AN ETHNOMATHEMATICS STUDY OF SANGHYANG DORA HILL AS A GEOMETRY LEARNING CONTEXT TO DEVELOP STUDENTS' SPATIAL ABILITIES

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Abstrak: Penelitian ini bertujuan untuk mengeksplorasi konsep geometri pada Bukit Sanghyang Dora dalam perspektif etnomatematika serta mengkaji keterkaitannya dengan kemampuan spasial siswa. Penelitian menggunakan pendekatan kualitatif dengan jenis eksploratif-deskriptif. Data dikumpulkan melalui observasi, dokumentasi visual, dan studi literatur. Objek yang dianalisis berupa lanskap Bukit Sanghyang Dora yang memperlihatkan bentuk bukit, lereng, kontur permukaan, arah pandang, dan perspektif ruang. Analisis data dilakukan melalui reduksi data, penyajian data, dan penarikan kesimpulan dengan mengidentifikasi unsur-unsur geometri yang tampak pada dokumentasi visual. Hasil penelitian menunjukkan bahwa Bukit Sanghyang Dora memuat berbagai konsep geometri, yaitu bentuk bukit menyerupai kerucut atau limas tidak beraturan, titik puncak, alas, tinggi, sisi miring atau garis pelukis, lereng sebagai bidang miring, kontur permukaan, sudut elevasi, dan perspektif ruang near–middle–far. Konsep-konsep tersebut berpotensi mendukung kemampuan spasial siswa, terutama visualisasi spasial, orientasi spasial, relasi spasial, dan representasi ruang. Kontribusi penelitian ini adalah memberikan alternatif sumber belajar geometri berbasis potensi lokal Majalengka yang kontekstual, visual, dan relevan untuk pembelajaran matematika di SMA.

Kata Kunci: etnomatematika, geometri, Bukit Sanghyang Dora, kemampuan spasial, pembelajaran kontekstual.

Abstract: *This study aims to explore geometric concepts at Sanghyang Dora Hill from an ethnomathematical perspective and examine their relationship with students' spatial abilities. A qualitative approach with an exploratory-descriptive design was employed. Data were collected through observation, visual documentation, and literature review. The objects of analysis included the landscape of Sanghyang Dora Hill, specifically its shape, slopes, surface contours, lines of sight, and spatial perspectives. Data analysis involved reduction, presentation, and conclusion drawing by identifying geometric elements visible in the visual documentation. The results indicate that Sanghyang Dora Hill embodies various geometric concepts, such as a hill shape resembling a cone or an irregular pyramid, a peak, a base, height, slant height (or generatrix), slopes acting as inclined planes, surface contours, angles of elevation, and near-middle-far spatial perspectives. These concepts have the potential to support students' spatial abilities, particularly spatial visualization, spatial orientation, spatial relations, and spatial representation. This study contributes an alternative geometry learning resource based on the local potential of Majalengka—one that is contextual, visual, and relevant for high school mathematics education.*

Keywords: *ethnomathematics, geometry, Sanghyang Dora Hill, spatial abilities, contextual learning.*

INTRODUCTION

Geometry learning plays a crucial role in mathematics education because it relates to students' understanding of shape, space, position, size, and the relationships between objects. Geometry not only requires students to memorize formulas but also the ability to observe, imagine, represent, and interpret objects visually. Dintarini *et al.* (2022) explain that solving geometric problems requires spatial thinking skills, especially when students are faced with numeracy-based problems that require an understanding of shape and space. More broadly, Žakelj & Klančar (2022) suggest that spatial ability is a fundamental skill required by students in learning geometry because students need to build understanding from visual representations to formal understanding.

PISA data shows that Indonesian students' mathematical abilities are still low compared to the international average, especially in solving problems requiring reasoning, representation, and visual interpretation (OECD, 2023). These findings demonstrate the importance of contextual and visual-based geometry learning to help students understand spatial concepts more meaningfully. In geometry learning, the ability to understand shape, position, perspective, and the relationships between objects is closely related to students' spatial abilities. Spatial abilities play a crucial role in helping students visualize geometric objects, represent two-dimensional and three-dimensional shapes, and interpret spatial relationships from various perspectives (Supli & Yan, 2024). Therefore, geometry learning needs to be designed through learning experiences that are close to students' environment and visual experiences to ensure that geometric concepts are not misunderstood, only abstractly, but can also be observed and interpreted through real objects around students.

Based on preliminary observations conducted at a school in Majalengka Regency, geometry learning still tends to be abstract and centered on the use of textbooks and two-dimensional drawings on the blackboard. When students are asked to identify the spatial shape of real objects, determine front and side views, or imagine the position of objects from different perspectives, some students still experience difficulties. For example, in the material on geometric shapes and angles of elevation, students can state formulas, but are not yet fully able to connect these formulas to the shapes of objects in the surrounding environment. This condition indicates that students' spatial abilities still need to be strengthened through learning that is more visual, contextual, and close to everyday experiences. This finding is in line with research by Dintarini *et al.* (2022) which shows that students' spatial thinking skills are necessary for solving context-based geometry problems. Research by Sabil et al. (2024) also emphasized that students' spatial abilities in geometry material need attention because they are related to students' abilities in spatial perception, visualization, and geometry problem solving.

One approach that can be used to link geometry learning to real-world contexts is ethnomathematics. Ethnomathematics views mathematical concepts as being found in culture, community activities, the environment, and everyday life practices. Rosa and Orey explain that an ethnomathematics perspective helps students understand reality, culture, society, the environment, and themselves through mathematical content that is close to their lives. In geometry learning, ethnomathematics can be a bridge between real objects and formal concepts, allowing students to build an understanding of geometry through observing shapes, patterns, sizes, spaces, and positional relationships (Ga'a et al., 2025). This approach is also relevant to the development of spatial abilities because students are trained to observe objects, imagine spatial shapes, transform visual representations, and interpret relationships between objects. Recent research by Gustina *et al.* (2025) shows that ethnomathematics-based learning combined with visual media can support students' spatial abilities in the context of three-dimensional geometry. In addition, Herman's (2025) research shows that project-based learning with an ethnomathematics approach has the potential to improve spatial reasoning because students are involved in contextual activities that require geometric modeling and visualization.

One of the local objects that has the potential to be studied through an ethnomathematics perspective is Sanghyang Dora Hill in Majalengka Regency. This hill not only has natural tourism value, but also presents various visual phenomena that can be linked to geometric concepts. The hill's cone-like shape can be used to explore spatial geometry, while the hill's slopes can be linked to inclined planes, gradients, and elevation angles. The hill's surface contours show changes in height and surface shape that can be linked to spatial representations. In addition, the view from Sanghyang Dora Hill allows observers to see objects in close, middle, and distant arrangements, so it can be used to discuss spatial perspective, visual orientation, and the representation of three-dimensional objects on a two-dimensional plane. The existence of these objects shows that Sanghyang Dora Hill is important to explore as a source for learning geometry because it is able to present mathematical concepts in a tangible, visual, and close to the students' environment in Majalengka.

Several previous studies have demonstrated that ethnomathematics can be used to explore geometric concepts in various local contexts. Sutarto *et al.* (2021) examined geometric transformations in Sasak Sukarara weaving and found that cultural motifs contained the concepts of reflection, translation, rotation, and dilation. Fauzi *et al.* (2020) explored geometric concepts in Sasak cultural objects and showed that traditional houses and local artifacts could serve as meaningful contexts for mathematics learning. In relation to students' spatial abilities, Mandala *et al.* (2025) developed augmented reality-based geometry learning media and demonstrated that interactive visual representations could facilitate students' spatial reasoning and understanding of three-dimensional objects. Similar studies have also been conducted in tourism settings. Paramita and Asrul (2023) identified plane figures, lines, geometric transformations, and sets in the spatial arrangement of Pematang Johar Rice Field Tourism. Alfiya and Rohmah (2024) found geometric concepts such as circles, quadrilaterals, and rhombuses in structures located around the Madiredo Lake tourism area, while Ica *et al.* (2025) identified several plane geometric forms in artifacts found at Leang-Leang Prehistoric Park. These studies confirm that cultural objects and tourist destinations can provide contextual resources for recognizing mathematical concepts in students' surroundings.

However, previous ethnomathematics studies have mainly focused on man-made cultural objects, tourism facilities, spatial arrangements, buildings, traditional crafts, and archaeological artifacts. Studies that specifically explore the morphology of a natural hill landscape and relate it to solid geometry, inclined planes, surface contours, elevation angles, visual perspective, and indicators of students' spatial ability remain limited, particularly in the local context of Majalengka. Based on this research gap, this study aims to explore the geometric concepts embedded in Sanghyang Dora Hill from an ethnomathematical perspective and examine their potential relevance to students' spatial abilities in geometry learning. More specifically, the study identifies the hill's form as a representation of a cone or an irregular pyramid, its slopes as inclined planes, its surface patterns as contour representations, the relationship between height and horizontal distance through elevation angles, and the near–middle–far arrangement of objects as a form of spatial perspective. The findings are expected to demonstrate that a local natural tourist attraction can be used as a contextual, visual, and meaningful geometry learning resource for senior high school students. In addition, this study is expected to provide a foundation for teachers to develop geometry learning activities that are closer to students' environment while introducing the local potential of Majalengka as a meaningful context for mathematics learning.

METHOD

This study uses a qualitative approach with an exploratory-descriptive type. The study aims to explore the geometric concepts contained in Sanghyang Dora Hill from an ethnomathematics perspective and analyze their relationship with students' spatial abilities. The research location is Sanghyang Dora Hill, Majalengka Regency, West Java, which was chosen purposively because it has visual characteristics such as hill shape, slope, contour, angle of inclination, and spatial perspective that are relevant to geometry learning.

The research data consists of visual data, verbal data, and document data. Visual data was obtained through photographic documentation of the research object from various perspectives, verbal data was obtained through semi-structured interviews with tourism managers, local residents, and mathematics teachers, while document data was obtained from location maps and literature related to ethnomathematics, geometry, and spatial abilities. Data collection techniques were carried out through observation, documentation, interviews, and literature studies. The research instruments included observation sheets, interview guidelines, and documentation sheets.

Data analysis was conducted through the stages of data reduction, data presentation, and conclusion drawing. Data from observations and documentation were analyzed by identifying geometric elements such as the cone-like shape of the hill, inclined planes on slopes, surface contours, elevation angles, and spatial perspective. Furthermore, the identification results were linked to indicators of spatial ability, namely spatial visualization, spatial orientation, spatial relations, and spatial representation. To strengthen the validity of the data, the results of the identification of geometric concepts in the visual documentation of Sanghyang Dora Hill were validated through technical triangulation and expert validation. Technical triangulation was carried out by comparing the results of observations, photo documentation, and literature studies. Expert validation was carried out by involving mathematics teachers or education lecturers.

mathematics to examine the suitability between the visual objects analyzed and the geometric concepts interpreted, such as cones, irregular pyramids, inclined planes, contours, elevation angles, and spatial perspective.

Image analysis was conducted using original photographs of Sanghyang Dora Hill. The photographs were annotated with simple guide lines, points, view directions, and geometric descriptions. Annotations were used to indicate geometric elements visible on the objects, such as the peak, base, height, slanted side, slope, contour lines, horizontal lines, sight lines, elevation angles, and the near, middle, and far positions of the objects. The use of annotations aimed to clarify the relationship between real objects and geometric concepts without changing the original characteristics of the observed landscape.

RESULTS AND DISCUSSION

Sanghyang Dora Hill is a natural tourist attraction located in Majalengka Regency. The area is characterized by a landscape consisting of hill masses, slopes, hiking trails, tourist access routes, and panoramic views that display the position and arrangement of objects in space. The landscape can be observed from several viewpoints, including frontal, lateral, and elevated views. These different viewpoints allow the hill to be interpreted not merely as a natural object, but also as a visual representation of several geometric relationships.

Geometrically, the findings can be classified into five main groups: solid geometry, line and plane relationships, slope and trigonometric relationships, contour representation, and spatial perspective. The overall form of the hill can be approximated as a cone or an irregular pyramid, with identifiable elements including an apex, a base region, vertical height, sloping surfaces, and slant height. This approximation does not imply that the hill has exactly the same properties as an ideal geometric solid. Instead, it represents a mathematical modeling process in which an irregular natural form is simplified into a geometric model so that its spatial characteristics can be studied more systematically.

The hillside and hiking routes also provide representations of line segments, oblique lines, inclined planes, and changes in vertical and horizontal positions. The steepness of a slope can be interpreted through the ratio between the change in height and horizontal distance, which may be introduced mathematically as $m = \frac{\Delta h}{\Delta d}$

When an observer looks toward the hilltop, the observer's position, the horizontal line, the line of sight, and the vertical height form an approximate right-triangle configuration. This configuration can be used to introduce the angle of elevation and the trigonometric relationship $\tan\theta = \frac{h}{d}$

Meanwhile, variations in the hill surface can be represented through contour lines. Each contour line represents points of approximately equal elevation, while differences in contour spacing can indicate variations in slope steepness. These representations help connect the actual three-dimensional surface of the hill with its two-dimensional geometric representation.

The panoramic view of Sanghyang Dora Hill also shows the relative positions of near, middle, and distant objects. Objects located closer to the observer appear larger and more detailed, whereas distant objects appear smaller and less distinct. This visual phenomenon can be discussed through perspective projection, apparent size, spatial depth, viewing direction, and the representation of three-dimensional objects on a two-dimensional plane. From an ethnomathematical perspective, these geometric concepts are connected to local activities such as selecting hiking routes, determining directions, estimating distance and slope, identifying high and low positions, and interpreting the arrangement of tourist spaces. The photographs analyzed in this study were therefore annotated using points, line segments, horizontal lines, sight lines, contour curves, viewing directions, and geometric labels to make these implicit mathematical ideas more explicit.

Figure 1. Documentation of Sanghyang Dora Hill as an object of geometric exploration

Hill Shape as a Representation Three-Dimensional Geometry

Based on the visual documentation, the landscape of Sanghyang Dora Hill consists of several hills with varying natural forms and sizes. One of the prominent hills appears to rise gradually from a broad lower region toward a relatively narrow highest point. From a geometric perspective, this visual form can be approximated as a cone-like or irregular pyramidal form. However, this approximation should be understood as a mathematical model rather than a statement that the hill has the exact properties of a formal geometric solid.

Natural landforms are generally irregular, non-uniform, asymmetrical, and characterized by uneven surfaces. Therefore, Sanghyang Dora Hill cannot be classified precisely as a cone or a pyramid. The approximation is used to simplify the hill’s complex natural form into a geometric representation that can be more easily observed and interpreted. In this modeling process, the highest point of the hill is interpreted as an apex, the broader lower region as a base area, and the vertical distance from the highest point to the represented base plane as the height of the model. Meanwhile, the hill’s inclined surface can be interpreted as a representation of the lateral surface of the modeled solid.

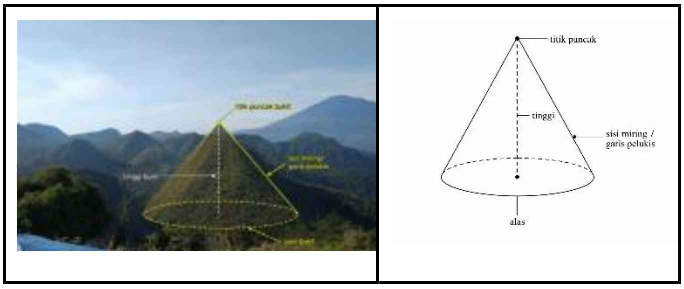


Figure 2. Visual approximation of one of the hills in the Sanghyang Dora Hill area as a three-dimensional geometric form

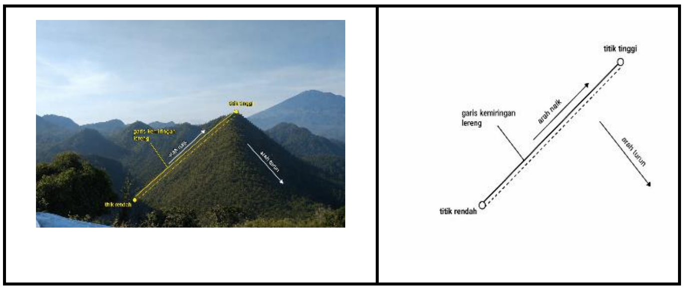
Description: the highest point as a representation of the apex, the lower region as the base area, the vertical distance as the represented height, and a line representing the sloping distance from the hilltop to the lower part of the hill.

In Figure 2, the line extending from the highest point toward the lower part of the hill does not represent an actual slant height in the formal sense. In a cone, the slant height is a precisely defined line segment connecting the apex to a point on the circumference of the circular base. Since the hill does not have a perfectly circular base or a uniform surface, the line in the figure is used only to indicate the approximate sloping distance between the upper and lower parts of the hill. Similarly, when the hill is imagined through a vertical cross-section, its profile may resemble a triangle, although the resulting form remains irregular.

This modeling process illustrates how an irregular natural object can be transformed into a simplified geometric representation. Students can begin by observing the actual form of the hill, identifying its highest and lower regions, and then constructing an approximate three-dimensional model. Through this process, geometric concepts such as apex, base area, vertical height, inclined surface, sloping line, and vertical cross-section can be introduced without assuming that the natural object is identical to an ideal geometric solid. This interpretation is consistent with the view that geometry learning involves not only understanding formal definitions and formulas but also interpreting visual representations and constructing mental images of spatial objects (Lavicza et al., 2023; Žakelj & Klančar, 2022).

The use of Sanghyang Dora Hill as a geometric representation also supports the findings of Fauzi and Setiawan (2020), who demonstrated that objects in the local environment can contain geometric ideas and serve as meaningful resources for mathematics learning. Their study identified various plane geometric concepts in traditional Sasak crafts. The present finding extends this perspective by showing that geometric ideas can also be explored through irregular natural landscapes. Unlike manufactured cultural artifacts, which generally have clearer and more regular geometric structures, the hill requires a process of abstraction and approximation before it can be connected to a formal geometric model.

The importance of visual representation in this modeling process is also supported by Mandala *et al.* (2025), who emphasized that visual media can facilitate students' spatial reasoning by helping them mentally represent and manipulate three-dimensional objects. While their study employed augmented reality as an interactive visualization medium, the visual documentation of Sanghyang Dora Hill provides a contextual representation derived from the students' local environment. The annotated photograph can therefore function as an initial visual stimulus through which students observe an irregular object, identify its spatial characteristics, and translate it into a simpler geometric form.



In relation to spatial ability, this activity has potential relevance to students' spatial visualization. Students are required to interpret a two-dimensional photograph and construct a mental representation of a three-dimensional object. They may also be encouraged to imagine the hill from different viewpoints, identify its possible vertical cross-section, and distinguish between the actual natural form and its simplified geometric model. Lavicza *et al.* (2023) explain that learning three-dimensional geometry is closely connected to the ability to construct, manipulate, and transform mental images of spatial objects. Similarly, Lowrie *et al.* (2019) show that visual-spatial activities can support spatial reasoning and mathematical performance. Thus, the geometric modeling of Sanghyang Dora Hill may help students recognize spatial elements while understanding that mathematical models are simplified representations of complex real-world objects.

Hillside as a Representation of a Sloping Surface

Observations of Sanghyang Dora Hill show that several parts of the landscape form sloping surfaces extending gradually from lower to higher positions. These natural slopes can be interpreted geometrically as representations of inclined surfaces because they display changes in vertical position relative to horizontal distance. However, the hillside should not be regarded as an ideal inclined plane because its natural surface is irregular, uneven, and does not form a perfectly flat geometric plane. Therefore, the concept of an inclined plane is used only as a simplified geometric approximation of the observed landscape.

In the annotated photograph, guide lines are used to indicate the direction of the slope, the relative positions of the lower and higher parts, and the direction of ascent and descent. These lines do not represent the results of direct topographic measurements. Instead, they function as visual aids that make the geometric characteristics of the hillside more explicit. Through these annotations, the hill slope can be discussed in relation to a horizontal reference line, an oblique line representing the direction of the surface, changes in elevation, and the relative positions of higher and lower points.

Figure 3. Geometric representation of the slope of Sanghyang Dora Hill as a sloping surface

Description: a horizontal reference line, a line representing the slope direction, a lower point, a higher point, and the direction of ascent and descent.

Based on Figure 3, several geometric concepts can be explored, including sloping surfaces, horizontal and oblique lines, lower and higher positions, vertical change, horizontal distance, and slope direction. A steeper surface can be understood conceptually as having a greater vertical change over a given horizontal distance, whereas a gentler surface has a smaller vertical change over the same horizontal distance. This relationship can be represented by the general concept of gradient:

$$\mathrm{m} = \frac{\Delta \mathrm{h}}{\Delta \mathrm{d}}$$

where Δh represents the change in elevation and Δd represents the horizontal distance. In this study, the formula is not used to calculate the actual gradient of Sanghyang Dora Hill because no direct measurements of elevation or horizontal distance were conducted. Instead, it is presented as a possible extension of classroom learning after students have visually recognized the relationship between vertical change and horizontal distance.

The slopes of Sanghyang Dora Hill may therefore provide a contextual starting point for introducing the concept of slope before students work with numerical values, coordinate systems, or trigonometric ratios. Students can first observe which parts of the hill are relatively higher or lower, identify the direction of ascent and descent, and compare surfaces that appear steeper or gentler. These observations can then be transformed into sketches or simplified geometric models involving horizontal and inclined lines. Such activities allow students to move gradually from visual observation of a real object toward a more formal mathematical representation.

This interpretation is consistent with the concept of outdoor mathematics learning, which uses the surrounding environment as a source for identifying and applying mathematical ideas. Pambudi *et al.* (2023) explain that outdoor mathematics activities enable students to engage with mathematical concepts through direct exploration of real-world objects rather than relying exclusively on abstract classroom representations. In the present study, the hillside serves as a contextual object through which students can recognize changes in position, direction, elevation, and surface inclination. Thus, the natural landscape does not merely illustrate an inclined surface but also provides an initial context for developing mathematical abstraction.

The finding also supports the discussion of Haji *et al.* (2017), who showed that outdoor mathematics learning can strengthen students' mathematical connections by linking mathematical concepts with objects in their environment. In relation to this study, the visual characteristics of Sanghyang Dora Hill allow the concepts of slope, direction, and elevation to be connected with an environment familiar to students in Majalengka. While Haji et al. focused on the implementation of outdoor learning to improve mathematical connection skills, the present study identifies the geometric ideas contained in a hilly landscape as a potential basis for designing such learning activities.

Similarly, Mardia *et al.* (2025) emphasized that integrating outdoor contexts into mathematics learning can create authentic and meaningful learning experiences. This perspective strengthens the interpretation that the slopes of Sanghyang Dora Hill can function as more than decorative examples in geometry learning. They may serve as contextual objects through which students observe, describe, compare, and model differences in elevation and inclination. The present finding therefore extends outdoor mathematics learning into an ethnomathematical context by positioning a local natural tourist landscape as a source of geometric meaning.

In relation to spatial ability, interpreting the hillside as a sloping surface has potential relevance to students' spatial orientation. Students need to recognize the direction of ascent and descent, distinguish higher and lower positions, and understand how changes in direction are related to changes in elevation. Harris (2023) explains that spatial reasoning involves understanding the position, direction, and relationships of objects in space. Accordingly, reading the slope direction of Sanghyang Dora Hill may help students interpret spatial situations from a particular viewpoint and understand the relative arrangement of different parts of the landscape.

Simplified Contour Representation of the Hill Surface

The surface of Sanghyang Dora Hill displays irregular variations in height. Some parts appear relatively higher, while others appear lower, descend gradually, or form sloping surfaces. These visual differences indicate that the hill does not have a flat or uniform surface. To clarify these variations, several illustrative lines were added to the photograph following the visible pattern of the hill's surface.

The lines shown in the annotated photograph do not constitute actual topographic contour lines because they were not produced from field measurements, elevation data, or a topographic survey. Instead, they function as a simplified visual representation of changes in the relative height and shape of the hill's surface. Therefore, the lines should not be interpreted as having a specific contour interval or as connecting points with exactly the same elevation.

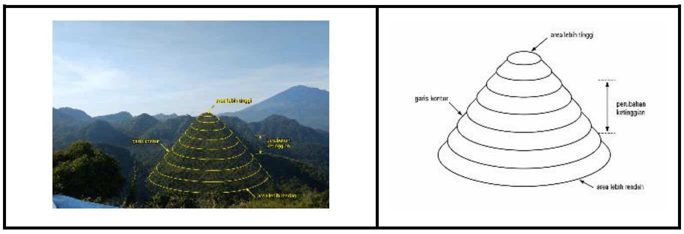


Figure 4. Simplified visual representation of changes in the surface height of Sanghyang Dora Hill

Description: illustrative lines representing the surface pattern, relatively higher and lower areas, and changes in the shape and height of the hill's surface.

Based on Figure 4, the geometric concepts that can be explored include changes in relative height, irregular surface forms, spatial relationships between higher and lower areas, and the representation of a three-dimensional surface in a two-dimensional image. In a formal topographic map, contour lines connect points of equal elevation and are constructed using measured elevation data. In this study, however, the annotated lines function only as a simplified visual representation of changes in the hill's surface height. Their purpose is to help readers identify the general pattern of the surface rather than determine its actual elevation.

The spacing between contour lines on a formal topographic map can be used to interpret surface steepness. Closely spaced contour lines generally indicate a steeper slope, whereas widely spaced contour lines indicate a gentler slope. This principle may be introduced as a conceptual extension in geometry learning. However, because the lines in Figure 4 were added illustratively and were not generated from elevation measurements, their spacing cannot be used to determine the actual steepness of Sanghyang Dora Hill. The photograph should therefore be treated as an initial visual model that may later be connected to more formal contour representations.

This interpretation is related to the concept of spatial representation in topographic maps. Johnson & McNeal's (2022) explain that interpreting topographic representations requires students to connect elevation information presented on a two-dimensional plane with the three-dimensional form of a land surface. Such activities involve spatial visualization and spatial orientation because students need to imagine how lines and symbols on a flat image represent variations in height, shape, and surface structure. In the present study, the simplified lines added to the photograph provide an introductory representation through which students may begin to recognize how an irregular hill surface can be transformed into a two-dimensional visual model.

The pedagogical relevance of this representation is also supported by Mayonita *et al.* (2026), who showed that topographic-map activities can facilitate the interpretation of spatial patterns and surface configurations. Their findings indicate that visual representations of landforms can help students understand the relationships among shape, elevation, and spatial arrangement. In the context of Sanghyang Dora Hill, the annotated photograph provides a local and contextual object through which these relationships can be introduced before students engage with formal topographic maps or numerical elevation data.

From an ethnomathematical perspective, the interpretation of the hill's surface is also connected to local experiences of recognizing higher and lower areas, selecting routes, and understanding the shape of the surrounding landscape. These activities reflect practical spatial knowledge that can be translated into geometric language. The simplified representation therefore serves as a bridge between the community's visual understanding of the natural environment and formal concepts of surface shape, relative height, and two-dimensional representation.

In relation to spatial ability, this activity has potential relevance to spatial representation and spatial relations. Students are required to connect the visible three-dimensional form of the hill with the illustrative lines presented on a two-dimensional photograph. They may also identify the relative positions of higher and lower areas and interpret how different parts of the surface are spatially connected. Sabil et al. (2024) emphasize that spatial ability in geometry includes understanding the position, relationship, and representation of objects in space. Accordingly, interpreting the simplified surface representation of Sanghyang Dora Hill may provide students with an initial visual experience in transforming real spatial objects into geometric representations.

Elevation Angle as a Representation of the Observer–Hilltop Relationship

Based on the visual documentation, the position of an observer in relation to the hilltop can be interpreted as a conceptual representation of an elevation angle. The observer's position, a horizontal reference line, and the line of sight directed toward the highest point of the hill form an angle above the horizontal direction. In geometry and trigonometry, this angle is referred to as the angle of elevation.

The angle shown in the annotated photograph does not represent an actual measured angle. The study did not directly measure the observer's horizontal distance from the hill, the difference in height between the observer and the hilltop, or the magnitude of the angle formed. Therefore, the annotations function as a simplified geometric model intended to clarify the spatial relationship between the observer, the horizontal direction, and the observed hilltop.

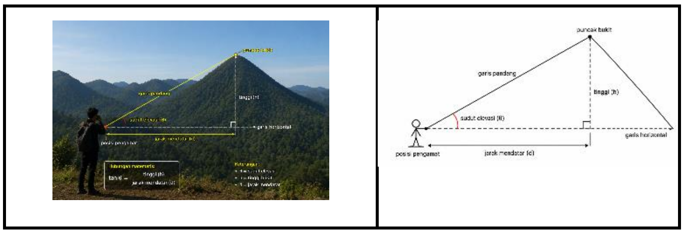


Figure 5. Analysis of elevation angles on Sanghyang Dora Hill

Description: observer's position, horizontal reference line, line of sight toward the hilltop, represented angle of elevation, horizontal distance, and vertical height difference.

As illustrated in Figure 5, the observer's position, the horizontal distance, the vertical height difference, and the line of sight can be modeled as a right triangle. In this model, the line of sight represents the hypotenuse, the vertical height difference represents the side opposite the elevation angle, and the horizontal distance represents the adjacent side. The relationship among these elements can be expressed conceptually through the tangent ratio:

$$\tan\theta = \frac{h}{d}$$

where θ represents the angle of elevation, h represents the vertical height difference between the observer's position and the hilltop, and d represents the horizontal distance between the observer and the point vertically below the hilltop. In this study, the formula is not used to calculate the actual height, distance, or angle at Sanghyang Dora Hill. Instead, it is presented as a potential extension of geometry and trigonometry learning based on the visual context of the hill.

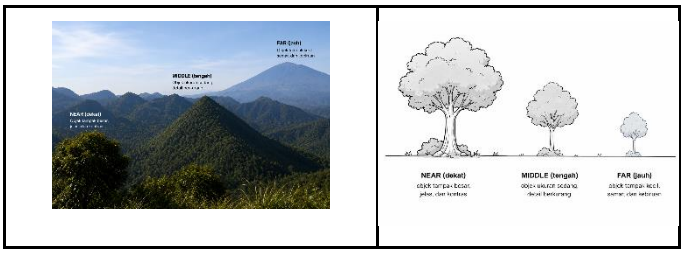
The concept of the elevation angle should also be distinguished from the angle of the hill's slope. The elevation angle is formed between the observer's horizontal line and the line of sight toward the hilltop, whereas the slope angle is formed between a horizontal reference line and the inclined surface of the hill. These two angles are not necessarily equal because the observer's line of sight does not always follow the direction of the hill's surface. In the present study, the annotated photograph primarily represents the angle of elevation rather than the actual slope angle of the hill.

The Sanghyang Dora Hill context may help students understand that elevation angles are not limited to abstract diagrams or textbook exercises. Through photographs and simplified sketches, students can identify the observer's position, the object being observed, the horizontal direction, the line of sight, the vertical height difference, and the horizontal distance. These visual elements may then be transformed into a right-triangle model. Such a process allows students to move from observing a real landscape toward understanding a formal trigonometric representation.

This interpretation is consistent with the Realistic Mathematics Education perspective, which emphasizes beginning mathematical learning with situations that are meaningful and recognizable to students. Andiani *et al.* (2024) explain that learning trigonometric ratios can be developed from contextual situations before students are directed toward formal symbols and calculations. In the present study, the visual relationship between an observer and the hilltop provides a local context for introducing the relationship among angle, height, horizontal distance, and line of sight.

The findings discussed by Reza *et al.* (2026) also reinforce the importance of real-world contexts in learning trigonometric ratios. Contextual situations can help students interpret the meaning of the components of a right triangle rather than merely applying formulas procedurally. Sanghyang Dora Hill extends this idea by providing a natural tourism landscape familiar to students in Majalengka. The hill can therefore serve as an initial visual context from which teachers may design activities involving sketches, estimation, measurement, and trigonometric modeling.

As a possible follow-up learning activity, students may use a simple clinometer to estimate the elevation angle from a specified observation point. The activity may be continued by measuring the horizontal distance and estimating the difference in height using the tangent ratio. However, this use of a clinometer should be understood as a recommendation for future classroom implementation rather than a procedure conducted in the present study.



In relation to spatial ability, interpreting the elevation angle has potential relevance to students' spatial orientation. Students need to understand their position as observers, identify the location of the hilltop, determine the viewing direction, and recognize the relationships among height, distance, and angle. Makamure & Jojo (2021) emphasize that visual-spatial skills contribute to the interpretation and application of spatial models in mathematics. Accordingly, the conceptual elevation-angle model of Sanghyang Dora Hill may support students in reading a spatial situation from a particular viewpoint and translating it into a two-dimensional geometric representation.

Spatial Perspective as a Representation of Relative Position and Visual Depth

The panoramic documentation of Sanghyang Dora Hill displays objects located at different relative distances from the observer. Some objects are positioned in the foreground, others occupy the middle ground, and the remaining objects appear in the background. Objects closer to the observer generally appear larger, clearer, and more detailed, whereas objects located farther away appear smaller, less distinct, and lower in visual contrast. This variation creates an impression of depth and illustrates how a three-dimensional landscape is represented in a two-dimensional photograph.

The near–middle–far classification used in this study does not represent an exact measurement of distance. Instead, it functions as a simplified visual interpretation based on the apparent position of objects in relation to the observer. The photograph was not analyzed using formal perspective-projection procedures involving vanishing points, horizon lines, or projection scales. Therefore, the discussion focuses on observable spatial relationships, including relative position, viewing direction, apparent size, overlapping objects, and visual depth.

Figure 6. Visual representation of relative position and depth in the panorama of Sanghyang Dora Hill

Description: foreground objects, middle-ground objects, background objects, the observer's viewing direction, relative position, and visual depth

Based on Figure 6, several geometric and spatial concepts can be explored, including the relative positions of objects, apparent distance, viewing direction, the observer's viewpoint, changes in apparent size, object overlap, and the representation of three-dimensional space on a two-dimensional image plane. Objects in the foreground may partially cover objects behind them, while more distant objects appear smaller even though their actual dimensions may not necessarily be smaller. These visual characteristics help explain that the appearance of an object in a photograph is influenced by its distance and position relative to the observer.

The panoramic image can therefore be used to introduce the basic idea of perspective projection without requiring students to perform a formal technical analysis. In this context, perspective projection refers to the visual process through which objects distributed in three-dimensional space are displayed on a flat image. The focus is not on calculating projection ratios, but on helping students recognize that changes in apparent size, clarity, and overlap provide visual information about the relative positions and distances of objects.

This interpretation is consistent with Harris's (2023) explanation that spatial reasoning involves understanding and representing the position, direction, form, and relationships of objects in space. The near–middle–far arrangement in the panorama provides a contextual example through which students may identify which objects are closer to or farther from the observer, determine the direction of view, and interpret the spatial relationships among different parts of the landscape. Thus, the photograph functions not merely as a visual illustration but as a representation that can be interpreted geometrically.

The relevance of visual activities to spatial thinking is also supported by Lokollo *et al.* (2024), who explained that spatial thinking involves visualization, understanding spatial relationships, and interpreting the arrangement of objects. Their findings reinforce the view that students need opportunities to observe and analyze visual representations of space. In the present study, the natural panorama of Sanghyang Dora Hill provides a local context in which students can identify relative distance, position, direction, and depth through objects encountered in a real landscape.

Izzati & Al Farizi (2025) also emphasized several indicators of spatial ability in geometry learning, including spatial visualization, spatial perception, spatial relations, and spatial orientation. These indicators are relevant to the interpretation of the Sanghyang Dora Hill panorama. Students use spatial perception when distinguishing foreground, middle-ground, and background objects; spatial relations when examining the positions of objects in relation to one another; and spatial orientation when interpreting the landscape from the observer's viewpoint. Although Izzati and Al Farizi used GeoGebra as a visual medium, their discussion supports the use of visual representations for examining spatial relationships. The present study extends this perspective by using a photograph of a local natural landscape as the visual context.

In relation to spatial ability, interpreting the near–middle–far perspective has potential relevance to spatial relations, spatial orientation, and spatial representation. Students may be asked to classify objects according to their relative positions, explain why distant objects appear smaller, identify overlapping objects, or create a simple sketch of the landscape from a particular viewpoint. They may also compare how the arrangement of objects would appear from another observation point. Such activities require students to connect visual information in a two-dimensional photograph with their mental understanding of three-dimensional space.

Lowrie *et al.* (2019) showed that visual-spatial activities can contribute to students' spatial reasoning and mathematical performance. In the context of this study, interpreting the panorama of Sanghyang Dora Hill provides an opportunity for students to understand visual depth, apparent size, and relative position while transforming a real landscape into a simplified spatial representation. Therefore, the panoramic photograph may serve as a contextual resource for introducing perspective and spatial relationships in geometry learning without treating the landscape as a formal geometric object.

CONCLUSION

Based on the exploration results, Sanghyang Dora Hill contains several geometric representations that can be grouped into five main categories. The hill form can be approximated as a cone-like or irregular pyramidal shape, including the highest point, base area, represented height, and sloping surface. The hillside represents changes in vertical and horizontal position, while the observer's view toward the hilltop illustrates an elevation angle and a right-triangle relationship. In addition, the surface pattern can be interpreted through simplified contour representations, and the panoramic view shows near–middle–far spatial perspective, apparent size, viewing direction, and visual depth.

These findings indicate that Sanghyang Dora Hill has the potential to be used as a contextual ethnomathematical resource for senior high school geometry learning. The identified concepts may support spatial visualization, spatial orientation, spatial relations, and spatial representation because students are encouraged to connect natural objects with simplified geometric models. However, the geometric forms identified in this study are visual approximations rather than exact formal figures, and the study did not directly measure changes in students' spatial abilities. Therefore, further research is needed to develop and test learning activities, worksheets, or geometry projects based on Sanghyang Dora Hill.

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