

Ethnomathematics of Sanggrahan Temple in Tulungagung: A Pañcatathāgata-Based Model of Rotational Symmetry and Geometric Transformations for Contextual Mathematics Learning

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Abstract. Ethnomathematics connects mathematical knowledge with cultural practices and community activities. Sanggrahan Temple in Tulungagung Regency, Indonesia, contains cultural and geometric features that have been examined in previous ethnomathematics studies. This article develops a conceptual-descriptive instructional design that explicitly connects cultural context, mathematical abstraction, and geometric transformation learning. The study synthesizes archaeological sources, ethnomathematics research, literature on the Pañcatathāgata, and mathematics curriculum documents. Five Buddha statues on the eastern side of the temple are interpreted as representations of the Pañcatathāgata based on established Buddhist iconographic conventions. Its symbolic structure of a center and four cardinal directions is abstracted into a configuration with one central point and four equidistant points at 90-degree intervals, producing fourth-order rotational symmetry. The model is then developed into a contextual instructional design aligned with Phase D mathematics learning outcomes. The contribution is a three-tiered framework distinguishing documented cultural facts, mathematical models, and pedagogical design.

Keywords: ethnomathematics, Sanggrahan Temple, Pañcatathāgata, rotational symmetry, geometric transformations, contextual learning

1 Introduction

Mathematics does not develop in isolation from human life. Activities such as measuring, grouping, creating patterns, constructing objects, and organizing space are part of cultural practices that involve mathematical ideas in various forms. The perspective of ethnomathematics broadens our understanding of mathematics by examining how communities develop, use, and interpret mathematical knowledge within specific cultural contexts [1, 2]. In education, this perspective provides opportunities to introduce contexts that are relevant to students' lives, allowing mathematical concepts to be studied not only as formal objects but also in relation to students' social and cultural environments.

The use of cultural heritage as a context for mathematics learning has been explored in various studies. Cultural objects, including fabric patterns, traditional buildings, ornaments, and historical sites, can provide opportunities to identify shapes, patterns, symmetry, measurement,

and geometric transformations. For example, concepts related to quadrilaterals have been identified in the Muaro Jambi Temple complex [3]. Such studies do not imply that cultural artifacts were originally created using school-based mathematical terminology or procedures. Rather, the ethnomathematical connection is established through the identification and abstraction of cultural activities or forms, which can subsequently be represented using mathematical concepts [1, 4]. However, most ethnomathematics research remains focused on the descriptive exploration of cultural objects, while the translation of such findings into explicit instructional designs remains limited [5]. This gap provides one of the motivations for the present article.

Sanggrahan Temple is a cultural heritage site in Tulungagung Regency with considerable potential for such an approach. Located in Sanggrahan Village, Boyolangu District, the temple was designated as a cultural heritage site under the Decree of the Regent of Tulungagung Number 188.45/96/013/2019 [6]. Official cultural heritage records indicate that the complex consists of a main structure and two ancillary structures situated on a base measuring 51×42.5 meters. The main structure measures approximately $12.60 \times 9.05 \times 5.86$ meters and consists of a base, a foot, and a body, while the roof has collapsed [7].



Fig. 1. Sanggrahan Temple, Tulungagung Regency. *Source: Author's documentation.*

Sanggrahan Temple, also known as Cungkup Temple, exhibits Buddhist religious characteristics based on the discovery of several Buddha statues with different mudras. However, its historical context should also be understood in relation to the syncretism of indigenous beliefs, Shaivism, and Buddhism during the Singasari and Majapahit periods [7]. Five Buddha statues on the eastern side of the main structure, each displaying a different mudra, have been documented [8]. The same study identified various geometric concepts and transformations in the physical structure of Sanggrahan Temple, including two-dimensional shapes, three-dimensional forms, lines and angles, similarity, congruence, and geometric transformations.

The presence of five Buddha statues with distinct mudras constitutes a configuration that, within Mahayana and Vajrayana Buddhist iconography, is commonly associated with the Pañcatathāgata, or the Five Tathagatas [9]. This article adopts this iconographic convention as a basis for interpreting the five statues at Sanggrahan Temple as representations of the Pañcatathāgata. However, this interpretation should be understood as an iconographic inference based on the general pattern of five statues with five distinct mudras, rather than as an archaeological identification confirmed by specialized publications establishing the identities

and historical arrangement of the statues. Further verification through archaeological reports or documentation from the relevant cultural heritage authority would therefore be necessary to strengthen the empirical basis of future research.

These findings indicate that research on Sanggrahan Temple from an ethnomathematical perspective is not entirely new. Previous research has identified plane figures, solid shapes, lines and angles, similarity, congruence, and geometric transformations based on the physical structure of the temple [8]. Accordingly, the novelty of the present article does not lie in claiming that geometric transformations had not previously been identified at Sanggrahan Temple. Rather, its contribution lies in developing a mathematical model based on the symbolic configuration of the Pañcatathāgata and explicitly connecting that model to an instructional design for geometric transformations.

In Mahayana and Vajrayana Buddhist traditions, the Pañcatathāgata, or Five Tathagatas, are commonly represented through a central position and the four cardinal directions. In the scheme commonly associated with the Vajradhātu mandala, Vairocana is positioned at the center, Akṣobhya in the east, Ratnasambhava in the south, Amitābha in the west, and Amoghasiddhi in the north [9, 10]. However, this directional arrangement can vary across traditions and religious structures. Research on Bubrah Temple within the Prambanan complex, for example, indicates that the placement of Pañcatathāgata figures in relation to the cardinal directions was associated with doctrinal considerations examined by the restoration team [11]. Iconographic studies of Borobudur have also documented debates concerning the identities of certain Dhyani Buddha statues [12]. In the present article, the scheme consisting of Vairocana, Akṣobhya, Ratnasambhava, Amitābha, and Amoghasiddhi is used consistently as the primary reference. This choice follows a commonly cited scheme in the literature while acknowledging that variations exist across Buddhist traditions.

The central and four-directional structure can be abstracted into a geometric representation. When the four directional positions are placed at equal distances from a central point and separated by 90-degree angles, they form the vertices of a square and exhibit fourth-order rotational symmetry. This abstraction provides an opportunity to explore rotation and rotational symmetry through a cultural context drawn from the learners' local environment.

A crucial distinction must nevertheless be maintained between cultural facts and mathematical models. The existence of the five statues and their interpretation as representations of the Pañcatathāgata are grounded in archaeological evidence and established iconographic conventions. In contrast, the arrangement of these elements as one central point and four points separated by 90-degree intervals is a mathematical construct developed in this study. The article therefore does not claim that the five statues at Sanggrahan Temple were historically positioned in precisely this configuration.

Maintaining this distinction is important to ensure that ethnomathematical inquiry does not conflate mathematical models with historical claims. In this study, the relationship between cultural structure and mathematics is organized into three layers: documented cultural facts, mathematical abstraction, and pedagogical design. Cultural facts provide the contextual foundation, mathematical abstraction represents the modeling process, and pedagogical design translates the model into a learning activity.

From an educational perspective, this approach is consistent with current directions in mathematics instruction. The Mathematics Learning Outcomes for Phase D, as established by the Decree of the Head of the Agency for Educational Standards, Curriculum, and Assessment Number 046/H/KR/2025, include students' ability to perform single transformations, namely reflection, translation, rotation, and dilation, on points, lines, and plane figures in the Cartesian coordinate plane and to use these transformations to solve problems [13]. Consistent with these

learning outcomes, the 2025 Mathematics Subject Guide provides examples of geometric transformation learning that use patterns, architecture, and contextual situations as part of the instructional process [14].

Against this background, this article aims to develop a conceptual model of rotational symmetry based on the Pañcatathāgata concept in the context of Sanggrahan Temple and to translate this model into an instructional design for contextual learning of geometric transformations. The study is intended to strengthen the use of local cultural heritage as a resource for mathematics learning while maintaining clear distinctions among historical facts, cultural interpretations, and mathematical constructions.

2 Methods

This study employs a conceptual-descriptive approach based on a literature review. This approach was selected because the research objective is not to reconstruct the history of Sanggrahan Temple or empirically test the effectiveness of the instructional design, but to develop a mathematical model and an instructional design based on documented cultural information.

The data sources comprise four groups. First, archaeological sources and official documents concerning Sanggrahan Temple were used to identify the characteristics of the site, its structure, and the presence of Buddha statues [8, 15]. Second, previous ethnomathematics studies provided a basis for mapping mathematical concepts identified at Sanggrahan Temple and similar cultural sites [3, 16]. Third, literature on the Pañcatathāgata was used to examine the symbolic structure of the Five Tathagatas and their associations with specific directions and identities [9–12]. Fourth, curriculum documents were consulted to ensure that the instructional design was aligned with the applicable mathematics learning outcomes [13, 14].

The analysis was conducted in four stages. The first stage was source mapping, which involved identifying information related to Sanggrahan Temple, the five Buddha statues, the Pañcatathāgata concept, mathematics, and mathematics learning. The second stage involved identifying cultural facts by distinguishing information explicitly supported by archaeological sources from the researcher's own interpretations or derived meanings. The third stage was mathematical abstraction, in which relevant cultural structures were translated into mathematical representations involving points, distances, angles, coordinates, and geometric transformations. The fourth stage was pedagogical synthesis, in which the results of the mathematical abstraction were developed into an instructional design for geometric transformation learning activities.

The analysis also applied a principle of traceability among cultural sources, mathematical models, and instructional designs. Each mathematical concept developed in the study was cross-checked to ensure that it was not presented as an inherent characteristic of the cultural object when it was actually a product of the researcher's mathematical abstraction.

The overall research analysis framework is presented in Figure 2. The framework consists of three layers that are applied consistently throughout the study: cultural facts traceable to documented sources, mathematical abstractions constructed by the researcher, and pedagogical designs that translate these mathematical models into learning activities.



Fig. 2. Three-layer framework for developing the ethnomathematical model of Sanggrahan Temple.

In the first layer, information concerning Sanggrahan Temple and the Pañcatathāgata is treated as the cultural context. In the second layer, the central position and the four cardinal directions are abstracted into coordinate-based and rotational representations. In the third layer, the resulting mathematical model is used to develop learning activities related to geometric transformations. Within this framework, the mathematical model is not presented as evidence of the historical arrangement of the five statues, but as a mathematical representation constructed from the cultural context.

3 Result and Discussion

3.1 Sanggrahan Temple as an Ethnomathematical Context

Sanggrahan Temple is a cultural heritage complex featuring architectural characteristics and artifacts that lend themselves to mathematical analysis. Official records document the presence of a main structure and two ancillary structures situated on a spacious raised platform. The main structure is constructed of andesite stone with a brick core, while other sections of the complex are built of brick [6].

The physical form of Sanggrahan Temple embodies various geometric concepts, including plane figures, solid shapes, lines and angles, similarity, congruence, and geometric transformations [8]. These findings establish Sanggrahan Temple as a relevant ethnomathematical context for the instructional design developed in this article. This is consistent with studies of other cultural objects, such as the identification of quadrilateral concepts at Muaro Jambi Temple [3] and the analysis of Yogyakarta batik patterns [16]. Such studies demonstrate that cultural heritage, including architectural structures and traditional motifs, can provide rich contexts for exploring mathematical concepts.

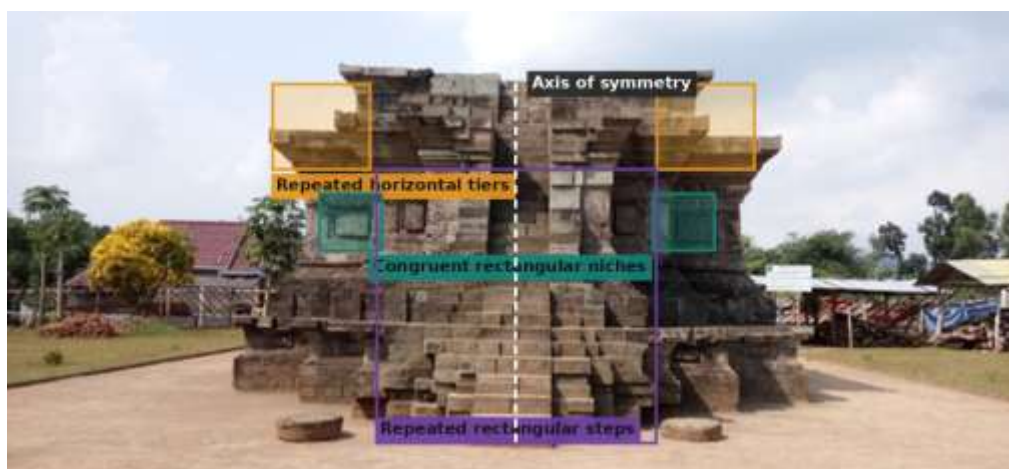


Fig. 3. Examples of geometric elements in the structure of Sanggrahan Temple.

From the perspective of this study, the geometric elements observed in the temple structure are not immediately interpreted as evidence of the mathematics used by its builders. Such a claim would require historical evidence concerning the mathematical knowledge, units of measurement, or construction procedures used at the time. Instead, the ethnomathematical approach adopted here focuses on identifying formal characteristics and spatial relationships that can subsequently be abstracted using mathematical concepts.

Accordingly, features such as squares, rectangles, repeating patterns, geometric similarity, and angular relationships within the structures can be treated as potential mathematical contexts. Their status as learning objects is established through the processes of mathematical modeling and instructional design undertaken in this study.

Beyond the physical characteristics of the structure, the presence of five Buddha statues provides a distinct cultural context. As described in the Introduction, the five statues, each displaying a different mudra and documented by [8] are interpreted in this article as representations of the Pañcatathāgata in accordance with commonly cited Buddhist iconographic conventions [9]. This interpretation extends the cultural context beyond the physical form of the temple to include the symbolic structure associated with the site.

At this point, two different types of relationships need to be distinguished. The first is a historical and archaeological relationship concerning the existence of the five Buddha statues and their identification in archaeological studies. The second is a mathematical relationship involving the use of this five-element structure as the basis for constructing a model consisting of a central point and four cardinal directions. The latter is a construct developed in this study and does not imply that the historical arrangement of the statues at their original site was identical to the mathematical model presented here.

3.2 The Pañcatathāgata as the Basis for the Rotational Symmetry Model

The Pañcatathāgata, or Five Tathagatas, refers to a group of five Buddhas represented within a symbolic spatial structure. In the scheme consistently used in this article, Vairocana is positioned at the center, while Akṣobhya, Ratnasambhava, Amitābha, and Amoghasiddhi are

associated with the cardinal directions of east, south, west, and north, respectively [10]; [9]. By comparison, research on Bubrah Temple within the Prambanan complex indicates that the directional placement of Pañcatathāgata figures in actual religious structures requires specific doctrinal and archaeological considerations and is not necessarily uniform across temples [11]. Similarly, the identities of some Dhyani Buddha statues at Borobudur remain the subject of scholarly discussion [12]. These comparisons indicate that the directional scheme used in this article represents one commonly cited iconographic convention rather than a universal arrangement applicable to all Buddhist temples in Java.

This symbolic structure provides a conceptual pattern consisting of one central position and four surrounding positions. In this study, the pattern is translated into a Cartesian coordinate representation. The central position is defined as

$$O = (0, 0)$$

The four directional positions are placed at an equal distance, (r), from the center. These positions are defined as follows:

$$\begin{aligned} E \text{ (East)} &= (r, 0) \\ N \text{ (North)} &= (0, r) \\ W \text{ (West)} &= (-r, 0) \\ S \text{ (South)} &= (0, -r) \end{aligned}$$

Connecting these four points forms a square centered at (O). Each point is at the same distance (r) from the center, and adjacent points are separated by an angle of 90° . Thus, the structure consisting of one center and four directions can be represented as a geometric model exhibiting rotational symmetry of order 4.

Table 1. Mapping of symbolic elements to model coordinates.

Symbolic element	Directional representation	Coordinate	Representation in the model
Vairocana	Center	($O=(0,0)$)	Central point
Akṣobhya	East	($E=(r,0)$)	Point 1
Ratnasambhava	South	($S=(0,-r)$)	Point 2
Amitābha	West	($W=(-r,0)$)	Point 3
Amoghasiddhi	North	($N=(0,r)$)	Point 4

The model exhibits rotational symmetry. For instance, if point $E = (r, 0)$ is rotated 90° counter-clockwise around the center $O(0,0)$, the result is:

$$R_{90}(x, y) = (-y, x)$$

yielding:

$$R_{90}(r, 0) = (0, r)$$

or:

$$E \rightarrow N$$

This means the position E (East) shifts to position N (North). Subsequent rotations result in:

$$N \rightarrow W \rightarrow S \rightarrow E$$

After four successive rotations of 90° , the point returns to its initial position. Therefore, the model exhibits rotational symmetry of order 4. Figure 4 illustrates the model on a Cartesian coordinate plane, showing the central point and four equidistant points forming a square, together with an arc indicating the 90° counterclockwise rotation from the east point to the north point.

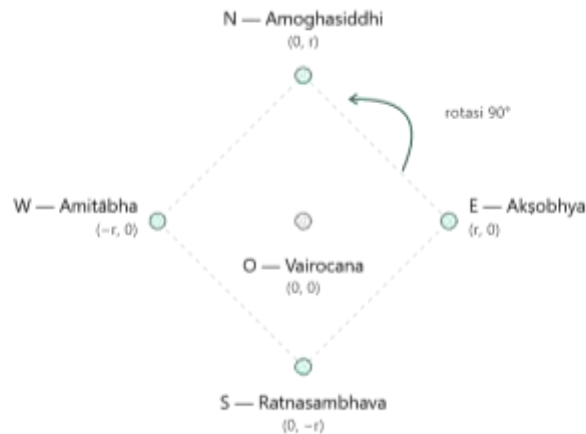


Fig. 4. Mathematical model of the central point and four directional positions of the Pañcatathāgata on a Cartesian coordinate plane.

The model is significant because it enables a cultural structure to be translated into a mathematical object that can be analyzed using geometric concepts. However, it should not be interpreted as evidence that the five statues at Sanggrahan Temple were historically arranged at the center and the four cardinal directions at equal distances.

The relationship among the three analytical layers can be stated more explicitly. The cultural fact is the documented presence of five Buddha statues at Sanggrahan Temple and their interpretation in relation to the Pañcatathāgata based on established iconographic conventions. The mathematical abstraction represents these elements as one central point and four equidistant points separated by 90° angular intervals. This representation produces a square and rotational symmetry of order 4. The resulting mathematical model is then used as the basis for a pedagogical design focusing on rotation and geometric transformations on the Cartesian coordinate plane.

This distinction is important because ethnomathematical research can risk conflating cultural facts with mathematical interpretations. In the present study, geometric transformation is not claimed to have been a historical mathematical system used within the Pañcatathāgata tradition. Rather, it is treated as a contemporary mathematical language for interpreting and modeling the cultural structure identified in the source material.

At a more interpretive level, the concept of transformation may also provide an opportunity to reflect on ideas of change and meaning-making within the Buddhist tradition. However, this connection is presented only as a structural analogy and does not equate mathematical transformation with spiritual transformation. The purpose is not to explain Buddhist doctrine through mathematics, but to show that the mathematical idea of positional change can provide a starting point for a limited dialogue across cultural and conceptual contexts.

3.3 From Mathematical Model to Contextual Learning

The mathematical model developed in this study was subsequently translated into an instructional design for mathematics learning. The design focuses on geometric transformations in Phase D, particularly rotation on the Cartesian coordinate plane.

The applicable Mathematics Learning Outcomes refer to the Decree of the Head of BSKAP Number 046/H/KR/2025. Changes introduced through the Decree of the Head of BKPDM Number 020 of 2026 concern only the Learning Outcomes for Religious Education and Character Education. Accordingly, the Mathematics Learning Outcomes remain based on the Decree of the Head of BSKAP Number 046/H/KR/2025.

The 2025 Mathematics Subject Guide also indicates that geometric transformation learning can be developed through contexts involving patterns and architecture. The guide provides examples of activities involving translation, reflection, rotation, and dilation, as well as the use of patterns, architectural forms, and designs as learning contexts.

The use of Sanggrahan Temple is therefore consistent with the types of contextual situations suggested in the curriculum documents for learning geometric transformations. The local cultural context provides a basis for introducing the mathematical model without being treated as evidence of a historical mathematical system.

The instructional design is organized into two learning sessions. The first session focuses on observing the cultural context, constructing the mathematical representation, and exploring rotation. The second session focuses on formalizing the model, solving contextual problems, and reflecting on the distinction between the cultural context and the mathematical model.

Table 2. Instructional design based on the Pañcatathāgata model.

Session	Activity focus	Student activities	Mathematical concepts	Product
1	Observing and modeling	Students observe an image of Sanggrahan Temple and information about the five Buddha statues, identify the central and four directional positions, and represent these positions on a coordinate plane.	Points, coordinates, distance, angles, and squares	Coordinate model sketch
1	Exploring rotation	Students rotate one of the points about the center by 90° , 180° , 270° , and 360° .	Rotation center and rotation	Rotation of results table
2	Formalizing the model	Students determine the rules of rotation and compare the coordinates before and after transformation.	Rotation rules: $((x,y) \rightarrow (-y,x))$, $((x,y) \rightarrow (-x,-y))$, and $((x,y) \rightarrow (y,-x))$	Symbolic representation
2	Solving a contextual problem	Students solve problems involving changes in the positions of points within the Sanggrahan Temple model.	Geometric transformations and spatial reasoning	Problem solutions
2	Reflecting	Students explain the distinction between documented cultural facts and the mathematical model developed in the study.	Mathematical literacy and reflection	Written reflection

At the initial stage, the teacher can display a photograph of Sanggrahan Temple together with information about the five Buddha statues. Students are then guided to distinguish between

information that can be directly observed and information obtained from historical or archaeological sources. This distinction helps students recognize that the mathematical representation is constructed through a process of interpretation and abstraction rather than directly read from the cultural object.

The teacher then introduces the mathematical model consisting of one central point and four directional points. Students plot these points on a coordinate plane and determine their coordinates. For example, when the distance from each point to the center is set at 4 units, the four points can be represented as

$$\begin{aligned} E &= (4, 0) \\ N &= (0, 4) \\ W &= (-4, 0) \\ S &= (0, -4) \end{aligned}$$

Students can then observe how the position of a point changes when it is rotated by 90° , 180° , 270° , and 360° about the origin ($O=(0,0)$). Through this activity, students can examine the pattern of coordinate changes and relate the repeated return to the initial position to the concept of rotational symmetry of order 4.

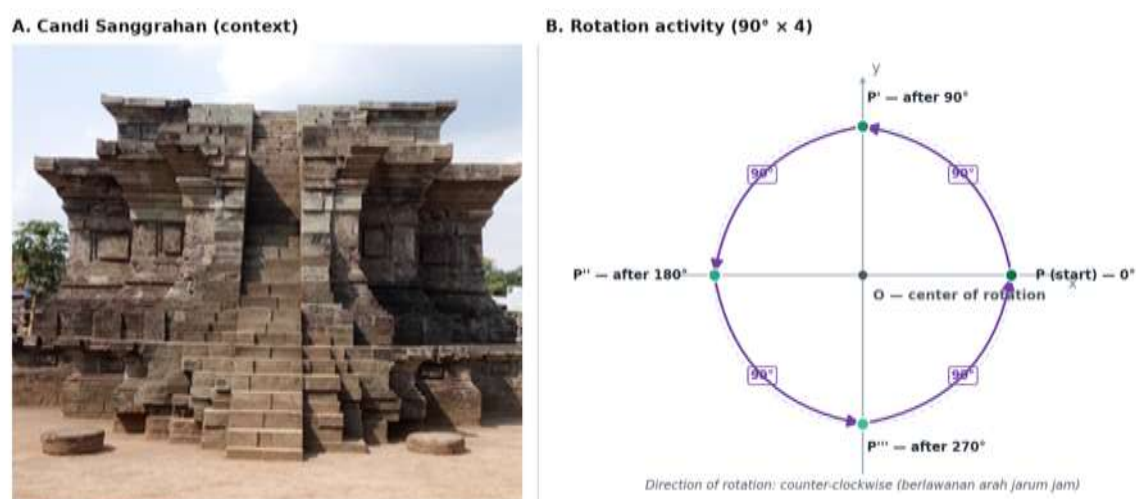


Fig. 5. Example rotation activity (90°) on the Sanggrahan Temple Model.

The learning activity can then be extended through a contextual problem. For example, students are given point ($A=(4,0)$) and asked to determine its image after rotations of 90° , 180° , and 270° about the origin. The activity can subsequently be extended by asking students to explain why the model exhibits rotational symmetry of order 4.

Example problem:

A geometric model inspired by a structure consisting of one center and four directions is represented on a coordinate plane. Point (A) is located at $((4,0))$. Determine the coordinates of the image of point (A) after rotations of 90° , 180° , 270° , and 360° about the origin $((0,0))$. Explain the relationship between the results and the model's rotational symmetry.

This problem allows students to connect the cultural context with mathematical representations without requiring them to interpret the model as a reconstruction of the historical arrangement of the statues.

The instructional design can also be extended to other types of geometric transformations. Repeated architectural elements may provide a context for discussing translation when a clear repetition pattern can be identified. Reflection may be explored when visual structures exhibit identifiable mirror symmetry. Similarly, similarity or dilation may be considered when measurement data are available and students can compare corresponding lengths and scale factors.

The possible relationships among the cultural context, mathematical abstraction, and learning concepts are summarized in Table 3.

Table 3. Mapping of cultural contexts, mathematical abstractions, and learning concepts.

Cultural context	Mathematical abstraction	Learning concept	Status
One center and four directions in the Pañcatathāgata model	A central point and four equidistant points	Rotation and rotational symmetry	Conceptual model
Repetition of architectural elements	Positional shift	Translation	Requires appropriate visual selection
Structure with left-right balance	Reflection across a line	Reflection	Requires visual verification
Comparison of the sizes of architectural elements	Scale factor	Similarity and dilation	Requires measurement data
Square and rectangular forms in the architecture	Plane representation	Plane figures and coordinates	Supported by previous studies

This mapping indicates that not every transformation concept needs to be derived from the same cultural element. A more appropriate approach is to select mathematical concepts according to the available visual evidence and data. Accordingly, the Pañcatathāgata model is used primarily to develop the concepts of rotation and rotational symmetry, while other transformations are considered only when the cultural object provides a sufficient basis for their mathematical representation.

In this way, the study moves beyond simply identifying mathematical concepts associated with a cultural object. The cultural context is used as a starting point for mathematization and mathematical modeling, which are then translated into an instructional design. The resulting design remains conceptual and therefore requires further validation and empirical testing before conclusions can be drawn about its implementation in classroom learning.

3.4 Three Layers of the Relationship among Culture, Mathematics, and Learning

Based on the analysis, the relationship between Sanggrahan Temple and mathematics can be understood through three interconnected layers.

The first layer is the cultural fact. At this level, the information used in the analysis must be traceable to archaeological sources, official records, or previous research. Examples include the status of Sanggrahan Temple as a cultural heritage site, its architectural characteristics, and

the presence of five Buddha statues documented in archaeological research. Their interpretation as representations of the Pañcatathāgata is based on commonly cited Buddhist iconographic conventions, as discussed in the preceding sections, rather than on a definitive archaeological identification of the statues' identities and historical arrangement.

The second layer is mathematical abstraction. At this stage, the researcher selects specific aspects of the cultural context and translates them into a mathematical system. The structure consisting of one central position and four directional positions is abstracted into points on a coordinate plane. When the four points are positioned at equal distances from the center and separated by 90° angles, the resulting representation forms a square and exhibits rotational symmetry of order 4.

The third layer is pedagogical design. The mathematical model is then used to develop learning activities through which students observe the context, construct mathematical representations, perform transformations, identify patterns, and explain the results.

The overall process can be represented as follows:

Sanggrahan Temple → Pañcatathāgata context → abstraction of one center and four directions → coordinate model → 90° rotation → rotational symmetry of order 4 → learning activity

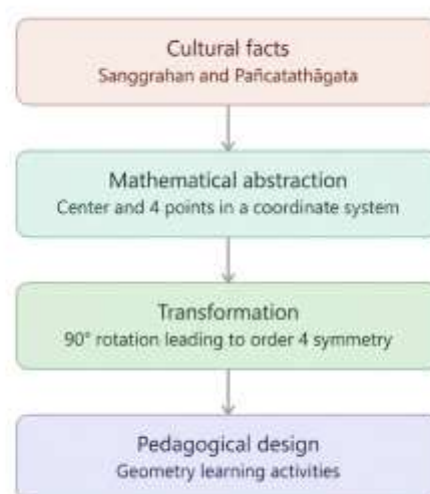


Fig. 6. From the Sanggrahan Temple context to a mathematical model and learning activity.

This three-layer framework provides a methodological structure for organizing the relationship among cultural information, mathematical abstraction, and instructional design. In ethnomathematics research, identifying geometric forms or relationships in cultural artifacts does not by itself constitute a learning design. The process also requires the selection of a relevant context, abstraction into a mathematical representation, and translation of that representation into learning activities. The framework presented in this study makes these stages explicit and helps maintain a clear distinction between documented cultural information and mathematical constructions developed for educational purposes.

4 Conclusion

Sanggrahan Temple in Tulungagung can serve as a context for culture-based mathematics learning. Previous studies have documented various geometric concepts and transformations in the physical structure of the temple. This study extends that line of work by developing a conceptual mathematical model based on the five Buddha statues documented in archaeological research and interpreted in this article in relation to the Pañcatathāgata.

The symbolic structure of the Pañcatathāgata, consisting of a central position and four cardinal directions, is abstracted into a central point and four equidistant points on a coordinate plane. With 90° angular intervals, this representation forms a square and exhibits rotational symmetry of order 4. The model is a mathematical abstraction developed for educational purposes and is not intended to reconstruct the historical arrangement of the five statues at Sanggrahan Temple.

The mathematical model is then translated into an instructional design for geometric transformations in Phase D. The design includes activities involving observation of the cultural context, construction of coordinate representations, rotation, identification of patterns, contextual problem solving, and reflection. These activities are organized through three interconnected layers: documented cultural facts, mathematical abstraction, and pedagogical design.

The study therefore contributes a conceptual framework that links the Pañcatathāgata context associated with Sanggrahan Temple to the mathematical concepts of rotational symmetry and geometric transformation. Rather than treating the temple only as a source for identifying geometric forms, the framework uses selected cultural information as a starting point for mathematical abstraction and instructional design.

This study has several limitations. The developed model has not been validated through direct measurement of the historical layout of the statues, is not intended as an archaeological reconstruction, and has not yet been tested in a classroom setting. Future research could involve collaboration with archaeologists or cultural historians to further examine the interpretation of the Pañcatathāgata context, obtain relevant measurements of geometric elements, and investigate the instructional design through classroom-based research. Such work would provide additional evidence for examining the relationship among cultural heritage, mathematical modeling, and students' learning experiences.

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