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From Cultural Heritage to Mathematics: An Ethnomathematical Exploration of *Petirtaan Jolotundo* Mojokerto

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Abstract: Mathematics is often perceived by students as abstract and detached from everyday experience. Integrating cultural contexts through ethnomathematics can bridge this gap by connecting mathematical ideas to local heritage. This study explores the ethnomathematical potential of *Petirtaan Jolotundo* (Mojokerto, Indonesia) by identifying mathematical concepts embedded in its architectural elements and transforming these findings into structured indicators for contextual mathematics problems. Employing a qualitative exploratory design, data were collected through site observations, semi-structured interviews with relevant stakeholders (i.e. the site manager and one staff member with comprehensive knowledge of the site's historical background and structural features), and documentation (photographs and field notes). Data credibility was strengthened through triangulation across methods and sources. The analysis involved categorizing salient site elements such as the gate, stairway, stone relief structures, water spouts and mapping their visual/structural features to mathematical concepts. The results indicate that the *gate* reflects *dilation* (scale relationships), the *stairway* illustrates *slope/gradient*, and the *reliefs and water spouts* exhibit *line symmetry*. The findings indicate that the entrance gate reflects dilatation, the staircase represents slope, and both the stone relief structure and the main fountain demonstrate line symmetry. These results show that mathematical reasoning is embedded in ancient Javanese architecture. Beyond identifying ethnomathematical concepts, this study provides teachers with culturally grounded references for designing contextual mathematical tasks that connect formal mathematics with local cultural heritage, thereby supporting meaningful and culturally responsive mathematics learning.

INTRODUCTION

Mathematics plays a fundamental role in developing logical reasoning, analytical thinking, and problem-solving abilities required in the twenty-first century (Ali et al., 2018; Aziz & Jupri, 2025; Boadu & Bonyah, 2024; Jawad, 2022; Kureethara & Joseph, 2017; Muliyana et al., 2024; Prahesti & Setianingsih, 2026; Supriadi et al., 2024). Despite its importance, mathematics is frequently perceived by students as abstract, rigid, and disconnected from everyday life (Arafah et al., 2025; Oladele et al., 2022; Pasha et al., 2025; Qurrotu'ain & Fadli, 2025; Sujatha & Vinayakan, 2023). Classroom instruction often emphasizes procedural fluency rather than conceptual understanding, resulting in limited opportunities for students to experience mathematics as meaningful knowledge (Aras et al., 2025; Azizah et

al., 2025). This condition contributes to persistent difficulties in mathematical literacy and reduces students' motivation to engage deeply with mathematical ideas (Isnani et al., 2023).

Meaningful mathematics learning requires contexts that are close to students' lived experiences (Haylock, 2007). Context-based learning enables learners to connect abstract symbols and formal procedures with tangible situations that they encounter in their environment (Firmando et al., 2024). Cultural practices, social interactions, and local environments provide authentic situations in which mathematical ideas naturally emerge (Nurhanan & Santoso, 2023). Integration of local contexts into mathematics instruction therefore becomes a strategic effort to make learning more relevant, reflective, and engaging (Kurniawan et al., 2024).

Ethnomathematics offers a theoretical perspective that recognizes mathematics as a cultural product (Handayani & Malasari, 2025; Hartoyo et al., 2025; Noerisahak & Kurniasari, 2024; Salsabiila & Setianingsih, 2025; Sofhya & Az-Zahwa, 2024). This perspective views counting systems, spatial arrangements, measurement practices, and architectural constructions as forms of mathematical expression developed within specific communities (D'Ambrosio, 2001; Prahmana & Ambrosio, 2020; Sa'id et al., 2026). According to (Fauziah & Zaenuri, 2025), ethnomathematics does not merely document cultural artifacts but seeks to interpret the mathematical reasoning inherent in them. Such an approach provides a bridge between informal mathematical practices in society and formal mathematics taught in schools (Asare, 2026; Digdayana et al., 2024; Fouze & Amit, 2025; Labuem et al., 2025; Putra, 2018; Runtu et al., 2025).

Cultural heritage sites represent historical spaces where architectural design, spatial organization, and symbolic structures intersect with mathematical principles. The construction of temples, water structures, and sacred spaces often involves geometric forms, proportional systems, symmetry, and measurement precision. These elements reflect sophisticated mathematical reasoning embedded within traditional knowledge systems. Cultural heritage areas therefore possess strong potential to be examined as sources of ethnomathematical knowledge that remain underutilized in formal education (Kusuma et al., 2024).

Petirtaan Jolotundo presents a historical and architectural environment that has existed since the ancient Javanese kingdom period and continues to be preserved as a cultural heritage site. The site is characterized by stone water pools, symmetrical structures, stair arrangements, relief carvings, and precisely constructed water channels. The spatial layout and architectural composition demonstrate measurable dimensions, geometric configurations, and proportional relationships that reflect structured planning. These characteristics indicate that mathematical elements have been embedded in the design and construction of the site across centuries.

Previous explorations of ethnomathematics have largely focused on traditional crafts, markets, architectural heritage, and indigenous calculation systems (Alvianto & Setianingsih, 2024; Istiqomah, 2024; Lail & Budiarto, 2022; Prahesti & Setianingsih, 2026b;

Sudirman et al., 2024; Yuliani et al., 2023). Although several studies have examined temples and cultural artifacts, limited attention has been directed toward transforming findings from cultural heritage sites into structured mathematical learning resources. Research that explicitly connects ethnomathematical exploration of heritage architecture with the development of mathematical problems for classroom use remains relatively scarce. A comprehensive exploration that bridges cultural heritage and mathematics learning is therefore needed.

Construction of context-based mathematical problems requires careful translation of cultural and architectural elements into mathematically meaningful tasks (Tasarib et al., 2025). Authentic problems derived from historical environments can stimulate reasoning, spatial visualization, and mathematical modeling skills among students (Elvianasti et al., 2021). Teachers often face challenges in identifying credible and contextually rich sources for problem design (Calavia et al., 2023). Systematic exploration of ethnomathematical elements within cultural heritage sites can provide a solid foundation for developing mathematical problems that are culturally grounded and conceptually rigorous (Suherman & Vid´akovich, 2025).

This study aims to explore ethnomathematical elements embedded in *Petirtaan Jolotundo* Mojokerto and to analyze the mathematical concepts inherent in its architectural and spatial structures. The exploration seeks to identify geometric forms, measurable dimensions, proportional systems, and spatial relationships that reflect mathematical structures. Findings from this exploration are subsequently used to construct mathematical learning tasks derived from the cultural heritage context. The study is expected to contribute to the integration of cultural heritage into mathematics education and to provide a structured model for transforming ethnomathematical exploration into meaningful learning resources.

This study offers a measurable contribution by proposing a structured transformation procedure that systematically translates cultural artifacts into mathematical concepts, problem indicators, and complete contextual tasks with alternative solutions for specific grade levels, including Grade 7, Grade 8, and Grade 10. Unlike previous ethnomathematical studies that predominantly focus on temple architecture or cultural crafts, this research examines a water heritage site as the primary object of analysis. Furthermore, this study does not merely identify geometric elements, but formalizes them into transformation geometry through dilatation, linear relationships through gradient, and line symmetry concepts aligned with the school curriculum. The inclusion of fully developed contextual problems along with structured solutions positions this research as a practical model for transforming ethnomathematical exploration into applicable mathematics learning resources.

METHOD

This research was conducted at *Petirtaan Jolotundo*, a historical bathing site located on the western gradient of Mount *Penanggungan* in Mojokerto, Indonesia. The site is characterized by its ancient architectural structures, including the entrance gate, staircase, stone relief

structures, and main fountain, which reflect the cultural and religious heritage of the Hindu period in Java. The research subjects were the site manager and one staff member with comprehensive knowledge of the site's historical background and structural features. The manager was selected to provide accurate information on the history and preservation of the complex, while the staff member contributed practical insights into the physical layout and architectural details of the structures.

This study employed a qualitative approach. The exploratory orientation to investigate ethnomathematical elements embedded in the architectural structures of *Petirtaan Jolotun*do. Data were collected through observation, semi-structured interviews, and documentation. The observation focused on identifying architectural elements that potentially embodied mathematical concepts in the entrance gate, staircase, stone relief structure, and main fountain. Particular attention was given to proportional scaling, inclined structures, and symmetrical arrangements observed within these architectural features. A semi-structured interview was conducted with the site caretaker to obtain contextual information regarding the history, function, and architectural characteristics of the structures, as well as to confirm the researchers' interpretations derived from field observations. Documentation, including photographs and field notes, was used to record the architectural features and support subsequent analysis.

The collected data were analyzed using an inductive qualitative analysis. First, observation notes, semi-structured interview transcripts, and photographic documentation were reviewed repeatedly to gain familiarity with the data. Second, meaningful architectural features were coded according to their observable mathematical characteristics, including proportional scaling, inclined structures, and symmetrical arrangements. Third, these codes were grouped into broader ethnomathematical themes representing the concepts of dilatation, gradient, and reflection symmetry. Finally, each theme was interpreted using formal geometric definitions within an ethnomathematical framework and subsequently transformed into context-based mathematical problems aligned with the mathematics curriculum. To enhance the credibility of the findings, source triangulation was conducted by comparing observation, semi-structured interview, and documentation data. Theoretical triangulation was applied by aligning the identified concepts with established mathematical definitions, while expert triangulation involved consultation with a mathematics education expert and a cultural heritage informant to verify both the mathematical interpretation and the cultural accuracy of the identified architectural elements.

RESULT AND DISCUSSION

Mathematical concepts become more meaningful when connected to real environments that are familiar and culturally significant to students. As a historical bathing complex, *Petirtaan Jolotundo* contains various architectural and spatial structures that reflect embedded mathematical ideas within its design. Elements such as the entrance gate,

staircase, stone relief structures, and main fountain are carefully crafted with attention to proportion, symmetry, scaling, alignment, and spatial balance. These structural characteristics indicate that mathematical reasoning was inherently involved in the planning and construction process, even though it was not formally expressed as mathematical theory during its historical period.

Based on observations and semi-structured interviews conducted at *Petirtaan Jolotundo*, several ethnomathematical elements were identified in the site's architectural composition and layout. Information obtained from site managers and caretakers suggests that the construction reflects deliberate proportional systems, geometric arrangements, and balanced structural patterns characteristic of ancient Javanese architecture. The findings reveal that the heritage structures embody mathematical concepts related to dilatation, gradient, and line symmetry as observed in the entrance gate, staircase, stone relief, and main fountain. The following discussion elaborates on the identified mathematical elements and explains how they are transformed into context-based mathematical problems derived from the cultural heritage of *Petirtaan Jolotundo*.

Entrance Gate of *Petirtaan Jolotundo*

The entrance gate of *Petirtaan Jolotundo* stands as a prominent vertical structure marking the boundary of the sacred bathing complex. Constructed from dark stone blocks, the gate exhibits a stepped formation composed of several stacked layers that gradually decrease in width toward the upper section. The arrangement creates a distinctive tapering silhouette, with each tier carefully aligned to maintain visual balance and structural stability. The consistent repetition of form and the gradual reduction in size between levels reflect a deliberate architectural design that invites further analytical interpretation. The entrance gate of *Petirtaan Jolotundo* is shown in **Figure 1a**.



Figure 1a. The Entrance Gate of *Petirtaan Jolotundo*



Figure 1b. Annotated Horizontal Layers of the Entrance Gate of *Petirtaan Jolotundo*

Figure 1b presents the annotated horizontal tiers of the entrance gate at *Petirtaan Jolotundo*, where the highlighted red lines indicate vertically arranged structural layers that form the overall composition of the gate. Each tier exhibits a similar geometric outline, with a gradual, proportional change in scale from the lower to the upper part, reflecting a consistent spatial pattern in its architectural design. The illustrated geometric representation of this proportional scaling, shown in **Figure 2**, formalizes the structure as a dilatation transformation, in which one tier can be modeled as the image of another under a constant scale factor with respect to a fixed center.

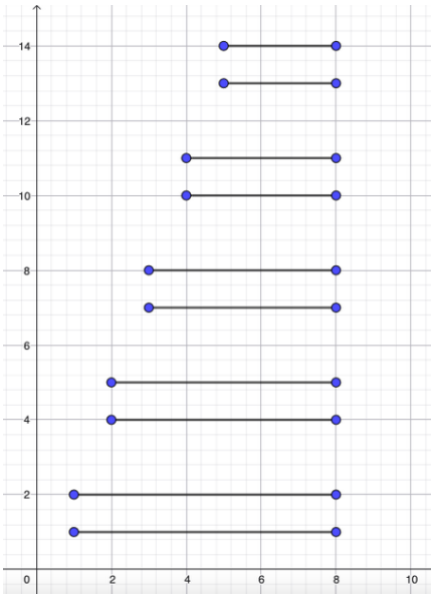


Figure 2. *GeoGebra* Construction of Dilatation Transformation

The identification of dilatation in the entrance gate structure provides a concrete basis for transforming cultural architecture into formal mathematical learning content. The proportional relationship observed between the tiers can be reconstructed into measurable geometric representations that allow students to analyze scale factors and corresponding lengths. This transformation from physical structure to symbolic model enables the development of structured learning objectives aligned with transformation geometry. Based on this formalization, specific problem indicators can be formulated to assess students' understanding of dilatation through context-based mathematical tasks derived from the site's architectural features. A contextual question indicator for the *Petirtaan Jolotundo* entrance gate is presented in **Table 1**.

Table 1. Question Indicator Related to the Entrance Gate of *Petirtaan Jolotundo*

Grade Level	**Grade 10^{th}**
Material	Transformation Geometry
Sub Material	Dilatation
Question Indicator	Students are able to identify dilatation relationships between similar geometric representations of the entrance gate tiers and determine the scale factor as well as the corresponding lengths resulting from the dilatation.
Cognitive Level	C3 (Applying)
Question Type	Essay

The entrance gate of *Petirtaan Jolotundo* consists of vertically arranged tiers that exhibit proportional scaling. Suppose the width of one lower tier is represented by segment $AB = 120\ cm$. The tier directly above it is modeled as the image of the lower tier under a dilatation centered at the point O, resulting in a segment $A'B' = 90\ cm$.

a) Determine the scale factor of the dilatation.
b) If another lower tier has a width of $160\ cm$ and undergoes dilatation with the same scale factor, determine the width of its image.

Alternative Solution

Given:

$AB = 120\ cm$

$A'B' = 90\ cm$

Center of dilatation: O

a) Determining the Scale Factor

The formula for dilatation scale factor is shown in **Equation 1**.

$$k = \frac{image\ length}{original\ length} \quad (1)$$

$$k = \frac{90}{120} \quad (2)$$

$$k = \frac{3}{4} \quad (3)$$

Thus, the scale factor is:

$$k = 0.75 \quad (4)$$

b) Determining the Image Length

Given original length = $160\ cm$

$$A''B'' = k \times 160 \quad (5)$$

$$A''B'' = \frac{3}{4} \times 160 \quad (6)$$

$$A''B'' = 120\ cm \quad (7)$$

This contextual problem demonstrates that the proportional structure of the entrance gate of *Petirtaan Jolotundo* can be mathematically modeled through dilatation within transformation geometry. The architectural tiers provide a meaningful visual representation of scale factor and corresponding lengths, allowing students to connect abstract geometric concepts with tangible cultural heritage. From an ethnomathematical perspective, integrating local architectural elements into formal mathematical tasks strengthens contextual learning and enhances students' conceptual understanding through culturally relevant experiences.

The staircase leading to *Petirtaan Jolotundo* forms a linear, ascending pathway connecting the outer area to the main bathing structure. The steps are arranged in a repetitive sequence with consistent height and depth, creating a structured vertical progression. This regular arrangement produces a patterned spatial rhythm in which each step maintains uniform proportions relative to the others. The observable consistency in dimension and alignment suggests the presence of an underlying geometric structure that

can be systematically examined through formal mathematical representation. The staircase leading to *Petirtaan Jolotundo is* shown in **Figure 3a.**

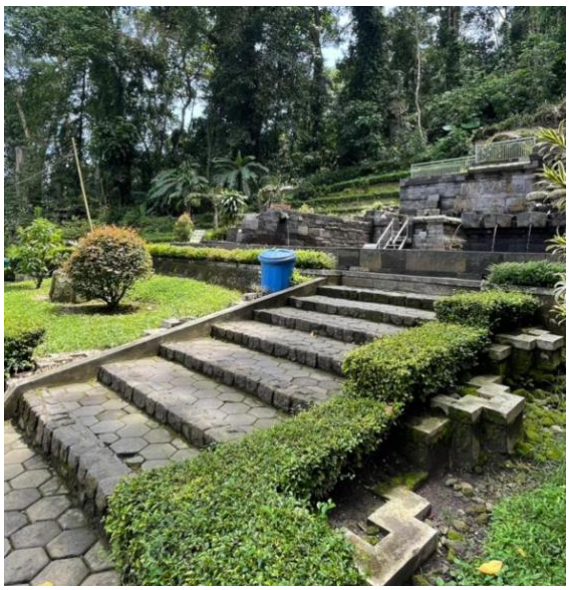


Figure 3a. Staircase Leading to *Petirtaan Jolotundo*



Figure 3b. Highlighted Proportional Structure of the Staircase

The annotated staircase structure illustrates a consistent vertical rise and horizontal run that together form a measurable inclination along the ascending path toward *Petirtaan Jolotundo*. The regular arrangement of steps allows the relationship between height and base length to be represented systematically within a coordinate framework. This structural configuration can be formalized through the concept of the gradient of a line, which then serves as the foundation for constructing question indicators related to linear relationships and rate of change. A contextual question indicator related to the staircase leading to *Petirtaan Jolotundo* is presented in **Table 2**.

Table 2. Question Indicator Related to the Staircase Leading to *Petirtaan Jolotundo*

Grade Level	**Grade 8^{th}**
Material	Linear Equation
Sub Material	Gradient
Question Indicator	Students are able to determine the gradient of a line representing the staircase toward *Petirtaan Jolotun*do by analyzing the relationship between vertical rise and horizontal run, and interpret its meaning in a real-world context.
Cognitive Level	C3 (Applying)
Question Type	Essay

The staircase leading to *Petirtaan Jolotundo* forms an inclined path toward the bathing structure. Suppose the total vertical height from the bottom step to the top step is 4 meters, while the total horizontal distance is 10 $meters$.

a) Model the staircase as a straight line and determine its gradient.
b) Interpret the meaning of the obtained gradient in the context of the staircase.

Alternative Solution:

Given:

Vertical height $= 4\ m$

Horizontal distance $= 10\ m$
Suppose:
Gradient of staircase is m

a) Determining the Gradient
   The formula for gradient as shown in **Equation 8**.

$$m = \frac{vertical\ height}{horizontal\ distance} \quad (8)$$

$$m = \frac{4}{10} \quad (9)$$

$$m = 0.4 \quad (10)$$

   So, the gradient of staircase is 0.4

b) Interpretation
   A gradient of means that for every horizontal movement, the height increases by . This indicates that the staircase has a moderate incline and that the vertical and horizontal distances are proportional.

The staircase leading to *Petirtaan Jolotundo* demonstrates that mathematical reasoning is embedded in the structural design of cultural heritage architecture. The proportional relationship between vertical rise and horizontal run reflects an intuitive understanding of gradient that guides the construction of a stable and functional pathway. From an ethnomathematical perspective, modeling this staircase through the concept of gradient enables students to connect formal linear concepts with tangible cultural environments, thereby strengthening meaningful, contextual mathematical learning. This finding supports previous ethnomathematics studies reporting that traditional architectural structures embody mathematical principles that can be integrated into mathematics education. For instance, Prahesti & Setianingsih (2026) showed that measurement activities in Pura Jala Siddhi Amerta reflect mathematical ideas embedded in the proportions and dimensions of cultural architecture. However, unlike previous studies that primarily emphasized measurement concepts, the present study demonstrates that the staircase of Petirtaan Jolotundo can be formally interpreted through the concept of gradient and transformed into contextual learning tasks. This extends the application of ethnomathematics by providing teachers with culturally relevant examples for introducing linear relationships and slope through authentic architectural structures.

Stone Relief Structure at *Petirtaan Jolotundo*

The Stone Relief Structure at *Petirtaan Jolotundo* is one of the architectural elements found within the sacred bathing complex, dating back to the ancient Javanese Hindu period. The structure is composed of stacked andesite blocks forming a compact arrangement, with a carved relief figure at the center and decorative stone ornaments on both sides. Such relief structures were commonly associated with ritual spaces, serving symbolic and spiritual functions within the water sanctuary, where architectural composition was not only

functional but also deeply embedded with cultural and religious meaning. The stone relief structure at *Petirtaan Jolotundo* is shown in **Figure 4a**.



Figure 4a. Stone Relief Structure at *Petirtaan Jolotundo*



Figure 4b. Stone Relief Structure at *Petirtaan Jolotundo* with Highlighted Axis of Symmetry

Figure 4b, a stone relief structure at *Petirtaan Jolotundo* with the highlighted axis of symmetry, shows a central vertical line that divides the structure into two visually balanced parts. The alignment of ornamental carvings and stone arrangements on both sides of the axis indicates a mirrored configuration within the architectural composition. This structural balance can be systematically examined through the concept of reflective symmetry, which serves as the basis for formulating question indicators to identify symmetry axes and corresponding elements. A contextual question indicator related to the stone relief structure at *Petirtaan Jolotundo* is presented in **Table 3**.

Table 3. Question Indicator Related to the Stone Relief Structure at *Petirtaan Jolotundo*

Grade Level	**Grade 7^{th}**
Material	Symmetry
Sub Material	Line Symmetry
Question Indicator	Students are able to determine the symmetrical point of a given coordinate across a vertical axis representing the axis of symmetry of the Stone Relief Structure at *Petirtaan Jolotundo* and explain the relationship between symmetrical elements.
Cognitive Level	C3 (Applying)
Question Type	Essay

The stone relief structure at *Petirtaan Jolotundo* is visually divided into two balanced parts by a vertical line at its center. If the structure is modeled on a coordinate plane, the axis of symmetry is represented by the line $x = 5$. The carved ornament on the right side is located at the coordinate (8,4).

a) Determine the coordinate of the symmetrical point across the line $x = 5$.
b) Explain why the two points are considered symmetrical with respect to the axis.

Alternative Solution:

Given:

Axis of symmetry, $x = 5$
Point $A = (8,4)$
Asked:
Coordinate reflection across the axis of symmetry

a) Determining the Symmetry Point
   For symmetry across a vertical line $x = a$, the $x - coordinate$ of the symmetrical point satisfies in **Equation 11**.
   $$x' = 2a - x \quad (11)$$
   Substitute the value of $a = 5$,
   $$x' = 2(5) - 8 \quad (12)$$
   $$x' = 10 - 8 = 2 \quad (13)$$
   The $y - coordinate$ remains unchanged:
   $$y' = 4 \quad (14)$$
   Thus, the symmetrical point is:
   $$A' = (2,4) \quad (15)$$
a) Explanation
   The two points are symmetrical because they are located at equal distances from the vertical line $x = 5$. Point (8,4) is 3 units to the right of the axis, while point (2,4) is 3 units to the left. Both points share the same y-coordinate, which indicates that they lie on a horizontal line parallel to the $x - axis$, satisfying the properties of line symmetry.

The symmetrical arrangement found in the Stone Relief Structure at *Petirtaan Jolotundo* reflects the aesthetic and philosophical principles embedded in ancient Javanese architectural design. The balanced placement of ornaments on both sides of the central axis demonstrates how cultural artifacts inherently embody geometric order without explicitly formulating it in mathematical language. From an ethnomathematical perspective, transforming this cultural structure into line symmetry tasks enables students to recognize that mathematical ideas are deeply rooted in local heritage and can be meaningfully connected to their surrounding environment. This finding is consistent with previous ethnomathematics studies reporting that traditional architectural elements often exhibit reflection symmetry. Prahesti & Setianingsih (2026) likewise found reflection symmetry in the entrance gate of Pura Jala Siddhi Amerta. However, the present study extends these findings by demonstrating that the stone relief structure of Petirtaan Jolotundo can be systematically interpreted through line symmetry and transformed into contextual mathematical tasks. This contributes to ethnomathematics by providing teachers with culturally meaningful resources for introducing geometric symmetry through authentic local heritage.

Main Fountain Structure at *Petirtaan Jolotundo*

The fourth object is the main water fountain structure at *Petirtaan Jolotundo*, characterized by a series of evenly spaced water spouts that flow into the central pool. The stone arrangement, relief carvings, and layered architectural composition exhibit a balanced configuration between the left and right sides of the structure. This visual equilibrium not only reinforces the sacred and aesthetic value of the site but also reflects the intentional proportional design embedded in ancient Javanese water architecture. The main fountain structure at *Petirtaan Jolotundo* is shown in **Figure 5a**.

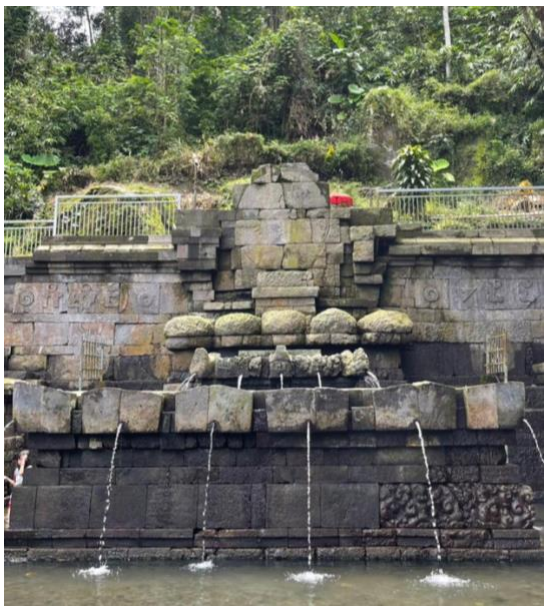


Figure 5a. Main Fountain Structure at *Petirtaan Jolotundo*



Figure 5b. Main Fountain Structure at *Petirtaan Jolotundo* with Highlighted Axis of Symmetry

Figure 5b, presented as the main fountain structure at *Petirtaan Jolotundo* with a highlighted axis of symmetry, illustrates the central vertical line that divides the fountain composition into two proportionally balanced sections. The equal distribution of water spouts, layered stone blocks, and ornamental elements on both sides of the axis indicates a clear line symmetry embedded within the architectural design. This symmetrical configuration can be systematically analyzed using the concept of line symmetry, which provides the foundation for developing question indicators to identify symmetry axes and corresponding structural elements. A contextual question indicator related to the main fountain structure at *Petirtaan Jolotundo* is presented in **Table 4**.

Table 4. Question Indicator Related to the Main Fountain Structure at *Petirtaan Jolotundo*

Grade Level	**Grade 7^{th}**
Material	Symmetry
Sub Material	Line Symmetry
Question Indicator	Students are able to identify symmetrical points and determine corresponding elements across a vertical axis representing the axis of symmetry of the main fountain structure at *Petirtaan Jolotundo*.
Cognitive Level	C3 (Applying)
Question Type	Essay

The main fountain structure at *Petirtaan Jolotundo* consists of evenly spaced water spouts symmetrically arranged on both sides of a central vertical axis. Suppose the structure is modeled on a coordinate plane, with the axis of symmetry represented by the line $x = 6$. One water spout on the right side is located at coordinate (9,3).

a) Determine the coordinate of the symmetrical water spout across the axis $x = 6$.
b) Explain why the two points represent symmetrical elements in the fountain structure.

Alternative Solution:

Given:

Axis of symmetry, $x = 6$

Point $A = (9,3)$

Asked:

Determine coordinate of the symmetrical water spout across the axis $x = 6$.

a) Determining the Symmetrical Point

   For symmetry across a vertical line $x = a$, the $x - coordinate$ of the symmetrical point as shown in **Equation 16**.

   $$x' = 2a - x \quad (16)$$

   Substitute the value of $a = 6$ to **Equation 16**.

   $$x' = 2(6) - 9 \quad (17)$$

   $$x' = 12 - 9 = 3 \quad (18)$$

   The $y - coordinate$ remains the same:

   $$y' = 3 \quad (19)$$

   Thus, the symmetrical point is:

   $$A' = (3,3) \quad (20)$$

b) Explanation

   The two points are symmetrical because they are located at equal horizontal distances from the vertical axis $x = 6$. Point (9,3) is 3 units to the right of the axis, while point (3,3) is 3 units to the left. Both points share the same y-coordinate, indicating that they lie on a horizontal line parallel to the x-axis and satisfy the properties of line symmetry.

The symmetrical arrangement of the main fountain at *Petirtaan Jolotundo* reflects the aesthetic principles and spatial harmony embedded in ancient Javanese sacred architecture. The balanced placement of water spouts and stone structures on both sides of the central axis demonstrates an intuitive application of geometric order within cultural design. From an ethnomathematical perspective, translating this architectural symmetry into formal line-symmetry tasks allows students to recognize that mathematical concepts are inherently present in local heritage and can be meaningfully explored through culturally contextualized learning experiences. This finding is consistent with previous ethnomathematics studies that identified reflection symmetry in cultural heritage architecture. Prahesti & Setianingsih (2026) similarly found reflection symmetry in the

entrance gate of Pura Jala Siddhi Amerta. However, unlike these studies, which primarily focused on architectural ornaments and gateways, the present study demonstrates that the spatial arrangement of the main fountain also embodies line symmetry and can be transformed into contextual mathematical tasks. This finding broadens the scope of ethnomathematical exploration by showing that functional architectural elements, in addition to decorative structures, can serve as culturally relevant resources for teaching geometric symmetry.

CONCLUSION AND SUGGESTIONS

This study reveals that Petirtaan Jolotundo embodies various ethnomathematical elements embedded within its architectural and spatial structures. The entrance gate reflects proportional scaling that can be modeled through dilatation, the staircase represents measurable inclination interpreted through the concept of gradient, and both the stone relief structure and main fountain demonstrate clear line symmetry within their compositions. These findings confirm that mathematical concepts such as dilatation, gradient, and symmetry are inherent to historical architectural design, even though they were not formally articulated as mathematical constructs at the time of construction. The transformation of these cultural elements into context-based mathematical problems demonstrates the potential of heritage sites to serve as meaningful learning resources that connect formal mathematics with local cultural identity.

However, this study is limited to the identification of ethnomathematical elements and the development of contextual mathematical problems based on *Petirtaan Jolotundo*. The proposed learning materials were not implemented or evaluated in actual classroom settings; therefore, their effectiveness in enhancing students' mathematical understanding, reasoning, or cultural awareness has not yet been empirically verified.

Future research is recommended to implement these ethnomathematics-based learning materials in classroom practice to examine their impact on students' conceptual understanding, mathematical reasoning, and appreciation of local cultural heritage. Further studies may also explore additional mathematical concepts, such as ratio, area measurement, or geometric composition, and investigate other cultural heritage sites to broaden the development of culturally responsive mathematics learning resources.

Acknowledgement

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