



## Perceptions of geometry and cultural values on traditional woven fabric motifs of the *Sasak* people

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### Abstract

This cultural diversity can be utilized in exploring mathematical concepts bridged by ethnomathematics to bring mathematics closer to students' cultures. However, on the other hand, many people think that mathematics is culture-free. The uniqueness and diversity of cultures in ideas, activities, and artifacts can be studied and used as learning resources, especially in mathematics. Therefore, this study seeks to explore the geometrical perceptions and cultural values contained in the traditional woven fabric motifs of the *Sasak* people. This research is qualitative research with an ethnographic method. Research data were collected through observation, literature study, and interviews with cultural practitioners, traditional leaders, woven fabric craftsmen, and cultural. The results of this study indicate that the traditional woven fabrics of the *Sasak* people have recognized and used mathematical concepts, especially lines, angles, flat shapes, and geometric transformations, in the design of traditional woven fabric motifs of the *Sasak* people. In addition, there is a philosophical meaning contained in each motif or pattern. The meaning is in the form of cultural values such as moral, historical, and philosophical values, which are used as messages to their children and grandchildren.

**Keywords:** cultural values; ethnomathematics; geometry perception; woven fabric

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## Introduction

Art and cultural values and beliefs are components that cannot be separated from people's lives. We understand that arts and culture are essential in promoting social and economic goals through local regeneration, attracting tourists, developing talent and innovation, and increasing welfare. Art and culture can be used to achieve goals and become instruments for achieving goals beyond the direct experience and intrinsic value of art itself (Juncker & Balling, 2016). These intrinsic effects enrich the lives of individuals and communities where they provide an identity for that society (Vallaster & Wallpach, 2013). The identity and reputation of a group of people are reflected in various joint activities in the form of social symbols through language and behavior (Vallaster & Wallpach, 2013). The cultural identity reflects the equality and socio-cultural level of a society in a positive way (Hunter & Hunter, 2017).

Every culture develops ways and techniques to respond and seek explanations about a phenomenon that occurs. This kind of activity is the origin of human knowledge. Community groups in an area with their unique culture will respond to their environment in ways and styles that they find themselves in building their knowledge system (D'Ambrosio, 2016; Rosa & Orey, 2016). Therefore, through observation, comparison, classification, evaluation, quantification, measurement, calculation, representation, and inference in each region and culture, humans attempt to explain and understand knowledge. With this cultural diversity, each region has a different way of observing, comparing, classifying, evaluating, measuring, calculating, representing, and concluding (Rosa & Orey, 2016).

Cultural diversity in Indonesia provides opportunities for improving the education system, one of which is the mathematics education system, namely an effort to bring mathematics closer to the reality and culture of students (Abdullah, 2017). The culture in each region has its uniqueness. Uniqueness like this can be seen from various points of view that can be used as a source of learning mathematics, including the culture of the *Sasak* people on the island of Lombok (Fauzi & Gazali, 2022; Fauzi et al., 2021; Fauzi, Hayati, et al., 2022). The *Sasak* people still preserve various cultural activities such as customs, traditional villages, traditional arts such as *gendang beleq* and *perisean*, and traditional crafts, one of which is traditional woven fabrics that can be explored in learning mathematics. This cultural activity is not only seen as a habit and art. However, historical and philosophical values impact student character building, such as diligence, thoroughness, economics, mutual respect, and social spirit (Widodo, 2019). Several researchers have explored and explored various uniqueness in the culture of the *Sasak* people. Fauzi et al. (2021) explore mathematics in the traditional village layout of *Segenter*. They were followed by Fauzi, Hanum, et al. (2022), exploring the idea of mathematics and the value of education in the traditional residential architecture of the *Sasak* people. Fauzi, Hayati, et al. (2022) exploration of mathematics and cultural values in *perisean* performing arts. Fauzi and Gazali (2022) study of ethnomathematics on residential characters based on *sikut awak*. Kusaeri and Pardi (2019) identify mathematical objects contained in the cultural products of the *Kembang Kerang* people of East *Lombok* and their implementation in Islamic educational institutions. Supiyati et al. (2019) examine ethnomathematics in the architecture of the traditional house of the *Sasak* tribe. In addition,

Sutarto, Hastuti, et al. (2021) explore the geometric transformation of the weaving of the *Sasak Sukarara* tribe.

On the other hand, few researchers have explored the mathematical concepts and cultural values contained in the motifs (*reragian*) traditional woven cloth of the *Sasak* people. Previous researchers have mainly studied ethnomathematics in traditional house architecture, traditional arts, and *Sasak* culture in general, like the research conducted by Kusaeri and Pardi (2019) about the traditional art of sugar gending. Furthermore, research was conducted by Hardiani and Putrawangsa (2019) on the measurement tradition of the *Sasak* people and the potential for integration into mathematics learning. Another research on ethnomathematics: geometry concepts in *Sasak* traditional crafts in mathematics learning in elementary schools (Fauzi & Setiawan, 2020). Due to the various types of woven fabrics, the rarity of the original motifs and the motifs contained in woven fabrics are only considered artistic decorations. Every motif or pattern contained in woven fabrics is not only related to aesthetics but also contains local values. It provides an overview of spiritual, historical, and metaphysical principles, which can be felt, expressed, and applied in everyday life (Prahmana & D'Ambrosio, 2020).

*Sasak* woven cloth is clothing used during the implementation of traditional processions. Even now, the traditional woven cloth of the *Sasak* tribe has been used as one of the uniforms for government agencies and schools on certain days. *Sasak* woven fabric has been used as a form of creative community effort (Anggraini et al., 2018). When viewed from the diversity of motifs contained in the traditional woven fabrics of the *Sasak* people, it provides an opportunity for educators to explore and use it as a context for learning mathematics. Thus, this study aims to comprehensively explore the perception of geometry and cultural values on the traditional woven fabric motifs of the *Sasak* people, which can be used as a source of learning mathematics in *Lombok*. In addition, the independent curriculum emphasizes that learning must integrate every learning content with culture and everyday life, especially local wisdom.

In the *Sasak* community, there are still customs and traditions left by their ancestors. It can be seen from the community's activities in various forms, always starting with traditional rituals. The *Sasak* people believe that three relationships must be harmonized in life: the relationship between humans and nature, the relationship between humans and humans, and the relationship between humans and God (Fathurrahman, 2017). This belief is actualized in the symbols attached to its cultural artifacts, such as motifs or symbols found on traditional woven fabrics of the *Sasak* community providing moral messages that contain ideology, ethics, norms, and values that govern how to relate between humans, relate to creators and how to connect with nature (Yamin, 2022).

Building knowledge by involving students' culture and everyday experiences as basic knowledge through artifacts makes mathematics learning more meaningful (Bonotto, 2017). In addition to using appropriate artifacts, the teaching or learning environment is also designed according to student culture and implemented in mathematics learning activities through new (Bonotto, 2017). Ethnomathematics is a way of studying mathematics in cultural aspects. The term ethnomathematics provides a sufficient understanding of collective perfection for many authors so that there is no simple definition of the scope of this context (Weldeana, 2016).

In general, ethnomathematics is as dynamic as language, values, and religion in culture. The application of ethnomathematics in education can be found in the natural environment where children grow and develop (D'Ambrusio & Rosa, 2016). Teaching mathematics by involving culture is termed ethnomathematics. Ethnomathematics can be defined through its educational aspect, namely the relationship between mathematics content and student culture (Amit & Qouder, 2017). However, most mathematics teaching in schools has yet to involve students' culture to explore the initial knowledge obtained from their environment because formal learning only describes abstract mathematical material. It allows one to recognize the diversity and dynamism of the mathematical knowledge system that grows and develops in society and teaches children to build a new understanding of the realities of life. Thus, the purpose of this study seeks to explore the geometrical perceptions and cultural values contained in the traditional woven fabric motifs of the *Sasak* people.

## Methods

This research method uses ethnographic methods. Ethnographic research is research that examines and describes the culture of a society (Spradley, 2016). This research method was chosen because it is in line with the objectives of ethnomathematics, which is to examine mathematical ideas, processes, and techniques in culture from the point of view of society (Shirley & Palhares, 2016). The interpretation of phenomena in ethnographic methods is a procedure for describing, analyzing, and interpreting elements of a cultural group, such as patterns of behavior, beliefs, and language that develop over time (Spradley, 2016).

In this study, we took locations in two places: Sukarara Village, Central *Lombok*, and *Peringgasela* Village, East *Lombok*. Two locations are central to traditional woven fabric craftsmen on the island of Lombok, Indonesia, where woven fabrics are produced in these two places and have very different motifs.

Data were collected through field studies and interviews with purposively selected sources. This purposive sampling technique was used to determine the criteria for informants following the data to be collected. The sources are Lalu Damsiah, a traditional leader of *Sukarara* Village, Central *Lombok*, who studied and comprehensively clarified the origin of the woven cloth of *Sukarara* Village. Moch. Yamin, West Nusa Tenggara Cultural, to find comprehensive information about the philosophy and meaning of the motifs of the traditional woven fabrics of the *Sasak* people. Mrs. Manggis, a songket woven fabric craftsman in *Sukarara* Village, comprehensively explored the meaning of symbols and forms of woven cloth motifs in *Sukarara* Village. Alimudin Mesir, a culturalist from *Peringgasela* Village, East *Lombok*, comprehensively explored the meaning and philosophy of the shape of the woven cloth motif in *Peringgasela* Village. In addition, Suharti, a woven cloth craftsman in *Peringgasela* Village, East *Lombok*, explored the meanings and symbols of the motifs found on the woven cloth of *Peringgasela* Village.

To complement the results of observations and interviews, the researchers conducted a literature review on the traditional woven fabrics of the *Sasak* people. The results of data collection were analyzed using triangulation techniques to comprehensively explore the

relationship between mathematical knowledge systems and cultural values contained in the traditional woven fabric motifs of the *Sasak* people. The collected data is then data reduction to select, simplify, abstract, and transform the rough data that emerges from the field data. After the data reduction process, the next stage is data presentation, selecting data based on content so that later conclusions can be drawn.

## Results

The results show that in the culture of the *Sasak* people, there are various types of traditional woven fabrics called *songket*, which are used in various traditional events, such as *sorong serah aji krame*, *nyongkolan*, *kepaten*, and art events. Women carry out the weaving tradition as part of their daily activities to take advantage of their free time after working in the fields. The manufacture length depends on the complexity of the motifs that adorn the fabric (Manggis, 2022; Suharti, 2022). In addition to the motif as part of the beauty of woven cloth, it also has meaning. Generally, the motifs on woven fabrics are used as the name of the woven fabric called *ragi*. Certain types of cloth are not made by just anyone and are made in certain months based on the beliefs of the *Sasak* people. In addition to the fabrics used in everyday life, several fabrics are used in traditional events or processions, depending on the name of the fabric. The motifs are mostly flat shapes, plants, and animals symbolizing prosperity. In addition, the pattern of motif placement on each fabric produced uses the concepts of geometric transformations such as reflection (reflection), shift (translation), rotation (rotation), and size change (dilation) which are learned naturally, based on experience, creativity, and also their cultural habits. Furthermore, a more detailed explanation of each pattern and cultural value is as follows.

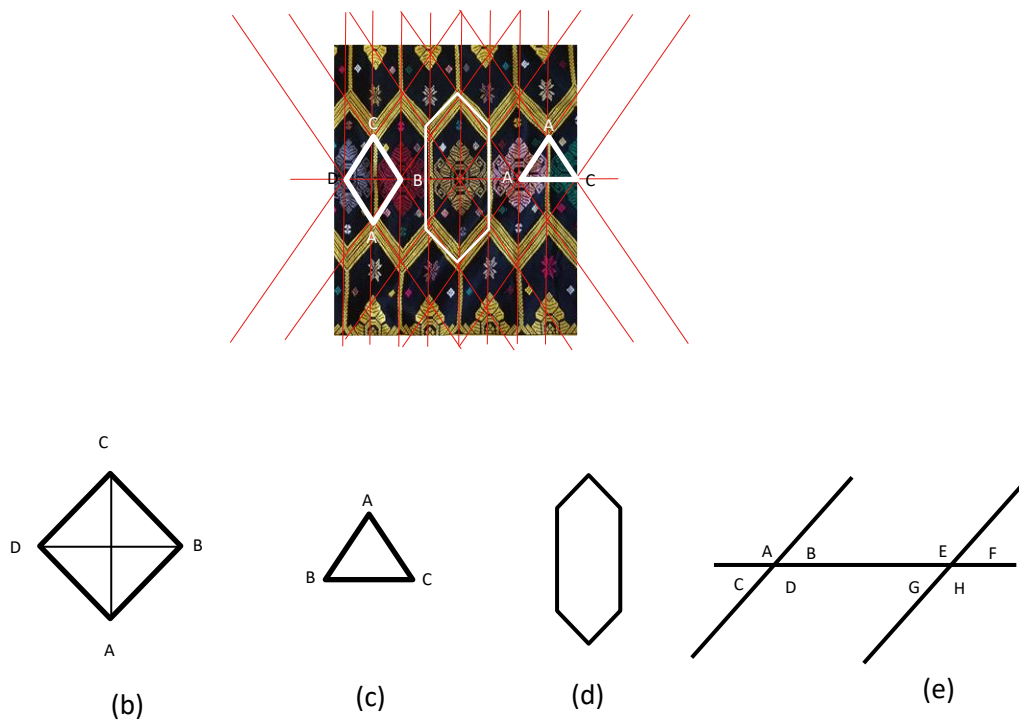
### Cultural values and geometric shapes on *ragi subahnale* woven fabrics

The traditional *songket* woven fabric of the *Sasak* tribe has a distinctive motif. This traditional *songket* woven fabric is very attached to the life of the *Sasak* people on the island of Lombok and is an inseparable unit. This *songket* cloth has an essential role in every level of *Sasak* society because this *songket* cloth is a means and infrastructure for carrying out traditional ceremonies and religious ceremonies.

In fact, in ancient times, people named each *songket* woven fabric *Subahnale* which came from the word *Subhanallah*. It started when a woman made a cloth that took quite a long time. Once the weaver finished making the cloth, the cloth was brought out to show everyone. Then everyone who saw it said *Subhanallah* because they felt amazed to see a beautiful and fantastic *songket*. People have called it *Subahnale* *songket*.

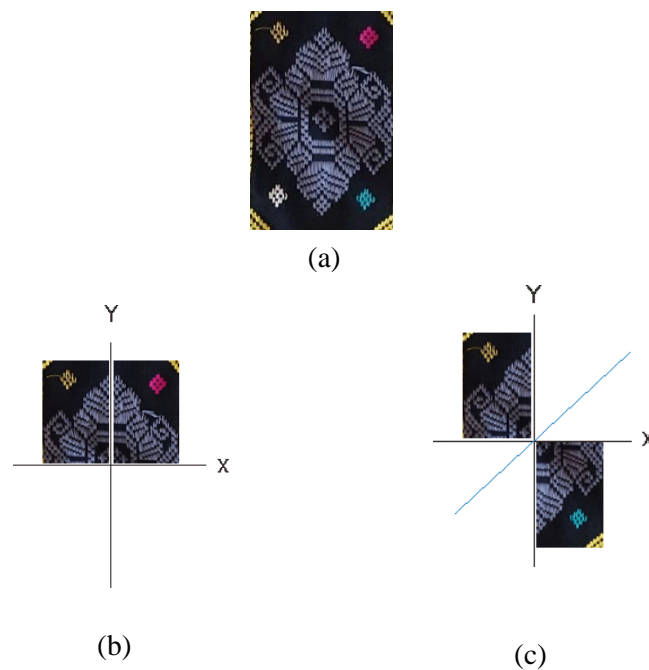
The moon ornament is a geometric hexagon, inside which there are decorations of *remawa* flowers, *ylang*, or *cape*. Men and women usually use this cloth at parties or traditional ceremonies. The term *Subahnale* comes from the word *Subhaallah* which means that by glorifying the name of *Alloh*, humans have sincerity, patience, and submission to God Almighty. In addition to its cultural values, the woven *ragi subahnale* motif also uses

mathematical concepts such as lines, planes, angles, and geometric transformations, as shown in Figure 1.



**Figure 1.** (a) The basic geometric shape of the *subahnale* woven fabric, (b) rhombus, (c) triangle, (d) hexagon, and (e) inner and outer corners

*Subahnale* woven fabric is composed of regular lines and forms a geometric shape. In addition to the basic form of the *ragi subahnale* woven fabric motif, other mathematical forms are geometric transformations, as shown in Figure 2 below.



**Figure 2.** (a) *ragi subahnale* woven fabric motif, (b) translation, and (c) reflection

### Cultural values and geometric shapes on woven *ragi panak* fabric

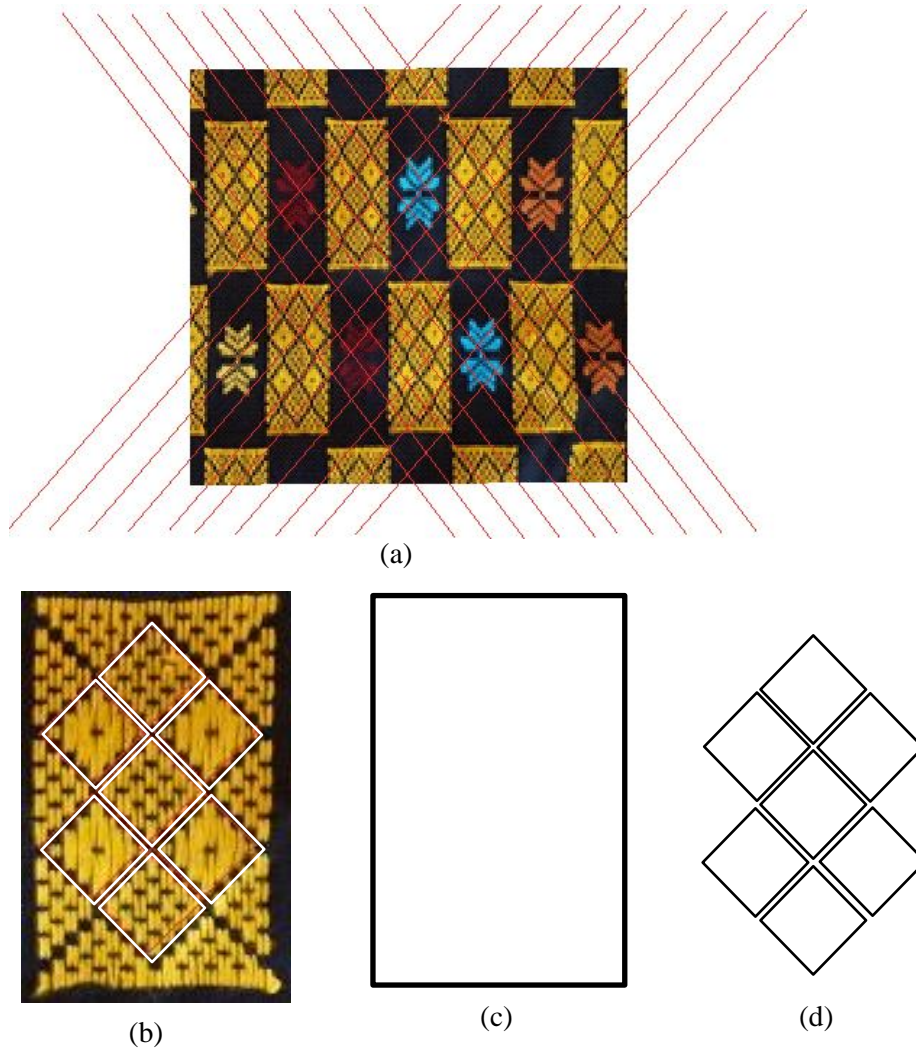
The *panak* motif has different basic colors depending on the craftsman and is decorated with arrows. The *Sasak* people commonly use this *songket* woven cloth to attend *Nyongkolan* traditional ceremonies. This motif symbolizes the honest nature of a human being, like an arrow that has been released will shoot straight into the sky front. The mathematical form in the woven *ragi panak* motif is composed of lines, planes, and geometric transformations, as shown in Figure 3.



**Figure 3.** (a) *ragi panak* woven fabric motif, (b) reflection, (c) reflection, and (d) reflection)

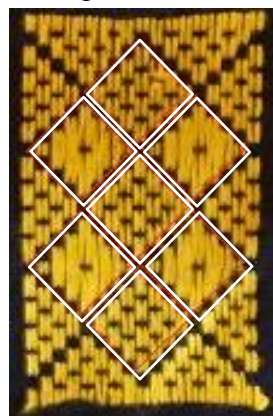
### Cultural values and geometric shapes on *ragi cungklik* woven fabrics

The *Cungklik* musical instrument is made of rectangular pieces of wood arranged in a row in one container. This instrument is a silophone. This cloth is usually used as a costume in art events. Giving meaning that togetherness is a strength. There is no power other than surrendering to the Almighty (Damsiah, 2022). This *ragi cungklik* is shaped like a rectangle, and inside there are other geometric shapes, flat shapes, making an orderly pattern, as shown in Figure 4.



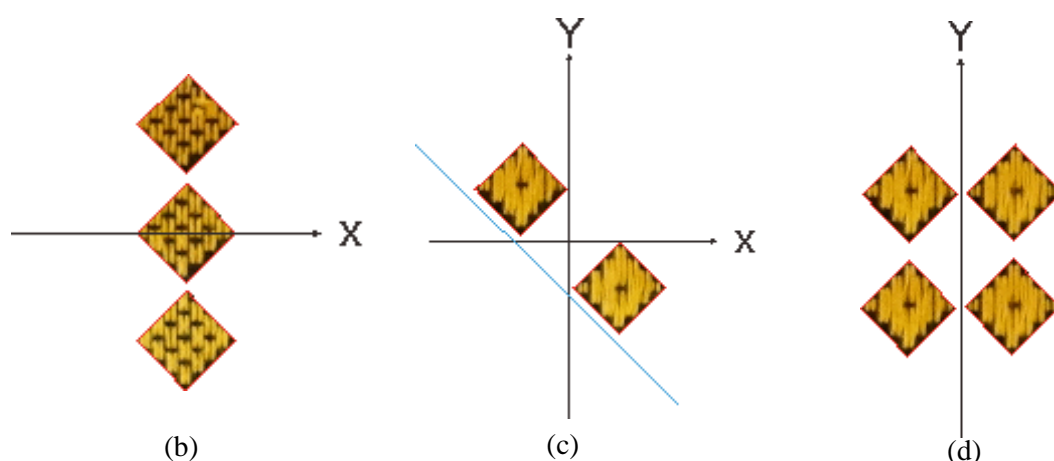
**Figure 4.** (a) basic pattern of *rasi cungklik* woven fabric motif, (b) basic motif, (c) rectangle, and (d) rhombus arrangement

In addition to the geometric shapes in the picture above, the shape of the *rasi cungklik* woven fabric motif is also built on mathematical forms, especially lines, planes, angles, and geometric transformations, as shown in Figure 5 below.



(a)  
160





**Figure 5.** (a) basic motif of *ragi cungklik* woven fabric, (b) reflection, and (c) diamond reflection, and (d) reflection

## Discussion

The results of exploring mathematical concepts in the traditional woven fabric motifs of the *Sasak* people illustrate that they have used flat shapes and geometric transformation concepts, which they learned and became part of their creative ideas, which emerged from the experience. Furthermore, their habits and the existence of particular motifs should not be abandoned as a feature of the woven fabric (Damsiah, 2022; Mesir, 2022; Yamin, 2022).

When viewed from the basic color of the traditional woven fabric of the *Sasak* people, most of them are black, and there are several colors, such as green and maroon. These colors are taken based on the character of the *Sasak* people themselves. In contrast, the black color is based on the understanding of the *Sasak* people that the color is black, showing simplicity, togetherness, and solidarity (Yamin, 2022). The motifs, colors, and symbols contained in the woven fabrics are mere artistic decorations and provide meaning as advice for future generations (Damsiah, 2022; Yamin, 2022). For daily activities, the woven fabric used by the *Sasak* tribe has a pattern with a striped or checkered motif called *kereng pelekat*, but for traditional events, the woven cloth worn depends on the form of the event being held (Suharti, 2022).

The study results indicate that every motif or symbol contained in the traditional woven fabric of the *Sasak* people provides a moral message. It contains ideology, ethics, norms, and values that govern how to relate between human beings relate to the creator and how to relate to nature in the end. In the *Sasak* tribe, the terms *adat gama* (how people practice religious law), *adat tapsila* (how people behave) and *adat krame* (how people practice customary law) appear (Yamin, 2022).

Indonesia, with various indigenous tribes and cultures, allows researchers to extract ethnomathematics from various viewpoints, such as exploring *Mbojo* culture as a source of learning mathematics (Sutarto, Ahyansyah, et al., 2021). In addition, introduction to flat shapes through museum contexts South Sumatra Country *Balaputera Dewa* (Lisnani et al., 2020),

Borobudur temple exploration (Utami et al., 2020), Ethnomathematical exploration of *Mlaten* pottery (Pertiwi & Budiarto, 2020), Ethnomathematics: *Soko Tunggal* Mosque in 2D geometry learning (Putra et al., 2020), Ethnomathematics study of geulis umbrella craftsmen *Tasikmalaya* West Java (Muslim & Prabawati, 2020). These various studies reflect that mathematics is around us and cannot be separated from our daily activities and culture. So teachers need to understand students' culture as the first step in integrating mathematics with their culture to change students' views of mathematics so far, which is later expected to reduce mathematics anxiety in students in various educational units.

Based on the research results described previously, the traditional woven fabric of the *Sasak* tribe provides many philosophical meanings. The meanings studied in the traditional woven fabrics of the tribal community can be viewed from various points of view, such as the motif's shape, the cloth's use, and the philosophical content as a cultural value. Judging from the shape of the motifs of traditional woven fabrics, the *Sasak* people describe geometric shapes, especially flat geometry. However, the basic pattern of making traditional cloth motifs of the *Sasak* people uses parallel lines. It intersects with corresponding angles so that geometric shapes such as rhombuses, triangles, hexagons, rectangles, etc. The motifs contained in the traditional woven fabrics of the *Sasak* tribe are placed in an orderly and patterned manner based on distances and angles, with transformational geometric concepts such as rotation, dilation, and translation. In addition to motifs as decorations on cloth, this motif also contains various philosophies or cultural values that are used as advice for the next generation, such as perseverance, thoroughness, patience, harmony, and sincerity.

The results of research on the ethnomathematical exploration of various cultures in every region in Indonesia can be used as a learning resource to transform mathematics contained in culture and people's lives so that they can change students' perceptions of the mathematics learning process. As a result, students perceive that mathematics is close to their life and culture, which can capture the meaning of the mathematical concepts they learn to apply in everyday life (Prahmana & D'Ambrosio, 2020).

By involving culture in ethnomathematics, mathematics provides many paradigm shifts for students toward the relationship between mathematics, reality, and culture. Previous researchers have also explored ethnomathematics from various points of view, both from cultural artifacts, customs, or other cultural activities. As done by Mardia et al. (2020), the formulation of mathematical representations in the *Marosok* Indigenous trade, by Fauzi et al. (2021) mathematical exploration of the *tui gubuk* layout and architecture of the *Segenter* traditional house, and by Ishartono and Ningtyas (2021) exploration of mathematical concepts in *Sidoluhur Solo batik*.

The research trend of ethnomathematics is not only in Indonesia but also in other countries. For example, research conducted by Massarwe et al. (2010) on the analysis and techniques of drawing geometric shapes on ornaments in Arab schools in Israel. Another research on aligning form, function, and social symbolism: ethnomathematical analysis on technology that develops in Zulu culture (Chahine & Kinuthia, 2013). It shows that researchers worldwide have realized the importance of exploring mathematics that develops in each country's society's culture. In these countries, they not only conduct studies related to the

substance of ethnomathematics, but they also conduct studies on the curriculum. In addition, they see opportunities to offer ethnomathematics in their respective curricula.

Several studies have examined the importance of ethnomathematics in the educational curriculum. Fouze and Amit (2018) conducted the importance of the ethnomathematics curriculum in mathematics education, where this study discusses the importance of developing and implementing a mathematics curriculum that integrates cultural values that are applied to everyday life students. The study by Zhang and Zhang (2017) found ethnomathematics and its integration into the mathematics curriculum. The secondary school curriculum in China can be reformed by adding ethnomathematics. We are seeing the success of ethnomathematics-based mathematics learning in Indonesia in overcoming the level of anxiety and disinterest of students in mathematics lessons. Designing ethnomathematics-based learning and conducting trials in academic units is deemed necessary.

## Conclusion

The study of ethnomathematics is not only to explore mathematics in Indonesian cultural activities, but in the future, it is hoped that it can be included in the mathematics education curriculum. The development of traditional woven fabrics of the *Sasak* people today still maintains its authenticity. It can be seen from the shape of the motifs and cultural symbols that are still attached to adorn these motifs. The motifs contained in the traditional woven fabrics of the *Sasak* people cannot be separated from mathematical forms such as lines, angles, flat shapes, and geometric transformations. It shows that the *Sasak* people have known and used these mathematical concepts. The motifs and spills of the basic colors of the traditional woven fabrics of the *Sasak* people are not only seen as mere beauty. However, they contain moral values both historically and philosophically in each pattern. A thorough study of the culture of the *Sasak* people can be used as a learning resource to find mathematical concepts that can be implemented in learning mathematics in schools.

The mathematical form that is poured into the traditional woven motifs of the *Sasak* tribe is parallel lines and intersecting lines with corresponding angles to form geometric shapes such as triangles, rectangles, rhombuses, and hexagons. At the same time, the shape of the fabric motif uses a geometric transformation pattern such as rotation, dilation, and translation. In addition to the motif as a beauty in the traditional woven fabric of the *Sasak* tribe, this motif also blocks various philosophical and cultural values such as perseverance, thoroughness, harmony, patience, and togetherness.

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## Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and / or falsification, double publication and / or submission, and redundancies, have been completed by the authors.

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## Author Contributions

**Lalu Muhammad Fauzi:** Conceptualization, methodology, data collection, and writing; **Nila Hayati:** Data collection, preparation of manuscript draft; **Rody Satriawan:** Data collection, documentation; **Fahrurrozi:** Data collection, writing and editing.

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