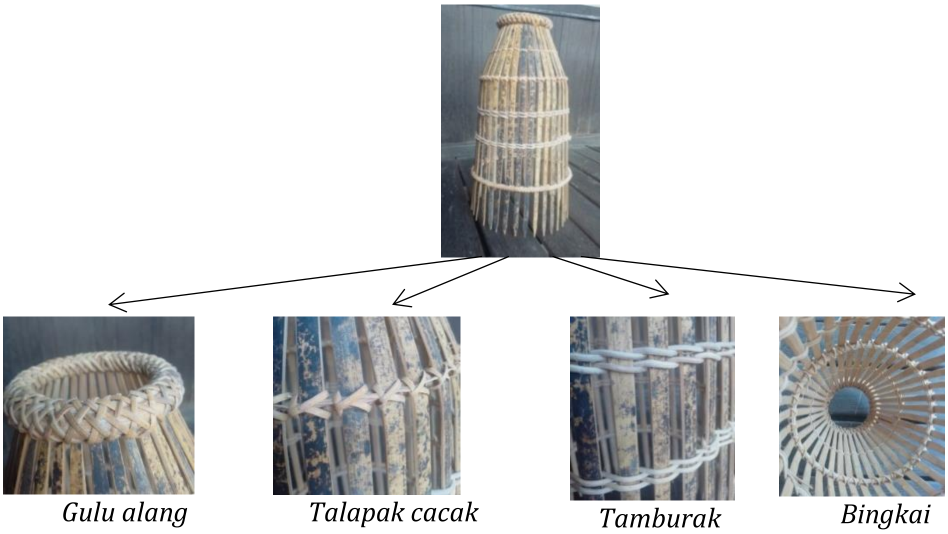


Figure 4. Parts of the *Sarakap*

Mathematical Concepts of *Bungkalang* and *Sarakap* Craft

According to the Indonesian Dictionary (Kemendikbud, 1996), a concept is a draft or letter or an opaque idea or meaning abstracted from a concrete event. Meanwhile, Woodruff defines the concept as (1) an idea that is relatively perfect and meaningful, (2) an understanding of an object, and (3) a subjective product that comes from the way a person makes sense of objects through his experience (after perceiving objects). At a concrete level, a concept is a mental representation of some object or event in the real world. At an abstract and complex level, a concept is a synthesis of a set of conclusions obtained from experience with a specific object or event (Irawan, 2015).

The concept of mathematics represents everything from mathematics in the form of understanding, special characteristics, nature, and content. Mathematical concepts are built on previous concepts so that a misunderstanding of one concept leads to a misunderstanding of the next. Ethnomathematics provides the necessary contextual meaning for many abstract mathematical concepts. Some community activities with mathematical nuances, such as arithmetic operations practiced and developed in society, including ways of adding, subtracting, counting, measuring, determining locations, designing shapes, practicing types of games, and spoken language.

Findings of the Mathematical Concepts of *Bungkalang* and *Sarakap* Crafts

Counting activity

In the *bungkalang* and *sarakap* crafts, there are a number of involved counting activities, as described in the following.

Odd-even numbers

From close observation, there are similarities between the calculation patterns used by the *bungkalang* craftsmen. The similarity is in the use of odd and even numbers. In detail, from the close investigation, if the number of *bilah uma* used by craftsmen is odd, then the number of *bilah anak* is even. In contrast, if the number of *bilah uma* used is even, then the number of *bilah anak* used will be odd. Further, the number of *bilah* varies from one craftsman to another.

According to Mrs. Armah, if *bilah anak* is 10 then the *bilah uma* is 7, for *jalin 2*. For *jalin 3*, if the number of *jalin uma* is 9, the *bilah anak* is 8. Besides, in *jalin 4,* if the number of *jalin uma* is 11, then the *bilah anak* are 6. This is different from Ibu Tini's calculation, wherein the *jalin 3* the *bilah uma is* 9 and the *bilah anak* is 10. Further, another different calculation is made by Mrs. Sanah, in *jalin 2* she uses 8 *bilah uma and* 9 *bilah anak.*

In addition, the number of *bilah* used in the *sarakap* craft is always odd, as described by Mr. Jamhari, during the interview process, shown in the following excerpt.

"...If you want to make sarakap, grind the 'paring' as wide as your thumb, by 43 bilah. If you want it bigger, 45 bilah. He didn't *want to be 44 when he made this, he didn't want to be even. Must be odd. Or you can also make 41 bilah. That's all the available options."*

There are only three choices of *bilah* according to size, namely 41 for small, 43 for medium, and 45 for large. Thus, subconsciously the Banjar community has used mathematics in their daily lives, especially in calculating using odd-even numbers.

Kilan size

Kilan size is a measure commonly used in the life of the Banjar people. *Kilan* in Indonesian is defined as span. In the Indonesian dictionary, span means the size along the stretch between the tip of the thumb and the little finger. Meanwhile, according to Shaharir bin Muhammad Zain, spans are the distance between the fingertips and other fingers (Asri, Sha'ri, & Hasnizam, 2019).

Our observation results showed that *bungkalang* craftsmen use the *kilan* measurement to measure the length of the *bilah bungkalang*. In the *bungkalang* craft, the size of the *kilan* is used in the *jalin 2, jalin 3,* and *jalin 4*. For the *jalin 2* is one *kilan*, the *jalin 3* is one and a quarter *kilan,* and the *jalin 4* is one and a half *kilan.*

One *kilan* is approximately 19 cm in size. If the size of the *bungkalang* is in centimeters, then the size of *kilan* is listed in Table 2.

Tabel 2. Conversion *of Kilan* Size to Cm Size

Bungkalang Type	Size (*Kilan)*	Size (Centimeters)
Jalin 2	1	19
Jalin 3	$1\frac{1}{4}$	23,75
Jalin 4	$1\frac{1}{2}$	28,5

Thus, inadvertently, in ancient times, people used mathematics, specifically in calculating using *kilan* measurements.

Multiples

In the process of measuring the length of the *bingkai*, *Bungkalang* craftsmen use the concept of multiples. *Bingkai bungkalang* length is three times the diameter of the top of the *bungkalang*. The shape of the top of the *bungkalang* is a circle. Thus, to calculate the length of the *bingkai*, the formula for calculating the circumference of a circle is used. The use of multiples in the process of making a *bingkai* can be proven from the formula for the circumference of a circle, which is by multiplying the constant pi (π) and the diameter of the circle. The pi constant value (π) is 3,14 or $\frac{22}{7}$. If the value of the constant pi (π) is rounded off to three, then the calculation for circumference of a circle is 3 times the diameter of the circle. The example of a question and its solvency is presented in the following.

Question:

If the diameter of the *bingkai* is 20 cm. Determine the perimeter value of the *bingkai.*

Completion:

Based on the concept from the craftsmen, the circumference of the *bingkai bungkalang*:

Circumference of the *bingkai bungkalang* $= 3 \times$ *bingkai's* diameter

$= 3 \times 20\ cm$

$= 60\ cm$

Based on the circle concept, the circumference of the *bingkai bungkalang*:

Circumference of the *bingkai bungkalang* $= \pi \times$ *bingkai's* diameter

$= 3{,}14 \times 20\ cm$

$= 62{,}8\ cm$

According to the calculation, the calculated result based on the craftsmen's concept is smaller than the calculated value based on the circle concept (60 cm < 62.8 cm). This occurs naturally as the craftsmen's formula is the minimum value in calculating the *bingkai bungkalang* length.

Geometry Concept

Geometry can be defined as a branch of mathematics that studies point, lines, planes, and space objects and their properties, dimensions, and their intercorrelated relationships, so geometry can be seen as a study that studies physical space (shape and form) (Budiyono, 2006, p. 4). In the crafts of *bungkalang* and *sarakap*, the craftsmen also use a number of geometric concepts, as described in the following.

Point

A point states a specific location or position of an object. In learning, points can be drawn as dots and can be modeled with small round objects (As'ari, Tohir, Valentino, & Imron, 2017). Based on observations of the crafts of the *bungkalang* and *sarakap*, the *bilah* of the *bungkalang* and *sarakap* use the point concept indirectly, as illustrated in Figures 5 and 6.

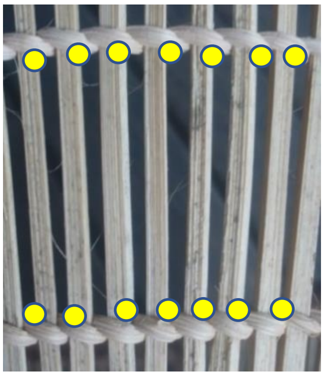


Figure 5. Points on the *Bilah Bungkalang*

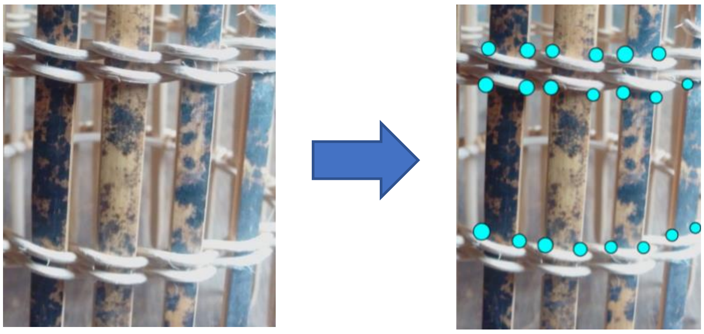


Figure 6. Points on the *Bilah Sarakap*

Line

A line is an abstract idea or notion that is straight and not thick, as well as extending in both directions, with no limitation and end. The line is the shortest connection between two points that do not coincide. In geometry, lines are known to have angles of 180 degrees (Hadi & Faradillah, 2022).

Based on observations of the crafts of the *bungkalang* and *sarakap*, indirectly the *bilah* of the *bungkalang* and *sarakap* use the concept of lines, as shown in Figures 7 and 8.

Figure 7. Lines on the *Bilah Bungkalang*

Figure 8. Lines on the *Bilah Sarakap*

Parallel lines

The following is a picture of parallel lines on the *bilah bungkakang* accompanied by guidelines.

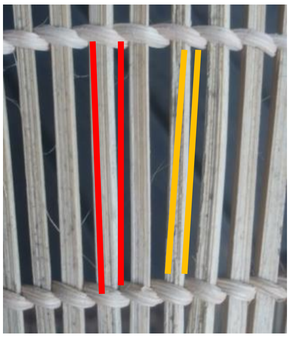


Figure 9. Two Parallel Lines on *Bilah Bungkalang*

Figure 10. Two Parallel Lines on *Bilah Sarakap*

Information:

There are lines that are parallel to each other, that is, lines that have the same color in the image.

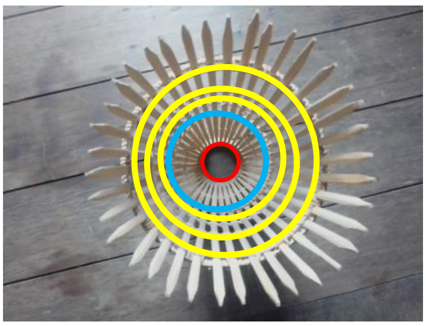
Based on Figures 9 and 10, there are two parallel lines on the *bilah* of *bungkalang* and *sarakap*. Thus, the Banjar people have unconsciously used mathematics in their lives, such as the parallel lines on the crafts of *bungkalang* and *sarakap*.

Circle

the results of our observation suggested that the Banjar community's *sarakap* crafts use the circle concept. The concept of the circle can be apparently observed at the bottom viewpoint of *sarakap* since the shape of the *sarakap* is widening downwards, so from the top, the concept of the circle on the craft is less clear.

Figure 11. The underside of the *Sarakap*

In addition, Figure 12 illustrates the circle concept in the *sarakap* craft.

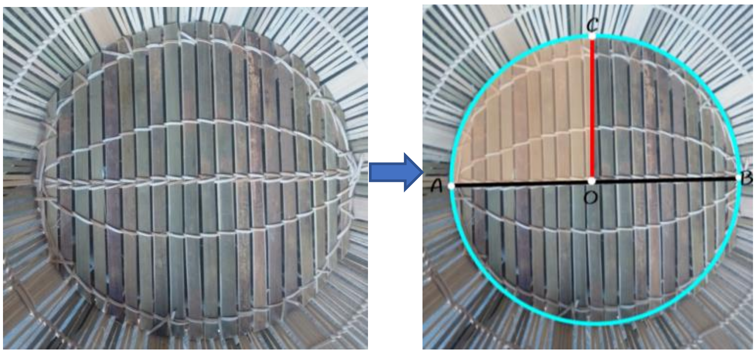


Information :

- Circles on the *gulu alang*
- Circles on the *talapak cacak*
- Circles on the *tamburak*

Figure 12. Circles on the *Sarakap*

Similarly, on the craft of *bungkalang*, we identified the use of circle elements, such as arcs, sectors, radius, diameters, and center points, as shown in the *talampin bungkalang* presented in Figure 13.



Information :

Titik O = center of *talampin*
AB = diameter of *talampin*
OC, AO, OB = radius
$\widehat{AC}$, $\widehat{AB}$, $\widehat{BC}$ = arc of *talampin*

= sector

Figure 13. Circle Elements on *Talampin*

Curve

A curve represents a line that connects two points and is non-straight. A curve is a designation for a curved line that connects at least two points in different positions (Tjolleng, 2022). In *sarakap* craft, we observed several parts that use the curve concept. Figure 14 shows some of the uses of the curve concept in *sarakap* craft.

Keterangan:

The curve on the *gulu alang*
The curve on the *talapak cacak*
The curve on the *tamburak*

Figure 14. The curve at *Sarakap*

Ellipse

An ellipse is the set or locus of all points in one plane with a defined distance between them (Mutia & Mursalin, 2018). An ellipse can be said to be a circle that extends in one direction. In the craft, the shape of the ellipse can be seen from the woven pattern found on the *talampin*, as presented in Figure 15.

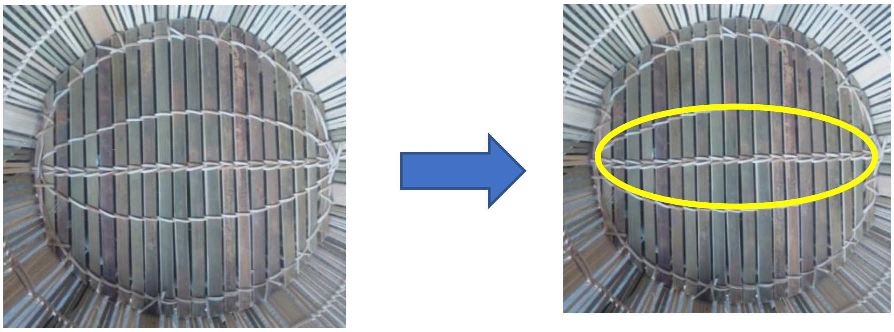


Figure 15. Ellipses on the *Talampin*

Rectangular

Based on our analysis results, in the crafts of *bungkalang* and *sarakap*, the rectangular concept is also used. The concept of the rectangle can be found on the *bilah* of the crafting. Figures 16 and 17 illustrate the rectangular shapes in the *bungkalang* and *sarakap* crafts.

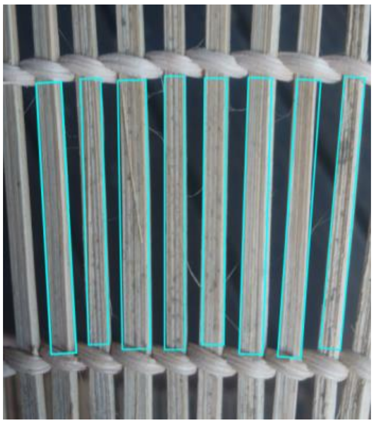


Figure 16. The rectangle on the *Bilah Bungkalang*

Figure 17. The rectangle on the *Bilah Sarakap*

Truncated cone

The truncated cone is the sub-cone material. If a cone is cut by a plane parallel to the base between the apex and the base plane, then the part of the cone bounded by the cutting plane and the base plane is called the truncated cone (Suwaji, 2008). The *bungkalang* craft has a shape resembling a truncated cone, as presented in Figure 18.

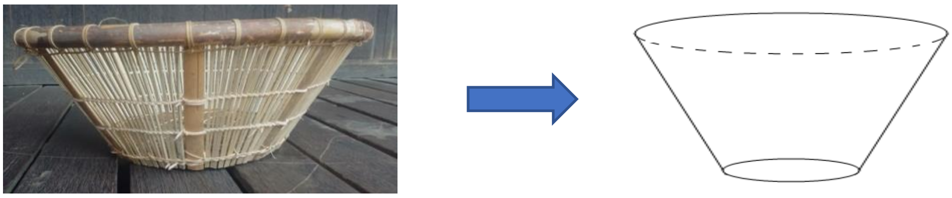


Figure 18. The *Bungkalang* is analogous to a truncated cone

If the distance between the *bilah* is neglected, then the area of the frame and volume of *bungkalang* can be calculated based on the truncated cone formula.

Bungkalang & *Sarakap* Mathematical Concepts and Basic Materials

The analysis results on the mathematical concepts used in the *bungkalang* and *sarakap* crafts showed their correlation with mathematics learning materials. In this sub-chapter, Figures 19, 20, 21, and 22 illustrate samples relevant to mathematics learning. In the following, we describe the connection between the geometry material in elementary to senior school level with the *bungkalang* and *sarakap* crafts.

Elementary level

In the following, the researcher provides examples of the ethnomathematics of the crafts of *bungkalang* and *sarakap* associated with mathematics lessons in elementary schools.

3 +

1 = 4

Figure 19. *Bungkalang* and *Sarakap* as Elementary School Material

As presented in Figure 19, the *bungkalang* and *sarakap* can be used to explain the concept of natural number addition. Besides, the numbers 1 and 3 are part of the odd numbers, so they can be used to explain the concept of odd numbers. Furthermore, the result of the addition, which is 4, can be used to explain the concept of an even number.

Middle or High School level

In the following, we provide an example of the ethnomathematics of the *bungkalang* craft associated with mathematics lessons in junior high or high school.

Example 1:

Look at figure 20 below. Figure 20 shows the bottom or *talampin* of the *bungkalang* craft. The *talampin* section has an elliptical webbing. For example, if the center of the ellipse on the tray is at point O (0,0), then the shape of the ellipse on the *talampin* fulfills the form of the equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. If the ellipse has the equation $x^2 + 4y^2 - 144 = 0$, determine the area of the ellipse.

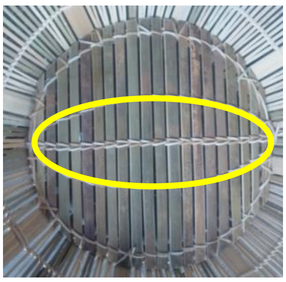


Figure 20. Ellipse on the *Talampin*

Completion:

Equation $x^2 + 4y^2 - 144 = 0$

The calculation for the area of the ellipse:

To calculate it, first convert the elliptic equation into general form.

$x^2 + 4y^2 - 144 = 0$

$\Leftrightarrow x^2 + 4y^2 = 144$

$\Leftrightarrow \frac{x^2+4y^2}{144} = 1$

$\Leftrightarrow \frac{x^2}{144} + \frac{4y^2}{144} = 1$

$\Leftrightarrow \frac{x^2}{144} + \frac{y^2}{36} = 1$

So the general form is $\frac{x^2}{144} + \frac{y^2}{36} = 1$

Next, determine the value of a and b from the ellipse equation $\frac{x^2}{144} + \frac{y^2}{36} = 1$. From these equations obtained:

$a^2 = 144 \rightarrow a = 12$

$b^2 = 36 \rightarrow b = 6$

Then calculate the area of the ellipse

Area of the ellipse $= \pi \times a \times b$

$= \pi \times 12 \times 6$

$= 72\pi$

So, the area of the ellipse from the equation $x^2 + 4y^2 - 144 = 0$ is 72π

Example 2:

Look at Figures 21 and 22 below. Figure 21 is a picture of the *bungkalang* craft. The craft is in the form of a truncated cone. Figure 22 is a geometric image of a truncated cone. If it is known that the diameter of the *talampin* or bottom of the *bungkalang* is 15 cm, the diameter of the top of the *bungkalang* is 30 cm, the height is 12 cm, and the painter's line is 14 cm. Determine the volume of the *bungkalang*.

Figure 21. ***Bungkalang***

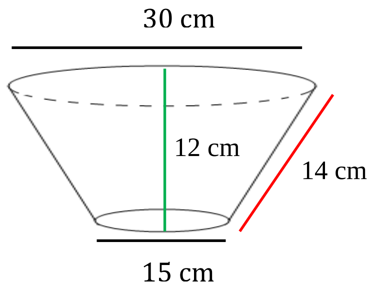


Figure 22. Illustration of a Truncated Cone Based on an Example Problem

Completion:

The value of the diameter is 2 times the radius, the radius of the *talampin* is 7.5 cm, and the radius of the *muara* is 15 cm.

a = 14 cm   b = 12 cm   r = 7.5 cm   R = 15 cm

Calculate the volume of the *bungkalang*

Answer:

The *bungkalang* has the shape of a truncated cone, so to calculate its volume, use the formula for the volume of the truncated cone

$$Volume\ of\ bungkalang = \frac{1}{3}.\pi.b(r.R + r^2 + R^2)$$

$$= \frac{1}{3} \times 3.14 \times 12(7.5 \times 15 + 7.5^2 + 15^2)$$

$$= 12.56(112.5 + 56.25 + 225)$$

$$= 12.56(393.75)$$

$$= 4945.5\ cm^3$$

So, the volume of *bungkalang* is 4945.5 cm^3

Bungkalang **and** ***Sarakap*** **Crafts as Mathematics Learning Media**

This section presents the response of teachers and students at Islamic State Senior High School 2 Banjar regarding the crafts of *bungkalang* and *sarakap* as a medium for mathematics learning.

Instructional Media

The use of mathematics learning media can maximize the student's learning outcomes. Three informants stated that educators use engaging media during mathematics learning. The media include interactive media, whiteboards, and PowerPoint. A total of 4 informants stated that educators used dice, games, and quizzes in the learning process. At the same time, the remaining three informants stated that educators did not use engaging media during mathematics learning.

Class

Based on the research results, the obstacles students face in learning mathematics are the introduction of new material, the lack of motivation as they consider mathematics difficult, the absence of everyday life context, and the monotonous usage of learning media. To overcome the obstacles in the learning process, classroom conditioning is completed to aid students in paying attention to class. Besides, the forms of mathematics are introduced using everyday life context to enhance students' learning, along with new references to realize a new atmosphere in every learning process, starting from methods, learning models, media, and so forth.

Learners

Various difficulties are experienced by students in learning mathematics. These difficulties include their inability to understand the material, different questions from the examples, positive-negative placement, the new material that has not been taught, its application to everyday life, story problems, lengthy teacher explanations, and many formulas.

Implementation of Teaching and Learning Mathematics

Students expect to learn mathematics in an enjoyable and uncomplicated means, so they can absorb, remember, and apply the mathematical concepts in life easily. In addition, informants expect the use of animated videos and quizzes to improve students' active participation in class.

Use of Ethnomathematics

Among the two educators, one of them used ethnomathematics in teaching mathematics by using the Banjar language in counting activities; for example, the number 25 is called *salawi,* and the number 9 is called *sambilan*. Based on the results of the study, nine students were interested in learning mathematics in South Borneo culture.

Our observation results on ethnomathematics in the craft of *bungkalang* and *sarakap* as a medium for learning mathematics suggested that all of our 12 informants (2 teachers and 10 students) know the craft of *bungkalang*. Meanwhile, only nine informants out of a total of 12 informants knew about *sarakap's* craft. Further, as many as 11 informants agreed on the use of *bungkalang* and *sarakap* crafts in mathematics. The remaining one informant did not know because it had not been applied in teaching mathematics.

The two educators stated that ethnomathematics is an excellent medium for mathematics learning because students will be more interested if the learning involves a media that they often see. In addition, both teachers agreed that the use of ethnomathematics could increase students' interest and achievement in learning mathematics. Of course, there is no solid basis for this because the researchers did not dig deeper into the effectiveness of using ethnomathematics in the *bungkalang* and *sarakap* crafts. This research is limited to seeking teacher and student responses in the use of ethnomathematics of the *bungkalang* and *sarakap* crafts as a medium for learning mathematics.

However, before using ethnomathematics in the crafts of *bungkalang* and *sarakap* to solve problems in learning mathematics, educators must understand the mathematical parts of these crafts. In addition, more explanation is needed when using ethnomathematics. The informants also hope that with the use of ethnomathematics of the *bungkalang* and *sarakap* crafts, students will be more interested and motivated to learn. In addition, the informants hope that ethnomathematics can be implemented immediately to enrich variations in the mathematics learning process.

4. Conclusion

Based on the results of the research signified that the mathematical concepts in the *bungkalang* and *sarakap* crafts include counting activities in the form of odd-even numbers, clan size, and multiplication, along with geometric concepts in the form of points, lines, parallel lines, curves, circles, ellipses, rectangles, and truncated cones. The use of *bungkalang* and *sarakap* crafts as a medium for learning mathematics received a good response from educators and students. Of the 12 informants, 11 of them were interested in trying to use the *bungkalang* and *sarakap* crafts in learning mathematics, while the remaining informant was not sure as the crafts had never been implemented in the learning process. Suggestions for future studies, they can further explore the existence of ethnomathematics in the crafts of *bungkalang* and *sarakap* or other elements of Banjar culture.

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