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Ethnomathematics in Jogi dance: An exploration of geometric concepts in Batam Malay traditional arts

Fauziah, Yesi Gusmania, Nailul Himmi*
Universitas Riau Kepulauan, Riau Islands, Indonesia
*Correspondence: nailulhimmi@fkip.unrika.ac.id

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Abstract
This study explores ethnomathematical elements in Jogi Dance, a traditional Malay art from Batam, identifying opportunities for its use in contextual geometry education. Using qualitative ethnographic design, data were collected through systematic observation of seven main dance movements, in-depth interviews, visual documentation, and literature review. Analysis employed the Spradley model to map cultural structure and emerging mathematical concepts. Results revealed that Jogi Dance embodies concepts of angles, lines, triangles, circles, rotations, translations, reflections, number patterns, and periodic functions reflected in movements, floor patterns, and dancer formations. These findings open opportunities to develop various learning media, including contextual geometry worksheets based on dance movements, floor pattern diagram modules representing transformations, motion analysis videos, and digital modeling using GeoGebra. Integrating local culture through Jogi Dance helps students understand abstract mathematical concepts concretely while supporting cultural preservation and character formation aligned with the Pancasila Student Profile. Although exploratory-descriptive, the mapping of ethnomathematical concepts and potentials serves as a fundamental stage before developing learning models or effectiveness tests, providing a solid foundation for pedagogical innovations that educators and teachers can maximize.

Keywords: Contextual learning, Ethnomathematics, Geometry, Jogi dance, Local wisdom

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Introduction

Humans are cultured creatures who pass on habits from generation to generation through traditions and practices of daily life. Mathematics has been an integral part of human culture since early civilizations, but most people are unaware that they have applied mathematical concepts in their daily activities. They tend to view mathematics only as an academic subject studied in school, whereas since ancient times mathematics and art have inspired each other and become important tools in various artistic fields such as architecture, sculpture, painting, photography, literature, and music (Leopold, 2023). According to (S. Stemn, 2010), mathematics education that is relevant to students' cultures makes learning more meaningful and effective, as students can relate the material to experiences and values they are familiar with.

Mathematics is one of the compulsory subjects in the Indonesian education curriculum because it plays a role as a basic science in the development of modern science and technology. However, the reality on the ground shows that the mathematics achievement of Indonesian students is still not optimal. Based on the results of the 2023 Minimum Competency Assessment (AKM), only 43% of Indonesian students have reached the minimum standard in mathematical literacy (Han et al., 2017) which indicates that students' reasoning and problem-solving skills still need to be significantly improved. Research by (Nurharyanto & Retnawati, 2020) It shows that many students have difficulty solving math story problems because they are unable to connect real-world context with relevant math concepts. These difficulties often arise at the stage of understanding the story, building a representation of the situation, and determining the right resolution strategy. Most students tend to focus on calculations without really understanding the context or meaning of the given question.

In mathematics learning in schools, teachers still tend to focus on material from conventional textbooks, so the use of alternative learning resources based on local culture has not been maximized. In fact, research confirms that mathematics should be taught in the context of society and student culture. (Liao, 2020) It shows that cultural integration in mathematics learning can improve students' literacy, motivation, confidence, and innovative thinking. With its rich culture, Indonesia has a great opportunity to include elements of local culture in mathematics learning, so that students' learning abilities increase while preserving the nation's culture. This effort is also in line with the Independent Curriculum which emphasizes contextual learning and strengthening the Pancasila Student Profile (Pendidikan, 2024).

Ethnomathematics is one of the approaches that can bridge formal mathematics with local culture. The concept introduced by D'Ambrosio studies how a cultural group performs mathematical activities such as grouping, measuring, modeling, and understanding the world in social, cultural, and historical contexts (Anderson & Shockey, 2022). The prefix "ethno" includes language, values, customs, food, clothing, and habits, while "mathematics" includes activities such as counting, grouping, making decisions, and modeling (Suharta, 2016). According to (Permana, 2023; Wulandari et al., 2024), the integration of ethnomathematics in mathematics learning in schools can be an effective means to increase motivation, learning satisfaction and strengthen identity and pride in local culture.

The Jogi dance as one of the typical cultural heritage of the Malay Batam was created by a married couple (late) Mr. Basri and Mrs. Normah on Panjang Island and was first performed with one dancer, Mrs. Normah in 1950-1960, then developed into a dance with 5-8 dancers performed by their children and grandchildren until it became a typical dance of Batam City during the leadership of the first Mayor (late) Raja Usman Draman and continued by the Mayor Drs H. Nyat Kadir. Philosophically, Jogi Dance tells the life of a coastal woman who is putting on makeup and doing housework as an expression of gratitude and happiness when welcoming her husband or brother home from the sea. This daily routine is poured into dance movements that mean "dance" in the local language with 7 main movements that are rich in geometric elements and mathematical transformations. The Jogi Dance has been designated as a National Intangible Cultural Heritage (WBTb) in 2023 and is maintained by

the Basri Beach Cultural Heritage Studio located in Setouk Village, Bulang District, Batam City, Riau Islands (Pendidikan, 2024).

The relationship between Jogi Dance and mathematics can be seen from its movements which contain the concepts of geometry and transformation. Each movement has a pattern and structure that can be analyzed using angles, symmetry, rotation, translation, and reflection. In geometry, an isometric transform is a change that maintains shape and distance. Isometrics are divided into two: (1) Direct isometry, such as translation and rotation, that do not reverse the orientation of the object; (2) Indirect isometry, such as reflection and combined reflection, that reverse the orientation of the object. In geometry algebra, direct isometrics are often associated with automorphism, while indirect isometrics are associated with antiautomorphism and reversion operations (Calvet, 2017). The geometric elements in the Jogi Dance also have the potential to be developed as a mathematics learning medium in accordance with the Independent Curriculum. Research Wardah, Panglipur, and Putra, 2023 shows that movements, angles, floor patterns, and transformations in this dance can be processed into teaching materials such as motion-based LKPD, contextual geometry modules, floor pattern analysis sheets, and videos or animations that model rotation, reflection, and translation.

Previous studies have not systematically and comprehensively examined the relationship between the movements and formations of the Jogi Dance and geometric concepts, particularly geometric transformations. Moreover, there is still a lack of in-depth and structured analysis that maps the ethnomathematical elements embedded in each movement and formation of the dance. Consequently, a research gap exists in developing a framework for utilizing the Jogi Dance as a contextual mathematics learning medium based on local culture. This study aims to explore and analyze in depth the ethnomathematical elements of the Jogi Dance, especially geometric concepts and transformations, and to illustrate their potential implementation in contextual geometry learning through the design of culture-based learning media or activities. Such a framework is expected to support students' conceptual understanding, align with national education goals, and contribute to the preservation of cultural heritage.

Method

Based on the problems formulated in this study, this study applies qualitative methods with relevant ethnographic designs to examine the relationship between culture and mathematics, especially in the context of education. Ethnography focuses on describeing, analyzing, and interpreting patterns of behavior, beliefs, and language within specific cultural groups, making it ideal for exploring how mathematics is practiced and interpreted in the context of local cultures. (Maryati & Prahmana, 2019) The research was carried out at the Basri Beach Malay Studio located on Panjang Island, Batam City, Riau Islands. This location was chosen because it is a center for the preservation of authentic Jogi Dance and an official place designated to preserve the National Intangible Cultural Heritage (WBTb) of Jogi Dance which is set in 2023. The subject of the research is Mr. Abdullah Basri as the Secretary of the Basri Beach Heritage Studio who was selected based on the criteria of having in-depth knowledge of the history and philosophy of Jogi Dance, being a direct descendant of the

creator of the dance, and having competence in explaining the meaning of each dance movement and also involving active dancers of the Basri Beach Studio, local cultural figures, and the younger generation who learn Jogi Dance.

The data collection technique used an observation method to systematically observe the 7 main movements of the Jogi Dance (worship, hips, beautiful, mirroring, dressing, washing, pulling the yarn) and lenggang movements with a focus on the identification of angles, geometric shapes, movement patterns, and dance formations. The semi-structured in-depth interview was conducted for approximately 1 hour with a focus on the history, philosophy, cultural meaning, and technique of each movement in the context of Batam Malay culture. Visual documentation is done through video recording from various points of view, photography of each key movement, creation of floor pattern diagrams, as well as written documentation to record detailed descriptions of movements and their meanings. The documentary study was carried out by collecting secondary data in the form of official documents on the determination of the Jogi Dance as a National Intangible Cultural Heritage, literature on Batam Malay culture, ethnomathematical references and geometric transformations, and previous research on mathematics in traditional dance arts.

The research uses instruments in the form of ethnomathematical observation guidelines that include checklists to identify geometric concepts (pointed, right-ang, straight, and triangular, circle, line-shaped), geometric transformations (rotation, translation, reflection, dilation), mathematical patterns (number patterns, symmetry, periodic functions), and spatial relationships (relative positions of dancers, distances, and formations). The interview guidelines are in the form of a list of open-ended questions that include historical aspects, cultural meanings, detailed descriptions of movements, rules and techniques, as well as the philosophy and values contained in the Jogi Dance. The mathematical analysis sheet is used as a template to analyze each movement based on the type of angle formed, the geometric transformations that occur, the mathematical patterns that appear, and the relationships between geometric elements, so that it can produce measurable and systematic data to answer the formulation of research problems (Dahal et al., 2022).

The data analysis technique applies the Spradley Model which consists of four stages of systematic analysis. Early-stage domain analysis to identify the main categories or domains of the data, i.e. the groups of meanings that often appear in interviews or observations (Hidayati et al., 2021). Taxonomic analysis organizes the domains that have been discovered into a hierarchical structure, so that the relationships between sub-categories within the domain can be systematically mapped. Component analysis analyzes the differences and similarities between elements in the domain, to find a deeper dimension of meaning, as well as cultural analysis finds the main cultural themes that are the common thread of the entire data, so that conclusions can be drawn about the cultural patterns being studied (Garrido, 2017). The analysis of cultural themes identified the cultural themes that are the basis of the practice of Jogi Dance, including the themes of cooperation, harmony, gratitude, and respect in the Batam Malay tradition. To ensure the validity of the data, the research used the technique of triangulation of sources (speakers, dancers, official documentation, literature), triangulation of methods (observation, interviews, documentation, literature studies), and triangulation of theory (D'Ambrosio ethnomathematics, geometric transformation, culture and contextual learning). External validation was carried out by comparing the results of the

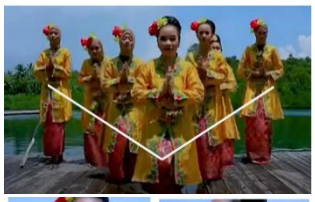
analysis with previous research on ethnomathematics in traditional dance arts (Dominikus et al., 2024). To strengthen the findings, group discussions were also held with the studio community so that the perspective obtained was broader and collective. The study also implemented several verification measures to ensure reliability. Cross-check between researchers so that the interpretation of each stage of Spradley's analysis remains consistent. Conduct member checking by confirming the results of the analysis to the main resource person and other dancers. Compile trail audits in the form of field notes, interview transcripts, and visual documentation that can be traced, and conduct peer debriefing with Malay cultural experts to test the consistency of interpretation so that it can produce valid, reliable, and scientifically accountable findings.

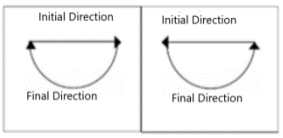
Result

One approach that can be applied in mathematics learning to connect mathematics with culture is cultural exploration (Nur et al., 2022). In this context, culture plays a crucial role in education and shapes students' perspectives in dealing with various issues. The exploration carried out in this study focuses on Jogi Dance, a traditional Malay art form from Batam, Riau Islands, which shows a significant relationship with mathematics learning, particularly in geometry education.

The Jogi Dance tells the story of coastal women who beautify themselves and do household chores as an expression of gratitude and happiness when welcoming their husbands or brothers who return from the sea (Tamara et al., 2022). It represents the daily routines and habits of coastal women. This routine is embodied in a dance called Jogi, which means "to dance" in the local language. The Jogi dance consists of seven main movements: (1) the worship movement—shaking hands, symbolizing saluting the audience; (2) hip movements—holding the waist while rotating left and right, as well as up and down, as if imagining yourself dressing up in front of a mirror and checking if the clothes are appropriate; (3) pretty gestures—checking their faces to see if they look beautiful; (4) mirror movements—in which the dancer is depicted looking in the mirror, taking care of themselves or applying makeup; (5) Dressing gestures—imagining their beautiful and graceful bodies; (6) Washing movement—depicting the activity of women washing clothes while waiting for their husbands to return to the sea; and (7) Thread pulling movements—depicting their joy when their husbands return home to sea. Each movement in the Jogi Dance not only has a physical aspect but is also full of meaning. For example, the movement of washing clothes symbolizes devotion and loyalty, while the movement of pulling and winding the thread depicts happiness and love in a coastal family. Studies show that cultural values such as politeness, hard work, and compassion can be expressed through dance movements. Based on the research conducted, the ethnomathematical elements identified in the Jogi Dance are presented systematically in the following analysis (Table 1).

Table 1. Ethnomathematical Concepts in Jogi Dance

Mathematical concepts	Kind	Documentation	Information
Taper Corners	The movements in the Jogi dance can form a pointed angle when the dancer makes a movement of cupping both hands in front of the chest as a greeting to the audience.		Gestures of worship in gestures
Taper Corners	The movements in the Jogi dance can form a pointed angle when the dancer takes the formation before performing the next movement.		Worship movements on floor patterns
Taper Corners	In the hand on the shoulder and the hand on the waist, the mathematical pattern formed from these movements is a pointed angle.		Dressing motion on gestures
Right Angle	In the movement of the left hand in front of the body, at the elbow of the hand forms an angle, namely the right angle		Beautiful gestures in gestures
Right Angle	In the movement, the dancer places the left hand on the waist and the right hand is perpendicular to the position of the hand forming a right angle.		Mirrored motion on gestures
Straight Corners	The dancer's movement that goes backwards to form a horizontal straight line. The mathematical pattern of this movement is a straight line		Dressing motion on gestures
Straight Corners	In this movement, if a straight line is drawn between the right hand and the left hand, there is a straight angle.		Thread roll pull motion on body gestures

Mathematical concepts	Kind	Documentation	Information
Crossed Lines	In the washing movement, the left hand goes forward and slightly obliquely to the right, while the right hand forward is slightly oblique to the left but does not touch. This movement is related to the concept of number lines.		Washing motion in body movements
Point Rotation	When the dancers enter the room, the dancers at the back initially face the back side of the stage and then rotate to face the front side of the stage. The mathematical concept that exists in this pattern is the rotation of 180 points.°	  	Worship movement On the floor pattern
Point Rotation	The dancer rotates to change the front of the dancer. Initially, the dancers faced the front side, then the rotational dancers faced the right side and then faced the front side of the stage again. The mathematical concept that exists in this pattern is the rotation of points as far as 90°	 	Hip movements in body movements
Point Rotation	In the mirror-like movement of the rotating wrist, this rotation is called rotation. The mathematical concept that exists in this pattern is the rotation of points as far as 90.°	 	Mirrored motion on gestures

Mathematical concepts	Kind	Documentation	Information
Equilateral Triangle	From the movements of the hands at the waist, the pattern formed from the body and hands forms an equilateral triangle pattern.		Hip movements in body movements
Circle	The shape of the circle can be seen on the formation or floor pattern when the dancer finishes dancing. The pattern suggests a circular flat build.		Thread Pull Motion on Floor Pattern
Reflection	There are two groups of dancers standing opposite each other in two rows in a row. If a vertical imaginary line is drawn in the center of the symmetry line, each group appears to be a mirror image of each other.		Worship movements on floor patterns
Number Pattern	In the first row there are 1 dancers, in the second row there are 2 dancers and in the third row there are 4 dancers. This concept forms a number pattern.		Gestures of worship on Floor pattern
Periodic and Arithmetic Functions	Lenggang has a movement pattern that is repeated regularly, for example steps back and forth or left-right. These loopholes can be analyzed using the concept of periodic functions. If the squat is done with a specific number of steps, e.g. 2 steps forward and 2 steps back, then this reflects an arithmetic sequence in the movement (e.g., 2, 4, 6 steps in a single movement session).		Squat movements in body movements
Translase Symmetry	If the langang is performed uniformly by several dancers in a single formation, then this movement reflects translational symmetry, where each dancer moves for the same distance in the same direction.	 Two steps forward  Two steps back	Squat movements on floor patterns

In addition to basic geometry, the dance also incorporates more advanced mathematical concepts. The pattern of the dancers' formation that follows the 1-2-4 sequence represents a geometric sequence, which introduces students to the pattern of exponential numbers in context. The periodic and repetitive nature of the langang movement describes the periodic function and arithmetic sequence, as the dancer performs consistent forward-backward or left-right steps at regular intervals. These patterns can be mathematically modeled using functions, which provide relationships between physical movements, cultural expressions, and algebraic representations. The mathematical concepts identified in the Jogi Dance are in line with the geometry curriculum standards at the elementary and secondary levels in Indonesia. Basic geometry standards, including angle identification, basic transformation, and symmetry recognition, are all evident in this dance. Secondary geometry standards involving coordinate geometry, formal transform analysis, and geometric proofing can be explored through more sophisticated dance pattern analysis. This alignment ensures that the ethnomathematical approach using Jogi Dance is not just additional enrichment, but can serve as core learning content that meets formal learning objectives.

Furthermore, the integration of Jogi Dance into mathematics education supports the broader goals of the Indonesian Independent Curriculum and the Pancasila Student Profile. The dance embodies the values of mutual cooperation through coordinated group movements, global diversity by celebrating and preserving local cultural heritage, creativity in artistic expression, and critical reasoning as students analyze mathematical structures in cultural practice. By learning mathematics through Jogi Dance, students simultaneously develop cognitive math skills, affective appreciation of cultural heritage, and character that are aligned with national educational values. This holistic approach overcomes the limitations of traditional math teaching that often develops cognitive skills separately from the broader educational goals, namely cultural preservation and character building.

Later in the Comparative Cultural-Mathematical Analysis, the mathematical richness identified in the Jogi Dance is consistent with findings from other traditional Indonesian dances, but each dance offers unique geometric characteristics that reflect its different cultural contexts. The Balinese dance emphasizes intricate hand and eye movements that create complex angular patterns, the Saman Dance from Aceh features highly synchronized group movements that demonstrate advanced concepts of periodicity and rhythm-based mathematical patterns, and the Tor-Tor Dance of Batak shows the symmetry of rotation and reflection in paired formations. This diversity suggests that Indonesia's vast cultural heritage offers almost unlimited resources for culturally contextualized mathematics education. Each region can develop math learning materials based on local traditional arts, creating a national ethnomathematics resource network that validates local cultural knowledge while teaching universal math concepts.

The findings of this study show that Jogi Dance is not just a means to teach predetermined mathematical content, but a true cultural-mathematical knowledge system in which mathematical thinking is authentically embedded. This reframes the relationship between culture and mathematics education from an instrumental relationship (culture as a tool to teach mathematics) to true integration (culture and mathematics as a mutually constructive knowledge system). Such integration allows students to see themselves and their

cultural communities as math thinkers, challenge narratives of inadequacy, and build positive mathematical identities grounded in pride and a sense of cultural belonging.

Discussion

The results of the exploration show that each element of dance, whether in the form of gestures, hand positions, floor patterns, or the arrangement of dancers, systematically contains geometric concepts such as angles (tapered, right, straight), transformations (rotation, translation, reflection), symmetry, as well as number patterns and periodic functions. For example, the sembah (salam) movement that the dancer performs when cupping both hands in front of the chest not only signifies respect but also forms a pointed angle, both in the position of the hands and in the body formation. Beautiful, mirrored gestures show right angles, while dressing gestures depict straight angles. In terms of geometric transformations, rotation is evident in changes in the orientation of the dancer, such as when the dancer rotates 90° or 180° while performing the bow and hip movements. Meanwhile, the translation is reflected in the backward and backward steps in the squat movement, and the reflection is clearly seen in the formation of two rows of dancers facing each other symmetrically. This discovery expands the understanding of the relationship between culture and mathematics, which was previously discussed by D'Ambrosio in ethnomathematical theory, which views mathematics not only as a universal science but also as a product of the construction of cultures that vary across different societies.

The practice of mathematics arises from local needs, habits, and values (Wahyuni et al., 2023). This study confirms this perspective by showing that the Jogi Dance explicitly represents geometric shapes in the local cultural structure of the Batam Malay community. However, the study goes beyond just descriptive documentation by providing a framework for systematic analysis using the Spradley model, which allows researchers to identify and categorize cultural themes that emerge from cultural practices, such as harmony, gratitude, and love in the lives of coastal communities (Kaliongga & Iriani, 2022). The Spradley model involves several stages of analysis, namely domain analysis, taxonomic analysis, component analysis, and cultural theme analysis that allow the excavation of the deep meanings contained in mathematics-related cultural activities (Sabaruddin et al., 2022). This structured approach moves ethnomathematical research from simple observation to cultural-mathematical analysis that is real and replicated in other traditional art forms.

Compared to previous research, this study deepens the ethnomathematical approach to traditional dance through a more comprehensive and systematic analysis. For example, research on Balinese dance movements shows that ethnomathematical elements appear in the form of parallel lines, intersecting lines, line segments, taper corners, blunt angles, right angles, reflections, rotations, and translations in various dance movements, including the Pendet Dance. Elements of reflection and translational symmetry are also found in floor patterns and repetitive movements, which show the relationship between dance and mathematical concepts such as symmetry and periodic functions in ethnomathematics (Dewi et al., 2022).

In addition, the pattern of number sequences such as 1-2-4 in the Jogi dance formation and the synchronous pattern in the Saman Dance reflect the periodic order and the use of

mathematical sequences in choreography. Research has also shown that the use of patterns, sequences, and symmetry in dance not only embellishes movements, but also strengthens artistic expression and enriches cultural meaning. Thus, both the Jogi Dance and the Saman Dance show that mathematics and culture are closely intertwined through the patterns, symmetry, and functions that are manifested in dance art (Farinha & Alves, 2024). Meanwhile, the Tor-Tor Dance from Batak also reveals the relationship between the type of symmetry in paired dance and the spatial management contained in the structure of the Jogi Dance (Albanese & Herrera Janques, 2024) However, the strength of this research lies in the systematic and structured approach in examining each movement of the Jogi Dance based on the type of angle, geometric shape, and spatial transformation, such as point rotation, vertical axis reflection, and translational symmetry modeling, which provides a firmer foundation for pedagogical application compared to previous research which is still general observational.

This research has substantial practical significance in developing learning media and contextual mathematics teaching materials based on local culture. Element mapping and geometric transformation in the Jogi Dance opens up opportunities to develop various learning media that bridge abstract mathematical concepts with concrete cultural experiences that are familiar to students. Specific teaching media and materials that can be developed include: (1) Context-based student worksheets (LKPD) in which students identify angles, transformations, and symmetry in certain Jogi Dance movements, such as analyzing worship movements to identify pointed corners or examining lenggang movements to understand translation concepts (Khairunnisa et al., 2025); (2) Thematic module "Geometry in Jogi Dance" which presents the concept of geometry systematically through dance movements, complete with visual illustrations, movement diagrams, and contextual problem exercises; (3) Floor pattern diagrams as a transformation visualization tool that explicitly shows rotation, reflection, and translation, allowing students to observe abstract transformations in concrete visual form (Korini & Sari, 2024); (4) A movement analysis video that documents each dance movement from different angles, with geometric overlay annotations that highlight the angles, lines, and transformations that occur directly (Dahal et al., 2022); (5) Digital modeling using GeoGebra which allows students to manipulate virtual models of dancers' movements and formations, experiment with various geometric transformations and directly observe the results; and (6) *Augmented Reality* (AR) learning media that allows students to visualize three-dimensional geometric concepts through their smartphones or tablets (Buchori et al., 2024) by scanning markers related to Jogi Dance movements. This media not only supports cognitive understanding but also integrates affective and cultural dimensions, in line with the Merdeka Indonesia Curriculum which emphasizes contextual learning and strengthens the Pancasila Student Profile (Pendidikan, 2024).

The integration of Tari Jogi into geometry learning can be implemented by combining physical activities through dance movements with mathematical concepts, creating a contextual, interactive, and meaningful learning experience. Students can practice floor patterns or movements of Tari Jogi to represent geometric concepts such as shapes, symmetry, transformation (translation, rotation, reflection), and measurement, which has been shown to enhance understanding as it activates both cognitive and motor skills (Hraste et al., 2018). Additionally, the use of digital media such as applications or videos that visualize the movements and geometric transformations in Tari Jogi can help students grasp concepts more

clearly while increasing motivation and engagement (Rachman et al., 2025). Inquiry-based and collaborative approaches may also be applied by guiding students to observe, analyze, and discuss geometric elements within the dance, either directly or through digital media, and present their findings to strengthen conceptual understanding (Uygun, 2020).

The worship movement embodies respect, the washing gesture symbolizes dedication and loyalty, while the pull of the thread depicts happiness and love in a coastal family. These cultural values are in line with the goals of character education in the Pancasila Student Profile, especially in the dimensions of faith and piety, global diversity, mutual cooperation, and critical reasoning (Faizah et al., 2023). Thus, integrating culture into mathematics learning not only reinforces the cognitive aspect but also internalizes affective and social values consistent with a holistic educational perspective, addressing critical gaps in mathematics education that often focus exclusively on cognitive skills while ignoring the affective and cultural dimensions that make learning meaningful and sustainable (Chiu et al., 2022).

It is important to acknowledge that this research is still exploratory-descriptive. However, this should not be seen as a limitation but as an important and valuable first stage in the process of greater pedagogical innovation. The mapping of ethnomathematical concepts and potentials in the Jogi Dance provides a strong and important foundation for the next phase of research, including: (1) The development phase that creates a prototype of learning media and teaching materials based on the identified geometry concepts; (2) Expert validation phase of the developed material for content accuracy, cultural appropriateness, and pedagogical effectiveness; (3) The implementation phase of classroom trials with a pre-test/post-test design to measure learning effectiveness; and (4) The refinement phase of repeated improvements based on implementation feedback. Without this basic exploratory work, subsequent development and testing would lack the rigorous cultural-mathematical analysis necessary to create teaching materials that are authentic, theory-based, and culturally meaningful. Therefore, future research is strongly recommended to build on these findings by developing a complete teaching instrument based on the Jogi Dance and testing its effectiveness in the classroom environment, thus maximizing practical benefits for teachers and educators.

This study contributes to a growing body of literature that shows that Indonesia's rich cultural diversity is not only a heritage that must be preserved, but also a vast pedagogical resource that can transform mathematics education. By systematically documenting how traditional practices embody sophisticated mathematical thinking, this research challenges deficit narratives that position local knowledge inferior to Western academic mathematics. Instead, this research suggests that ethnomathematics can serve as a bridge that validates students' cultural identities while providing a pathway to formal mathematical understanding. Furthermore, in an era where education increasingly emphasizes STEM competencies, this research shows that cultural arts do not need to be marginalized, but can be strategically integrated to improve mathematical literacy, motivation, confidence, and innovative thinking (Liao, 2020).

Jogi Dance provides a replicable model for other regions in Indonesia to explore their own traditional arts through a mathematical lens, creating a national movement towards culturally responsive mathematical pedagogy. This exploration of the Jogi Dance shows that

traditional cultural practices contain sophisticated mathematical structures that can be systematically analyzed and used pedagogically. These findings advance ethnomathematical theory by providing a detailed analytical framework, offering a practical foundation for developing diverse culturally-based learning media, and contributing to the broader educational goals, namely cultural preservation and character building. Although more research is needed to develop and test specific teaching materials, this study builds the necessary foundations for such innovations, which ultimately support mathematical literacy and cultural sustainability in Indonesian education.

Conclusion

This study succeeded in identifying various ethnomathematical concepts in the Jogi Dance movement ranging from angles, geometric transformations, number patterns, symmetry, to periodic functions which show that dance movements and formations based on the routine of coastal Malay women in Batam contain mathematical elements that have the potential to be used as contextual learning media. In general, Jogi Dance can be used as a local culture-based mathematics learning approach that is fun, relevant, and able to bridge abstract concepts with real student experiences while preserving culture according to the Pancasila Student Profile. This research is still exploratory-descriptive, it should be emphasized that the mapping of ethnomathematical concepts and potentials is a fundamental stage before the development of learning models or effectiveness tests, so that these findings actually provide a strong foundation for future learning innovations. Therefore, the next research is recommended to develop a teaching tool based on Jogi Dance and test its effectiveness in the classroom so that its practical benefits can be maximized by teachers and educators.

Declaration

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