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EXPLORATION OF ETHNOMATHEMATICS IN TRADITIONAL HOUSE ORNAMENTS PAKPAK AS A REPRESENTATION OF MATHEMATICS IN CULTURE

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Abstract

The research conducted is titled "Exploration of Ethnomathematics in Pakpak Traditional House Ornaments as a Representation of Mathematics in Culture," which is based on the fact that Pakpak traditional houses have ornaments that are used to provide beauty and a belief in protecting the people who live in Pakpak traditional houses from evil forces. The current state of Pakpak traditional houses is such that they are very difficult to find. A few still stand in remote villages in Pakpak Bharat Regency, notably in Salak II Village. These traditional houses are now used as recreational sites for tourists and local residents, though some are left to decay and remain uninhabited. The research methodology employed a qualitative approach with an ethnographic perspective. Data and sources were collected through primary and secondary data. Data collection techniques included observation, interviews, and documentation. Data analysis was conducted using data reduction, presentation, and conclusion drawing/verification. The research findings revealed the presence of concepts related to plane geometry, similarity, and geometric transformations. The plane geometry concepts found in traditional Pakpak houses ornaments include squares, triangles, rectangles, trapezoids, pentagons, and circles. Based on the above research findings, the ornaments found in traditional Pakpak houses have their own meanings. The ornaments found in traditional Pakpak houses contain mathematical concepts.

Keywords: ethnomathematics, geometry, pakpak house ornaments

Abstrak

Penelitian yang telah dilakukan berjudul "Eksplorasi Etnomatematika Pada Ornamen Rumah Adat Pakpak Sebagai Representasi Matematika Dalam Budaya", yang dilatar belakangi bahwa Rumah adat Pakpak memiliki ornamen yang dipergunakan dapat memberi keindahan dan adanya kepercayaan dalam melindungi orang-orang yang menghuni rumah adat Pakpak dari kekuatan jahat. Keadaan rumah adat Pakpak saat ini sangat sulit untuk ditemukan, terdapat beberapa yang berdiri diantaranya pada desa terpencil Kabupaten Pakpak Bharat, dikenal dengan Desa Salak II Rumah adat Pakpak saat ini dipergunakan untuk lokasi rekreasi bagi wisatawan maupun penduduk setempat, terkadang tidak sedikit pula rumah adat yang dibiarkan begitu saja hancur dan tak berpenghuni. Metodologi penelitian menggunakan metode kualitatif dengan pendekatan etnografi. Data dan sumber data yang dilakukan dengan data primer dan data sekunder. Teknik pengumpulan data dengan observasi, wawancara dan dokumentasi. Teknik analisis data dilakukan dengan menggunakan reduksi data, penyajian data dan penarikan kesimpulan/verifikasi data. Hasil penelitian mengungkapkan bahwa terdapat konsep geometri bangun datar, kesebangunan dan transformasi geometri. Adapun konsep geometri bangun datar yang terdapat di ornamen rumah adat pakpak di antaranya segi empat, segitiga, persegi panjang, trapesium, segi lima dan lingkaran. Berdasarkan pada temuan hasil penelitian di atas bahwa ornamen yang terdapat pada rumah adat Pakpak memiliki makna tersendiri yang terkandung di dalamnya. ornamen yang terdapat pada Rumah Adat Pakpak di dalamnya mengandung konsep matematika.

Kata kunci: etnomatematika, geometri, ornamen rumah pakpak

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INTRODUCTION

Indonesia is called the largest archipelago in the world, and it is known for its rich cultural diversity, including its art, language, and architecture. One of the most valuable cultural heritages is the traditional house, which not only reflects the identity of a tribe but also holds philosophical and scientific values that can be explored, including in the field of mathematics. One such traditional house is the Pakpak house from North Sumatra (Farhaeni & Martini, 2023). Exploration is an activity that allows for the acquisition of new knowledge and conditions (Heldanita, 2019). According to (Turmuzi et al., 2022) Mathematics and culture cannot be avoided in everyday life, because culture is an integral and comprehensive whole that applies to a society. In addition, mathematics encompasses the knowledge humans use to solve everyday problems.

According to Simbolon, (2020) The cultural wealth and uniqueness of the Pakpak Bharat Regency in North Sumatra Province are highly diverse and undoubtedly contain mathematical concepts within them. Culture encompasses all forms of human creation, taste, and work, reflecting the complexity of life patterns (Syakhrani & Kamil, 2022). Education cannot be separated from cultural values; culture is an important element in education. (Widyastuti, 2021). The existence of an ethnomathematics-based learning system, which will create changes in the scope of learning that is more enjoyable for both teachers and students, to be more active in exploring the cultural environment they already know, will enable the learning process to take place optimally. Furthermore, ethnomathematics-based mathematics learning can improve students' thinking or reasoning processes, problem-solving skills, argumentation and communication (Aulia & Afri, 2023).

History shows that mathematics emerged as a product of cultures related to human social activities (Martyanti & Suhartini, 2018). Mathematics is a science based on reason that deals with abstract objects and thoughts (Khairunnisa et al., 2022). Moreover, mathematics is a subject matter with abstract objects built with a deductive reasoning process, namely, the truth of a concept obtained as a logical result. The purpose of learning mathematics is to train students to think systematically, logically, critically, creatively and consistently, and in learning mathematics requires skills in cognitive, affective, and psychomotor aspects (Indriani, 2022).

Mathematics is included in the subjects studied at all levels of education. According to Mulyati & Evendi in (Siregar and Hasibuan 2019) mathematics is often considered a complicated and frightening subject because it is not interesting nor boring. Fazariah argues in (Azizah & Ananda, 2024) that learning difficulties are a diversity of difficulties in learning correctly in listening activities, stories, reading, writing, reasoning, and counting. This view arises because the teaching methods used by some teachers are still traditional, so they are less able to attract students' interest in learning mathematics. Concept understanding is an essential aspect in the process of learning mathematics.

Ethnomathematics is mathematics that arises and develops within the culture of a particular region. The term Ethnomathematics was first introduced by a mathematician from Brazil, named D'Ambrosio, in 1977. The term ethnomathematics comes from 3 words, namely “ethno”, which means something that leads to a cultural context, and symbols. Next is the word “mathema”, which means explaining, knowing, understanding, and doing activities such as coding, measuring, clarifying, inferring, and modeling. Finally, there is the word “tics”, which comes from the word “techne” and has the same meaning as technique (Aminah, 2023).

Ethnomathematics links culture, mathematics, and education (Safira et al., 2021). In addition, using ethnomathematics can make learning less boring for students and improve children’s creative abilities (Nurhaliza, 2023). Ethnomathematics activities can be reflected through several forms of activities, including counting activities, measuring activities, finding directions and locations, building design activities, and activities related to games (Ajmain et al., 2020).

Based on the observation I gathered through interviews with Mr. Jaunuddin Manik, an elder in the village and a very influential person in the village, or what could be called a community leader, the traditional Pakpak house serves other functions besides being a place of residence. As in the days of their ancestors, when building a house and a burial site, the traditional symbols must be preserved. Therefore, the traditional Pakpak house is not only used as a place of residence but also as a burial site. Additionally, it serves as a symbol of identification, indicating that this is the traditional way of the Pakpak people. Regarding its position within the community, the people say that the traditional Pakpak house is

merely a symbol to identify that this is the Pakpak tradition and that this is how it is built, so it has no specific status. According to Mr. Rudi Sinamo, head of the cultural division at the Pakpak Bharat Tourism Office, traditional Pakpak houses, especially those called “sapo jojong” with their distinctive “jojo” or tower, are very difficult to find, especially in Pakpak Bharat Regency. Only three old houses still have ‘jojo’: two in Siul-Tari Subdistrict (one in Cikau and one in the Red House owned by King Johan) and one in Kaban Tengah. This scarcity is due to age and damage; heirs preferring modern architecture because it is simpler, and there is a lack of skilled labor to build traditional houses. The limited durability of the wooden materials also plays a role. The philosophical meaning of the Pakpak traditional house lies in the head statue on the triangular part of the building, symbolizing that this is the Pakpak tribe, please come. The head facing forward signifies that it can accept anyone who comes to our house, provided they follow the rules or guidelines within the house. This means that whatever decision the house owner makes must be fulfilled; no matter who they are, they must obey. Some say, “Please come in, take off your shoes, and get ready to visit.” For example, the curved roof symbolizes willingness to bend to achieve something good. The Pakpak traditional house is used as a tourist site because such houses are now rare. In the Cikawak area, the Pakpak traditional house is used as a reading room and only as a residence. In the construction of stairs, if the number is even, it means the home owner is not the landowner of that area, and if the number is odd, it indicates the home owner owns the original land of that area. Regarding its role in the community, Mr. Rudi Sinamo stated that the traditional house is a place to discuss customs or general issues. If there are larger issues, they are brought to the Bale, where the Bale leaders or men gather.

Another contributing factor is the lack of concern among some members of the Pakpak community, especially the younger generation, for the cultural heritage and traditions of the Pakpak tribe (Tumangger et al., 2023). Through this study, the researcher aims to explore Ethnomathematics in the ornamentation of traditional Pakpak houses. Previously, the researcher conducted observations and identified several ornamental forms containing mathematical elements resembling plane figures, similarity, and geometric transformations. As such, the researcher seeks to delve deeper into and understand the

ethnomathematics present in the ornamentation of traditional Pakpak houses. This study is similar to a previous study that also discussed ethnomathematics, research (Hasibuan & Hasanah, 2022), entitled Exploration of Geometric Transformations of Interior Ornaments in the Maimun Palace Hall as a Source of Mathematics Learning, Research (Arifin et al., 2025) entitled Exploration of Ethnomathematics in the Design of the Al-Mashun Grand Mosque, research (Reza et al., 2024) entitled Exploration of Ethnomathematics in Congklak Games for Integer Operations in the Batu-belah Community, and research (Fitriani, 2022) entitled Exploration of Ethnomathematics in Bimbang Gedang Dance Among the People of Bengkulu City. There is a significant difference between other ethnomathematics research and the researcher's own research because other research focuses on the interior ornamentation of the Maimun Palace hall, the design of the Al-Mashun Grand Mosque, the game of congklak, and the bimbang gedang dance. Meanwhile, the researcher's study focuses on the ornamentation of traditional Pakpak houses, as well as topics covering plane geometry, similarity, and geometric transformations.

The study aims to provide additional information, new insights, and knowledge in mathematics education. The study provides information and literature to the Faculty of Tarbiyah and Teacher Training as a reference for its research. Providing motivation and innovation in learning to create a more enjoyable learning atmosphere to avoid boredom. It can add more insight into the science of mathematics education in culture. Based on the above explanation, the researcher conducted a study entitled Exploration of Ethnomathematics in Pakpak Traditional House Ornaments as a Representation of Mathematics in Culture.

METHODS

This research used a **qualitative** method with an **ethnographic** approach. This method was chosen because it is suitable for exploring the cultural meaning of traditional Pakpak house ornaments and their relationship with mathematical consepts. Ethnographic research requires researchers to be directly involved in the cultural context under study, observe in the cultural context under study, observe in depth, and record and interpret phenomena found in the field naturally. This approach aims to explore and find the connection between local culture and contextual mathematical knowledge (Mahendra Arivan, 2024).

The researcher interviews two informants, one from head of the cultural affairs division and another from the community. The interview technique used in this study was semi-structured interview to give the researcher flexibility. The research was conducted in Salak II village. This location was chosen in the village where there are still Pakpak traditional houses with various traditional ornaments. The research subjects were ornaments on Pakpak traditional houses that reflect mathematical concepts, such as geometris shapes, symmetry patterns, and elements of songruence and transformation. Researchers do not use samples in the statistical sense because qualitative research emphasizes the richness of information rather than the number of respondents. The research focuss was directed at the object of traditional house ornaments as the primary data source. Data collection was conducted using three main techniques, namely observation, interviews, and documentation, and refers to two types of data: primary and secondary. Data validation was collected and analyzed using the **Miles and Huberman** model, which includes three main stages: **data reduction, data presentation, and drawing conclusions/verifying data** (Wahidmurni, 2017).

RESULTS AND DISCUSSION

This study aims to explore ethnomathematics in traditional Pakpak house ornaments. Data were collected through direct observation with 2 participant, where the researcher acted as an observer with direct involvement. Observations and interviews were conducted on April 30, 2025, in Salak II Village, Salak District, Pakpak Bharat Regency. Documentation of ornaments was done using a cell phone camera.

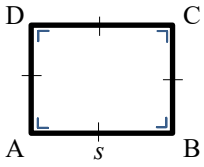
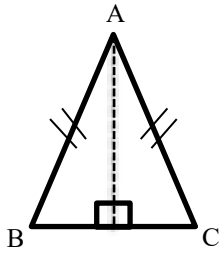
Pakpak Traditional Houses today have undergone significant changes from their original form, which used to be made of wood and palm fiber, to become more modern. Moreover, in the Pakpak traditional house, there are supporting poles and stairs, and the number of supports must be odd, not even, according to the size of the house, so that it is sturdy. However, traditional ornaments can still be found.

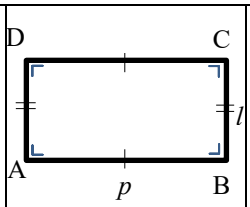
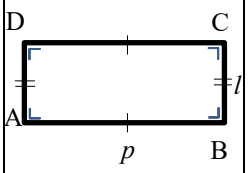
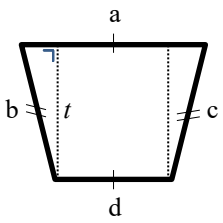
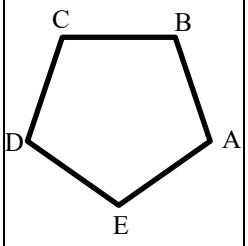
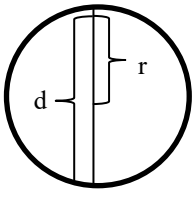
The following is the appearance of the Pakpak traditional house from various points of view:

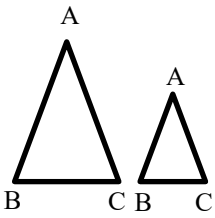
Figure 1 Pakpak Traditional House From the Front

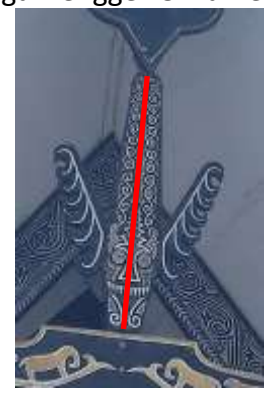
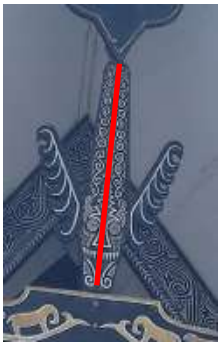
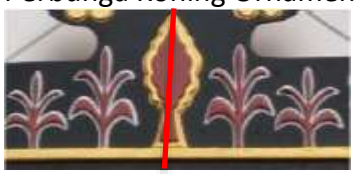
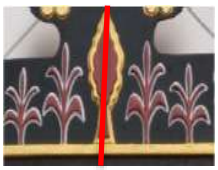
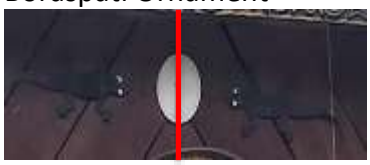
Figure 2 Pakpak Traditional House From the Side

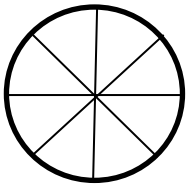
Based on the observation, interview and documentation analysis results, researchers found that Pakpak Traditional House ornaments contain the concepts of geometry, congruence, and geometric transformation. The researcher focuses on the study of flat geometry supported by evidence in the form of tables, and explains the relationship between ornaments and the concepts of congruence and transformation as an application of ethnomathematics in Pakpak Bharat traditional houses.

No	Ethnomathematics	Flat Geometry	Explanation
1	Siwaluh Village Ornament 		Village ornament from siwaluh viewed from the front, have a square-shaped pattern.
2	Silima Tumpak False Ornament 		The shape of the ornament on the front of the house, in the form of a triangle, is isosceles.

3	Persalimbat Ornament 		On the decoration, the front of the house has a rectangular pattern.
4	Kumeke Perhebun Ornament 		The shape of the ornament on the support of the house pakpak traditional house has a rectangular pattern.
5	Gerga Nengger Ornament 		Shape decoration of the home's traditional pakpak that hangs in the upper area of the house has atrape zoid-shaped pattern.
6	Silima Tumpak False Ornament 		The shape of the ornaments on front section of the traditional pakpak house forms a triangle.
7	Silima Tumpak False Ornament 		The shape of the ornaments on the tumpak wrong silima is a circular pattern.

No	Ethnomathematics	Equivalence	Explanation
1	Silima Tumpak False Ornament 		At silima tumpak false ornament there is a pattern shaped, because has the shape of and size the same shape and size.

No	Ethnomathematics	Geometric Transformation	Explanation
1	Gerga Nengger Ornament 		The shape of the ornaments at the top of the house, the pakpak traditional house, forms a reflection pattern (mirroring)
2	Perbunga Koning Ornament 		The shape of the decoration on the pakpak traditional house forms a pattern of reflection (mirroring)
3	Boraspati Ornament 		For home decoration, traditional pakpak, available at the front of house, forma a reflection pattern (mirroring).

4	Epen-epen Ornament 		Shape edge decoration on a traditional house forms a translational pattern (displacement).
5	Moon Ornament 		The shape of the moon ornament on the house, the pakpak traditional house, forms a rotation pattern.

Ethnomathematics is an approach to understanding mathematical concepts that develop and are applied according to a community's cultural context. In community life, mathematical principles are often present indirectly through cultural elements such as traditional games, architecture, musical instruments, and building ornaments which indirectly reflect the application of mathematical principles.

This research explore the concept of Ethnomathematics in Pakpak traditional house ornaments as a representation of mathematics in local culture. A traditional house is a cultural identity that reflects a society's values, beliefs, and philosophy. In Pakpak Traditional Houses, various traditional ornaments were found to contain the concepts of flat geometry, congruence, and geometric transformation.

Flat geometry objects include a square, a triangle, a rectangle, a trapezoid, a pentagon, and a circle. Each of these shapes is found in various typical ornaments. For example, the square shape is found in the Siwaluh Village ornament, and the triangle and pentagon are found in the Tumpak Salah Silima ornament. In contrast, the rectangular shape is seen in the Persalimbat, Perhembun Kumeke, and Epen-Epen ornaments. The flat geometry objects found include square, triangle, rectangle, trapezoid, pentagon, and circle. Each of these shapes is found on various typical ornaments. For example, the square shape is found on the ornament in Siwaluh Village, and the triangle and pentagon are found on the Tumpak Salah Silima ornament. In contrast, the rectangular shape is seen on the

Persalimbat, Perhembun Kumeke, and Epen-Epen ornaments. Trapezoidal shapes are found in Gerga Nengger ornaments, and circles also appear in Tumpak Salah Silima ornaments.

In addition to geometric shapes, the concept of congruence is also identified, especially in the Tumpak Salah Silima ornament, which features a triangular congruence. Meanwhile, the elements of geometry transformation include four main concepts: reflection, translation and rotation. Reflection is found in the Gerga Nengger, Perbunga Koning, and Boraspati ornaments. Translation is seen in Epen-epen. At the same time, rotation is found in moon-shaped ornament. Each ornament observed not only functions as decoration, but also has symbolic and spiritual meanings. Some were explicitly to convey cultural messages or as a form of protection for the home occupants. This indicates that elements of mathematics are not present randomly, but rather are part of the value system and aesthetics of the Pakpak community.

Based on the overall results of observations, interviews, and documentation, the researcher concluded that the ornaments on Pakpak Traditional Houses reflect the close relationship between culture and mathematics. Flat geometry, congruence, and geometric transformation are clearly found in the ornaments, making them a real representation of Ethnomathematics in people's lives.

The uniqueness of this research lies in its focus on exploring building geometry in general and specifically examining ornaments as mathematical objects. Previously, many studies only highlighted the architectural structure of traditional houses, without paying attention to the details of the ornaments that decorate them. In fact, these ornaments hold great potential as a contextual and meaningful medium for learning mathematics.

Overall, this research shows that understanding math concepts does not have to be limited to the classroom or textbook. Instead, by linking these concepts to local cultural contexts, such as traditional house ornaments, math learning can be made more interesting, relevant, and rooted in local wisdom. These findings are expected to enrich insights in mathematics education and encourage cultural preservation through educational approaches.

This study differs fundamentally from similar ethnomathematics studies. While research on geometric transformations in the interior ornaments of the Maimun Palace focuses on the decorative aspects of the palace building, research on the design of the Al-

Mashun Grand Mosque emphasizes the relationship between architecture and mathematical concepts. Research on the game of congklak is more directed toward applying integer operations in traditional games, while research on the Bimbang Gedang dance emphasizes movement patterns as mathematical representations. Meanwhile, this study explores explicitly the ornaments of the traditional Pakpak house, emphasizing plane geometry, similarity, and geometric transformations as mathematical representations in culture. The main contribution of this study is to provide a more in-depth analysis of specific cultural ornaments as mathematical representations and to present direct implications for the development of teaching materials and mathematics learning designs based on local wisdom.

CONCLUSION

Based on the research results, the ornaments of traditional Pakpak houses resemble mathematical concepts. Several geometric concepts include squares, triangles, rectangles, trapezoids, pentagons, and circles. Furthermore, concepts of similarity and transformation were also found within them. This research can provide benefits for future researchers to use as a guideline so that discussions regarding mathematics with culture or Ethnomathematics can be expanded, and provide teacher benefits when they apply material regarding basic mathematical concepts in the classroom.

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