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# Analysis of Mathematical Concepts in Cowongan Rituals: An Ethnomathematics Study of the Soka Village Community in Batang Regency

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**ABSTRACT**

This study is an ethnomathematical analysis that focuses on the mathematical concepts embedded in the Cowongan Ritual, an agrarian tradition of the Javanese community that is still preserved in Soka Village, Batang Regency. This ritual is typically performed as a plea for rain during prolonged droughts and represents local wisdom passed down through generations. The research employs a qualitative-descriptive method with an ethnographic approach to understand the symbolic meanings and cultural context of the ritual. Data were collected through observations of all stages of the ritual, in-depth interviews with community members, and documentation. Data analysis focused on identifying mathematical concepts that appear in the symbols, structures, and ritual actions. The main findings identify three formal mathematical concepts that are intuitively applied in this cultural practice: first, the concept of odd numbers, which appears in determining the number of offerings and the repetition of movements, which mathematically reflects an arithmetic sequence with the nth term formula Un=2n−1; second, modular arithmetic, which underlies the determination of the ritual time on the night of Friday Kliwon, where the 35-day repeating cycle (selapanan) can be modeled as a solution of simultaneous congruences between modulo 7 (day cycle) and modulo 5 (Javanese market-day cycle); and third, symmetry and geometry, which are evident in the circular formation of the procession and the swinging movements of Nini Cowong that contain rotational symmetry, while the ornaments of the effigy also display reflective symmetry. The conclusion of this study is that the Cowongan Ritual contains a strong mathematical structure that is closely integrated with Javanese spiritual and cosmological values, thus making a tangible contribution to the development of contextual mathematics learning based on local culture.



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## INTRODUCTION

The Cowongan Ritual is one of the agrarian traditions of the Javanese people that is still preserved in several rural areas, including Soka Village, Batang Regency. This tradition is commonly performed to ask for rain during prolonged droughts or when the community perceives an imbalance between humans and nature (Masrokhah et al., 2021). In practice, Cowongan is not merely a spiritual medium; it represents local wisdom transmitted across generations, sustaining communal memory and ecological ethics through ritual performance

(Andini, 2023). In this sense, Cowongan can be read as a cultural testimony of how Javanese communities interpret their relationship with nature and the metaphysical forces believed to govern ecological order (Jákl, 2017).

Cowongan is infused with symbols, prayers, traditional music, and choreographed movements that carry culturally specific meanings. These ritual elements reflect Javanese philosophical commitments to harmony and balance values that regulate not only spiritual life but also the community's ecological imagination and social cohesion (Andini, 2023; Irawan et al., 2022). Such ritual practices resonate with broader discussions of Javanese communal religiosity, where ceremonies and collective rites become key mechanisms for articulating belief systems, negotiating uncertainty, and reaffirming shared norms (Hakam, 2017). In contemporary contexts, Javanese ritual traditions also function as culturally grounded strategies for coping and maintaining collective resilience in the face of disruption (Septian & Yunanto, 2023). Accordingly, Cowongan should be understood as a living cultural system: it mediates relations between humans and the environment while simultaneously reinforcing communal identity and moral order (Syafiq & Putri, 2022).

**Figure 1. Cowongan Procession**

In recent years, studies on local traditions have increasingly developed through the perspective of ethnomathematics, defined as the study of how mathematical ideas and practices are embedded in cultural activities and everyday life (Serepinah et al., 2021). From an ethnomathematical viewpoint, mathematics is not confined to formal, abstract symbols; it is also alive within ritual structures, material arrangements, number selection, movement patterns, and the rules that communities reproduce through practice. Therefore, cultural performances such as Cowongan may contain an internal mathematical logic that is meaningful both analytically and pedagogically.

The Cowongan ritual in Soka Village is particularly compelling for ethnomathematical inquiry because it exhibits repeated and patterned features that can be modeled mathematically. The use of odd numbers in offerings, the repetition of movements and mantras, and rhythmic musical sequences indicate numerical principles that align with Javanese cosmological reasoning, where odd numbers are often associated with "productive imperfection" a symbolic openness that invites blessing, transformation, or change (Tupan et al., 2022). Beyond numerical symbolism, modular arithmetic, number patterns, and symmetry can also be inferred from the geometric forms of offerings and the structured repetition within ritual choreography. These features position Cowongan as a culturally situated site where mathematical structures and symbolic meaning co-produce ritual coherence.

Understanding mathematical concepts within traditional ceremonies such as Cowongan also opens pathways for educational development, particularly for designing culturally responsive mathematics learning (Tandililing & Belakang, 2013; Dari, 2024). Prior research suggests that integrating local cultural values into mathematics education can strengthen student engagement and improve critical thinking by making mathematical ideas more relatable and experientially grounded (Luxcya, Martir, Wona et al., 2024). In line with this argument, contextualizing mathematics through local cultural practices can also reduce the perception that mathematics is distant, overly difficult, and detached from social life (Budiarto, 2016). In other words, ethnomathematics does not only enrich cultural interpretation but can also function as a bridge between formal curriculum goals and students' lived worlds.

Based on this background, this study focuses on how the Cowongan ritual is carried out in Soka Village and how mathematical concepts are embedded in its symbols, structures, and actions. Specifically, the study (1) describes the form and stages of the Cowongan ritual as practiced by the community; (2) identifies mathematical concepts expressed through ritual objects, spatial arrangements, and patterned repetition; (3) examines how odd numbers, modulo principles, and symmetry operate within the ritual sequence; and (4) discusses how these ethnomathematical findings may be connected to formal mathematics learning. By linking Cowongan to mathematical reasoning, this research aims to support a more inclusive and contextually rich educational paradigm that values local wisdom (Kurniasari et al., 2019).

## METHOD

This study employs a qualitative-descriptive design with an ethnographic orientation to investigate the symbolic meaning and cultural context of the Cowongan ritual in Soka Village. The ethnographic approach was selected because it enables an in-depth exploration of cultural practices through prolonged observation, direct engagement, and social interaction with members of the community (Yosevina et al., 2025). Ethnography, in this context, is not merely a method of documentation but a framework for understanding how meaning is constructed, transmitted, and sustained within ritual performance.

In addition, this research adopts an ethnomathematical perspective to examine mathematical concepts embedded within the ritual structure. Ethnomathematics positions mathematics as a cultural product that emerges through social practices rather than solely through formal abstraction. This perspective is particularly relevant in analyzing the systematic use of odd numbers in offerings, the patterned repetition of mantras, and the rhythmic movements within the Cowongan dance. Such elements demonstrate that local cultural practices often contain implicit mathematical reasoning that serves social, symbolic, and spiritual functions (Fatimah et al., 2024; Siregar et al., 2024).

Data collection was conducted across all stages of the ritual, beginning with the preparation of offerings and culminating in the closing ceremony. Systematic observations focused on documenting the number of ritual objects, spatial arrangements, sequence of movements, repetition patterns, and temporal structures. These observations were complemented by in-depth interviews with community elders, ritual leaders, and participants who possess historical and cultural knowledge of the Cowongan tradition. Through these interviews, the researchers explored the symbolic meanings attached to numerical patterns, particularly the use of odd numbers, which in the Javanese cultural framework signify fertility, dynamic balance, and cosmological harmony (Wardani et al., 2023).

Supporting documentation was obtained in the form of photographs, video recordings, and detailed field notes to ensure data credibility and contextual accuracy. The data were analyzed through a process of reduction, categorization of recurring patterns, and triangulation of observational and interview findings. Analytical emphasis was placed on identifying numerical regularities, repetition sequences, geometric configurations, and cyclic temporal structures within the ritual. This interpretative process draws upon established ethnomathematical frameworks applied in previous cultural studies in Indonesia (Sarah et al., 2022).

The qualitative interpretation situates the consistent use of odd numbers as an integral component of Javanese spiritual structures and cosmological representation. At the same time, the findings reaffirm the explanatory power of ethnomathematics in illuminating the relationship between cultural systems and mathematical cognition (Fatimah et al., 2024; Yosevina et al., 2025). By integrating ethnographic depth with mathematical modeling, this methodological design enables a comprehensive understanding of Cowongan as both a cultural and mathematical phenomenon.

## RESULTS AND DISCUSSION

### The Cowongan Ritual in Soka Village

The Cowongan ritual in Soka Village, Batang Regency, Central Java, is an agrarian tradition that has been transmitted across generations as a communal supplication for rain and soil fertility. Performed during prolonged dry seasons, the ritual functions as an ecological-cultural response to drought conditions that threaten agricultural productivity. Within the Javanese cosmological framework, rain is not perceived merely as a meteorological phenomenon but as a manifestation of divine blessing that emerges through harmony between humans, nature, and spiritual forces.

Offerings in the Cowongan ritual are carefully arranged according to inherited patterns rather than assembled arbitrarily. Common components include young coconuts, free-range chicken eggs, incense, flowers, holy water, and traditional snacks. The number of offerings is consistently determined using odd numbers typically three, five, or seven which reflect Javanese numerical cosmology associating odd numbers with dynamic spiritual energy and balance between humans, nature, and the divine (Wardani et al., 2023).

Preparation of the ritual is primarily undertaken by married women, who are symbolically associated with fertility and generative power. They prepare both the offerings and the central ritual object known as *Nini Cowong*, often fashioned from a decorated coconut shell or ladle representing a female guardian spirit of water. The ritual is usually conducted on Friday Kliwon, a day believed to hold collective spiritual potency within the Javanese calendar system.

At the opening stage, a female ritual leader (*mbok Cowongan*) recites mantras and burns incense to invoke Dewi Sri, the goddess symbolizing agricultural fertility and prosperity. The community then sings the Cowongan chant in repeated rhythmic patterns. This repetition functions not only as devotional expression but also as a structured rhythmic mechanism that strengthens collective memory and shared spiritual focus. At the ritual's peak, water is sprinkled toward four cardinal directions and upward, symbolizing the five-direction cosmological structure central to Javanese metaphysics. The ceremony concludes with a *kenduren* (communal feast), reinforcing gratitude and social cohesion. In this sense, Cowongan operates simultaneously as spiritual practice and as a mechanism for strengthening communal identity (Yosevina et al., 2025).

From an ethnomathematical perspective, this ritual context reveals that cultural practices embody structured numerical and spatial patterns that persist within community traditions (Siregar et al., 2024).

**The Concept of Odd Numbers in Symbols and Ritual Tools**

The structured repetition of 1, 3, 5, or 7 cycles within the Cowongan ritual is not a random or purely devotional act; rather, it reveals an embedded numerical logic that intertwines mathematical regularity with Javanese cosmology. Within ritual practice, repetition operates as both symbolic reinforcement and patterned sequencing. The use of odd numbers represents progressive intensification an ordered growth that mirrors a spiritual journey toward harmony, balance, and proximity to ancestral and natural forces (Wulandari & Laksono, 2022). In Javanese philosophical thought, odd numbers are attributed protective and transformative qualities, believed to guard against misfortune and strengthen ritual potency (Prabowo, 2021). From a mathematical standpoint, the repetition pattern 1, 3, 5, 7 forms an arithmetic sequence whose general term is:

$$u_n = 2n - 1$$

This demonstrates a consistent common difference of 2, reflecting systematic numerical progression. Ritual repetition therefore exhibits structural regularity. For example, general supplication rites often involve three repetitions, while more sacred contexts such as protection rituals for infants—may require seven repetitions. The escalation in repetition corresponds not merely to quantity but to symbolic intensification. Such patterned repetition may be interpreted as a form of mathematical enculturation: a process by which cultural values shape intuitive engagement with mathematical structures. Each additional repetition reinforces meaning cumulatively, resembling recursive formulation:

$$u_n = u_{n-1} + 2$$

The first repetition establishes symbolic grounding; subsequent repetitions reinforce spiritual resonance. Although not articulated in formal notation by participants, this recursive layering demonstrates implicit mathematical reasoning embedded in ritual organization. As argued within ethnomathematical discourse, mathematical ideas often emerge organically in cultural practices rather than through formal abstraction (Tandililing & Belakang, 2013; Fitriani et al., 2019).

Beyond numerical modeling, odd repetition creates rhythmic stability. Participants experience structured cadence that facilitates concentration and transcendental awareness. Numbers such as three and seven hold particular cosmological significance, representing layered metaphysical dimensions within Javanese thought (Agustina et al., 2016; Azmi, N. and Rosdiana, 2022). Thus, repetition functions simultaneously as symbolic communication, psychological reinforcement, and structured numerical sequencing.

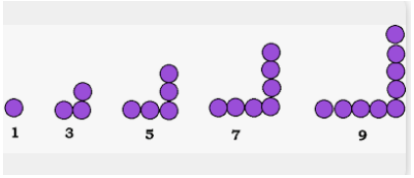


**Figure 2. Odd Number Pattern**

**Structural Manifestation of Odd Numbers in Ritual Organization**

Odd-number logic extends beyond repetition cycles into the broader structure of the Cowongan ritual. The ritual is organized into three principal stages—preparation, implementation, and closure—each containing sub-elements frequently arranged in odd quantities. The number of main participants is often three or five; mantra recitations may occur five times; and symbolic processions may circle seven times.

This layered structuring reflects the internalization of the odd-number principle within collective memory. In Javanese cosmology, the number three corresponds to *triwikrama* (upper, middle, and lower realms), while five symbolizes *pancadharma*, foundational ethical-spiritual principles sustaining cosmic balance (Wulandari & Laksono, 2022). The application of odd numbers therefore embodies both hierarchical structuring and metaphysical representation.

From an ethnomathematical perspective, such organization aligns with D'Ambrosio's view that mathematics develops within cultural activity as a means of structuring social reality. Odd-number arrangement here functions not merely as belief but as patterned ordering demonstrating regularity, sequence, and internal coherence.

**Odd Numbers in Offerings and Discrete Structure**

The consistency of odd-number usage is particularly visible in the preparation of offerings, which are arranged in quantities of three, five, or seven. These numbers are selected because odd numbers are believed to retain stronger spiritual force, whereas even numbers being divisible are symbolically "closed" or neutralized. Within local belief, divisibility may reduce ritual efficacy.

Offerings commonly include flowers, incense, yellow rice, fruits, and water. Five-item arrangements are typical for intermediate rites, while seven-item configurations mark more sacred intentions, such as rain invocation or protection rituals (Afaq & Mahmudah, 2023).

Mathematically, odd numbers can be expressed in modular form:

$$n \equiv 1 \ (mod\ 2)$$

This reflects the property that odd numbers leave a remainder of one when divided by two. Conceptually, odd numbers resist equal partitioning; they preserve a central or residual element. From a set-theoretic analogy, they represent configurations without perfect pairing, leaving one unit unpaired symbolically interpreted as concentrated spiritual energy.

Although the community does not employ formal modular terminology, parity reasoning is intuitively applied. Even numbers are perceived as static and balanced; odd numbers as dynamic and generative. This illustrates how mathematical properties may acquire symbolic meaning within cultural interpretation. In contrast to Western applications of modular arithmetic for technical computation, Javanese cultural practice employs numerical logic as cosmological symbolism. As suggested by Gerdes, mathematical structures in traditional societies often function as symbolic systems representing broader cosmological order.


**Figure 3. Offering**

**Iterative Structure and Perfect Square Symbolism**

The sequence 1, 3, 5, 7 also reveals deeper structural coherence. The sum of the first $n$ odd numbers follows:

$$S_n = n^2$$

This produces a perfect square pattern. Symbolically, the progression from one to layered accumulation culminating in square formation may be interpreted as movement toward completeness or wholeness resonant with spiritual notions of perfection. The iterative layering of repetition resembles fractal-

like scaling, where micro-patterns replicate within macro-structures. Ritual movement, mantra recitation, and offering arrangement follow analogous incremental intensification. This patterned growth offers significant pedagogical value for contextualizing sequences, recursion, algorithmic thinking, and pattern generalization within mathematics education.

**Modular Arithmetic and the Javanese Calendar System in Determining the Time of Cowongan**

The determination of the timing of the Cowongan ritual by the people of Soka Village shows the relationship between traditional calculation logic that has been passed down from generation to generation and spiritual beliefs. As a ritual to summon rain, cowongan must be performed on Friday night or specifically on Friday Kliwon (Andini, 2023). Friday Kliwon is considered a day associated with spirituality and sacredness, and is regarded as a meeting of two cosmic forces. This belief has existed for a long time and is shaped by a broad understanding of Javanese cosmology. However, there is a mathematical structure that can be studied scientifically behind this belief.

The Javanese calendar system consists of two time cycles that run simultaneously, namely the seven-day cycle (Monday to Sunday) and the five-day cycle or pasaran (Legi, Pahing, Pon, Wage, and Kliwon) (Afaq & Mahmudah, 2023). In Javanese culture, these two cycles are never separated, as days and markets are always mentioned in pairs, such as Tuesday Kliwon, Wednesday Wage, or Friday Pon. This differs from the Gregorian calendar, which only uses a seven-day cycle. Since each day is a pairing point of two cycles that move separately but remain in the same rhythm, the Javanese calendar is mathematically rich.

The pattern of the intersection between days and market days emerges when both cycles run concurrently. This pattern can be described using modulo arithmetic (Nofriyanti, 2024). If days are represented by a set of numbers modulo seven, such as Monday = 0, Tuesday = 1, and so on until Sunday = 6, then we can calculate the rotation of each day using the operation $(Hari + n)\ mod\ 7$. Conversely, if the market is represented by a set of numbers modulo five, such as Legi = 0, Pahing = 1, Pon = 2, Wage = 3, and Kliwon = 4, then the market rotation will be performed using the operation $(Pasaran + n)\ mod\ 5$ (Agustina et al., 2016). The parallel rotation pattern that never coincides is produced by rhese two operations except at certain multiples.

In mathematics, the meeting between Friday and the Kliwon market day is an example of doouble or simultaneous congruence. This indicates that there is a value n that satisfies the condition that $n \equiv 0\ (mod\ 7)$ to represent the weekly cycle and $n \equiv 0\ (mod\ 5)$ to represent the five-day market cycle (Nofriyanti, 2024). The concept of the Least Coomon Multiple (LCM) is closely related to the solution of two congruence equations like this in number theory (Edy et al., 2020). Since the prime numbers 7 and 5 have no common factors, their least common multiple is 35. In other words, every 35 days, the second cycle returns to the same starting point, combining the Kliwon market day and Friday.

The appearance of Friday Kliwon every 35 days in the Javanese calendar system shows that Javanese society intuitively understands the existence of a stabel repetitive cycle (Handayani, 2024; Husna, et al. 2024). They refer to this cycle as selapanan, or a 35-day period, although they do not write down the calculation in formal form (Prabowo, 2021). In an interview with one of the residents of Soka Village, if was explained that the timing of the ritual is determined by counting selapan from the previous Friday Kilwon. This shows that the community has traditionally used a cyclic mathematical model even though they have never articulated it as modulo airthmetic.

The selection of Friday Kliwon is not only related to cyclic calculations, but also influences the social lives of people who wait for a certain time to perform certain rituals, such as Cowongan. The 35-day interval serves as a mathematical calculation and a marker of rhythm in social life (Setiadi & Imswatama, 2017). The community recognizes that every selapan, inner mood, and spiritual connection with nature is considered the right time to convery requests to God through rituals (Wulandari & Laksono, 2022). Therefore, this mathematical interval becomes an important part of the culture, showing how closely mathematics is related to the structure of daily life (Yosevina et al., 2025).

This analysis shows that the determination of Cowongan time is not only based on spiritual beliefs but also on a mathematical calculation system that can be modeled. To explain the mechanisms underlying the Javanese calendar system, including the formation of time cycles that impact rituals and other social activites, modular arithmetic becomes a highly useful tool. Ethnomathematics plays a very improtant role in connecting cultural practices with formal mathematical structures. This method not only allows for a scientific understanding of local traditions, but also shows that traditional scienties have used sophisticated mathematical ways of thinking long before modern mathematics emerged (siregar).

Therefore, the discussion of modular arithmetic in determining Friday Kliwon helps us understand that the Javanese calendar is a concrete example of the use of mathematics in culture (Agustina et al., 2016;

Musnaini, et al. 2022). The results show that mathematics in not merely abstract academic knowledge but also knowledge rooted in society (Marsigit, 2016). An in-depth analysis of the Cowongan ritual shosw that the process of determining the ritual time is based on strong mathematical logic and spiritual values that are highly regarded in Javanese culture. The combination of the two results in cultural practices that are rich, valuable, and menaingful to the community.

**Analysis of Symmetry and Geometry in Ritual Movements and Formations**

The Cowongan ritual in Soka Village is a cultural practice that displays a close relationship between spiritual symbolism and mathematical sturctures implied in the movements, promations, and ornaments of the ritual. Field observations show the involvement of around 30 to 50 risidents in each ritual, with most of the processions being performed repeatedly in odd numbers, namely 3, 5, or 7 times. The odd repetition pattern not only reflects local beliefs about luck and cosmic balance, but also illustrates how the community intuitively uses the concepts of repetition, rhythm, and proportion, which can be explained through the perspective of geometry and symmetry in ethnomathematics. In line with D'Ambrsio thinking, cultural practices such as this contain mathematical ideas that are not formalized in academic symbols but are present in a tangible way through the collective actions of the community.


**Figure 4. Cowongan Procession**

One of the mathematical structures that is clearly visible in the rotational symmetry in the swinging motion of Nini Cowong. This movement is performed with a repetitive rhythm, where the doll is swung to the right and left around the center point on the hand of the holder. When the movement is performed three times, the pattern that is formed can be analyzed as a triple rotation. The formula for calculating the angle of rotation in n-fold rotation is

$$\Theta = \frac{360^\circ}{n}$$

If n = 3, then we obtain:

$$\Theta = \frac{360^\circ}{3} = 120^\circ$$

Thus, each swing cycle can be represented as a rotation of 120°. When the number of repetitions becomes five, the angle of rotation changes to 72°, and for seven repetitions it becomes approximately 51,43°. Although people do not calculate it formally, the consistent repetitive movement pattern reflects their intuitive understanding of angular regularity and rotation dynamics. This phenomenon reinforces the view that human cognitive patterns often produce mathematical structres even without explicit awareness of formal mathematical concepts.

**Figure 5. Swinging the Cowong Doll**

The next geometric structure appears in the procession of residents surrounding the ritual center. The procession formation forms a circular path with a radius that is empirically measured at approximately four meters. With this radius, the circumference of the circle can be calculated using the formula

$K = 2\pi r = 2\pi(4) = 25{,}12$ meters.

If the procession is carried out for three full rounds, the total distance traveled by each resident is $3 \times 25{,}12 = 75{,}36$ meters. Based on the number of participants, which is 30 people, the averange distance between individuals can be calculated by dividing the circumference of the circle by the number of participants, which is:

$\frac{25{,}12}{30} = 0{,}84$ meters.

This value indicates that there is an even distribution of space between participants so that the formation remains stable and they do not bump into each other. This regularity reflects intuitive spatial reasoning as described by Hersh and John-Steiner (1989), who state that humans naturally understand space and geometric patterns through social activities.

**Figure 6. Procession**

Central symmetry is also an important part of the Cowongan ritual formation. Residents stand around the center of the ritual, where Nini Cowong or offerings are placed, and their positions form pairs of ponits that correspond through the center of the circle. Mathematically, central symmetry can be modeled with a transformation.

$$(x, y) \rightarrow (-x, -y)$$

For example, if a participant stands at position (3,2) meters from the center of the ritual, then the participants directly opposite them will be at position (-3,-2). This structure is consistent throughout the documentation of the Cowongan ritual, showing that the community places itself harmoniously in a spatial structure centered on a symbolic point. This symmetry not only reflects an intuitive mathematical understanding, but also illustrates the philosophy of cosmological balance in Javanese culture.

In addition to central symmetry, there is also a reflection symmetry seen in the faces and ornaments of Nini Cowong. The eyesm nose, and mouth of the dolls, as well as the patterns on the wrapping cloth, almost always shwo symmetry along the vertical axis. The mathematical transformation relevant to reflection is

$$(x, y) \rightarrow (-x, y)$$

For example, if the position of the left eye ornament is at coordinates (2,5), then the right eye will be at (-2,5). The perfection of this pattern demonstrates the Javanese aesthetic principle that prioritizes balance and order, while also showing that the fold symmetry structure is not merely a decorative element, but a mathematical representation contained within cultural expression.

**Figure 7. Reflection of the Cowong Doll**

The movements of residents during the parade can also be analyzed through the concept of translation transformation. When participants move along a circular path, their positional shifts can be represented by a translation model.

$$(x, y) \rightarrow (x + a, y + b)$$

where a and b are the horizontal and vertical displacement componets. If a participant is at point (3, 4) and then moves one meter to the right and two meters backward following the rhythm of the procession, their new position weill change to (4, 2). Although simple, the continuous pattern of translation builds a dynamic, orderly, and coordinated space, making it an important part of ethnomathematical analysis in collective rituals.

Field data collected from three ritual performances showed consistency in the mathematical patterns observed. The number of participants was stable between 30 and 50 people, the radius of the circle formation was about four meters, and the repetition of the Nini Cowong movement was at odd intervals of 3, 5, and 7 times. Reflection symmetry and central symmetry appeared repeatedly in the ornaments and formations of the residents. These empirical findings are in line with the ethnomathematics theory of, which asserts that communities naturally practice mathematical ideas in a cultural context without the need to express them in formal symbolic form. The integration of field observations and theoretical analysis reinforces that the Cowongan ritual is an authentic source for studying geometry, symmetry, and transformation in a local cultural context. Thus, this ritual is not only anthropologically relevant, but also has the potential to be a menaingful medium for contextual mathematics learning.

**Integration of Cultural Values and Mathematical Concepts (Ethnomathematics Analysis)**

The integration of cultural values and mathematical concepts in the Cowongan ritual shows how mathematical knowledge does not always come from formulas or formal models, but lives and develops within the collective actions of the community. In this ritual, the community does not use mathematical terms such as “symmetry,” “rotation,” or “circular geometry,” but they practice these concepts consistently and repeatedly. This is in line with the ethnomathematics wies that culture has its own way of organizing space, patterns, rules, and relationships, so that mathematics is actually presents as an intuitive cultural practice. When the residents of Soka Village form a circle, maintain distance, repeat movements in odd numbers, or place symbols in certain positions, they are actually applying mathematical structures through cultural practices that have been passed from generation to generation.

The mathematical concepts that live on in the Cowongan tradition are evident in every aspect of the ritual, both in terms of movement and spatial arrangement. The circle created by the villagers’ positions, for example, illustrates how the community organizes space with stable geometric patterns. The relatively consistent radius and balanced distance between participants demonstrate a natural understanding of spatiality. Even in the swinging movements of Nini Cowong, there is a rotation pattern that shows the repetition of angles in a certain rhythm. The repetition pattern of three, five, or seven times is not just a cultural preference for odd numbers, but also indicates a geometric rhythm that has a pattern of regularity. Thus, mathematics is present as a living process that functions to regulate the movements, positions, and rhythms of the ritual.

Cultural values and mathematical concepts are interwined because both work to preserve the menaing and structure of rituals. The center of the ritual, where offerings and dolls are placed, not only has spiritual value as a point of energy, but also becomes a geometric center that regulates the position of all participants.

The symmetry of the center created by the arrangement of the residents reinforces the symbol of order in life, social balance, and the harmonious relationship between humans and nature. In the Nini Cowong ornament, reflective symmetry displays a distinctive Javanese aesthetic that emphasizes harmony. The left and right eyes, the nose line, and the foldable fabric motif produce identical shapes on both sides, showing that the spiritual meaning of balance is also manifested in mathematical symmetry. These patterns show that mathematical concepts and symbolic values are inseparable; both work to create meaning, beauty, and ritual solemnity.

The role of mathematics in reinforcing symbolism is clearly seen in the consistency of the movement patterns and formations performed by the community. When residents walk around the central point in a circular path, they are not only performing a procession, but also displaying a visual representation of cosmic order. The circle is a shape that symbolizes perfection, without beginning or end, so that the circular motion in the ritual reinforces the symbol of the continuous relationship between humans and the forces of nature. The rotational symmetry of the doll swings emphasizes the symbolism of renewal and the cycle of fate, while the repetition of movements signifies the balance between the material and spiritual worlds. Thus, mathematics helps clarify and reinforce the symbolism tat has lived on in tradition, making each movement pattern a form of cultural communication.

The implications of etnomathematical analysis in the Cowongan ritual are enormous for contextual mathematics learning. By utilizing this ritual as a learning context, students can understand mathematical concepts through real experiences that are close to their lives. Learning is no longer abstract, but is connected to cultural practices that they are familiar with. When students are invited to analyze the radius of the procession circle, calculate the circumference, or model the angle of rotation in the Nini Cowong movement, they not only learn formulas but also understand that mathematics is present in the daily lives of the community. This increases interest in learning, strengthens student engagement, and makes complex concepts easier to undertand. In addition, this approach encourages appreciation for local culture, as students see that their traditions contain rich and menaingful knowledge.

The contribution of ethnomathematics analysis to the preservation of Cowongan culture is also very improtant. By documenting and linking mathematical structures in rituals, these traditions are not only seen as spiritual activities, but also as intellectual heritage. This kind of research helps communities understand that their culture contains high cognitive values, thereby increasing pride and motivation to preserve it. When traditions are positioned as sources of scientific learning, their subtainability becomes stronger because younger generations can see their benefits, both as an identity and as knowledge. The integration of mathematics and culture not only gives rise to academic understanding but also strengthens the subtainability of Cowongan traditions through a broader appreciation of their values.

## CONCLUSION

The Cowongan ritual in Soka Village is an agricultural tradition that is not only useful as a spiritual medium for praying for rain, but is also used as a cultural space where values about origins, development, structure, society, history, and mathematics are harmoniously intertwined. Based on ethnomathematical analysis, this shows that a cultural practice that has been passed down from generation to generation actually contains a comlex mathematical structure, even down it has never formally stated by the community.

First, odd numbers such as 1, 3, 5, and 7 appear consistently in the number of offerings, the number of mantra repetitions, the stages of the procession, and even the symbolic movements. This pattern not only reflects the Javanese cosmological belief in the sacred meaning of odd numbers, but also mathematically forms an odd arithmetic sequence with the formula $(Un = 2n - 1)$. This number pattern also demonstrates the community's innate understanding of regularity, iteration, ryhthm, and numerical symbolism.

Second, the determination of the ritual time on Friday Kliwon night shows the application of modulo arithmetic in the Javanese calendar system. The meeting of the seven-day cycle and the five-market cycle, which produces a combination of Friday Kliwon every 35 days (selapanan), is a mathematical representation of double congruence, which in number theory is explained through modulo 7 and modulo 5. This shows that the people of Desa Soka apply stable cyclic calculations without realizing that they are applying formal mathematical concepts.

Third, the Cowongan ritual also displays a structure of symmetry and geometry, as seen in the circular formation of the residents' procession, the reflective symmetry of the Nini Cowong ornaments, and the rotational symmetry of the dolls' swinging movements. Geometric concepts such as the circumference of a circle, the distance between participants, rotational and translational transformations, as well as central

symmetry and reflection, are reflected in the overall layout and movements of the ritual, demonstrating the internalization of spatial reasoning in the local culture.

Overall, it can be concluded that the research findings reinforce the view that mathematics lives in the midst of society as part of cultural practices. The Cowongan ritual is not only a means of spirituality and cultural identity, but also a concrete illustration that mathematical structures are naturally present in social activites. The integration of cultural values and mathematical concepts also makes an important contribution to the world of education, especially in the development of local wisdom-based mathematics learning that is more meaningful, contextual, and relevant to students. Thus, the Cowongan ritual is not only a cultural heritage, but also a rich source of mathematical knowledge with potential for development in ethnomathematics and modern education.

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